AP ECET 2026

Mechanical Engineering

Complete Preparation System

Concept Clarity | Smart Practice | Rank Booster Questions

BANDI DAYASAGAR

Diploma Mechanical Engineering
B.Tech Mechanical Engineering
M.Tech Thermal Engineering
MS (Computer Information Systems), USA

An Initiative of Sagar Educational Society

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First Edition: 2026

Published in India

Author: **Bandi Dayasagar**
An Initiative of: **Sagar Educational Society**

ISBN: 978-93-5777-946-3

Publisher:

Bandi Dayasagar
Imprint: An Initiative of Sagar Educational Society

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Printed and bound in India

Dedication

This book is dedicated to all Diploma students who dream of becoming engineers and building a better future for themselves and their families.

To the students who study silently, who struggle quietly, and who continue moving forward even when the path feels difficult.

I was once in your place. I understand your journey.

This book is for you.

May your hard work turn into success, and your effort turn into confidence.

Bandi Dayasagar

Preface

AP ECET is not just an entrance exam.

For Diploma students, it is a gateway to B.Tech and a better future.

Success in ECET does not depend on studying more books. It depends on understanding the exam pattern, focusing on important topics, and preparing in a smart way.

During my academic journey — from Diploma to B.Tech, M.Tech, and MS — I understood one important truth:
Students do not fail because they are weak.

They lose marks because they prepare without direction.

This book is written in very simple and clear language so that every student can understand concepts easily and prepare with confidence. Instead of of lengthy theory, this book focuses on:

- Important concepts based on weightage
- Frequently repeated questions
- Clear formulas and comparison tables
- Practice questions from basic to rank level
- Smart revision strategy

Every unit is prepared after carefully analyzing previous ECET question papers and scoring patterns.

This book is designed not just to help you pass ECET, but to help you score maximum marks and build strong confidence for your B.Tech journey.

If you follow the structure given in this book with discipline and consistency, you can achieve excellent results.

Wishing you focus, confidence, and great success.

Bandi Dayasagar
Founder – Sagar Educational Society
Diploma – Mechanical Engineering
B.Tech – Mechanical Engineering
M.Tech – Thermal Engineering
MS – Computer Information Systems (USA)

ABOUT THE AUTHOR

BANDI DAYASAGAR

BANDI DAYASAGAR is an academician, researcher, and career mentor with a strong foundation in Mechanical Engineering and advanced expertise in Computer Information Systems. He began his academic journey with a Diploma in Mechanical Engineering, followed by B.Tech in Mechanical Engineering and M.Tech in Thermal Engineering under JNTUK University. He later completed MS (Computer Information Systems), USA from New England College with an outstanding CGPA of 3.96/4.00.

His academic and research interests focus on thermal engineering, power plant systems, fluid mechanics, computational simulations, and data-driven engineering analysis.

In 2020, he received the Research Excellence Award from the Institute of Scholars (InSc) for his published research work titled "Improving Thermal Power Plant Efficiency" published in International Journal of Recent Technology and Engineering, Volume 8, Issue 6, March 2020, Pages 1265–1274, ISSN: 2277-3878. His research focused on improving thermal power plant efficiency using analytical methods, simulations, and performance optimization techniques.

He has also completed multiple NPTEL e-verifiable certifications from premier IIT institutions, including Power Plant Engineering from IIT Roorkee; Introduction to Fluid Mechanics, Laws of Thermodynamics, and Conduction and Convection Heat Transfer IIT Kharagpur; and Computational Fluid Dynamics for Incompressible Flows along with IC Engines and Gas Turbines from IIT Guwahati.

Throughout his academic journey, he gained practical exposure through internships and research roles at prestigious national organizations including National Remote Sensing Centre (ISRO), Bharat Heavy Electricals Limited (BHEL), Rashtriya Ispat Nigam Limited (RINL), Indira Gandhi Centre for Atomic Research (IGCAR), and Dr. Narla Tata Rao Thermal Power Station (APGENCO). These experiences helped him combine theoretical knowledge with real industrial applications, simulations, and performance analysis.

With years of academic guidance experience, he founded Sagar Educational Society to mentor Diploma and Engineering students. His mission is to provide structured, exaa-m–focused, and confidence-building preparation systems that help students achieve top ranks and build strong technical careers.

His teaching philosophy is simple: *Clear concepts. Smart preparation. Disciplined execution.*

He strongly believes that with the right strategy and guidance, every hardworking student can achieve academic excellence and career success.

ACKNOWLEDGEMENT

This book is the result of many years of learning, teaching, and guiding students.

First, I thank my **parents** for their constant support, values, and belief in education. Their encouragement shaped my journey from **Diploma to higher** studies.

I sincerely thank my **teachers and professors** who guided me during my academic journey. Their knowledge, discipline, and clarity helped me build a strong foundation in **Mechanical Engineering.**

I am grateful to the institutions and organizations where I gained academic and practical experience. Each stage of my journey from **Diploma to MS (CIS)** helped me understand both theory and real-world applications.

I also thank the students I have mentored over the years. Your questions, struggles, and determination inspired me to create this book. This book is built from your needs and your challenges.

Special thanks to everyone who supported the preparation of this book directly or indirectly — through encouragement, feedback, and motivation.

Finally, I thank every student who chooses this book as a part of their preparation. Your trust means a lot.

This book is written with one clear purpose:
to help students prepare in a smart way, build confidence, and achieve success in **AP ECET**.

With gratitude,

BANDI DAYASAGAR **Diploma, B.Tech, M.Tech, MS (CIS), USA**

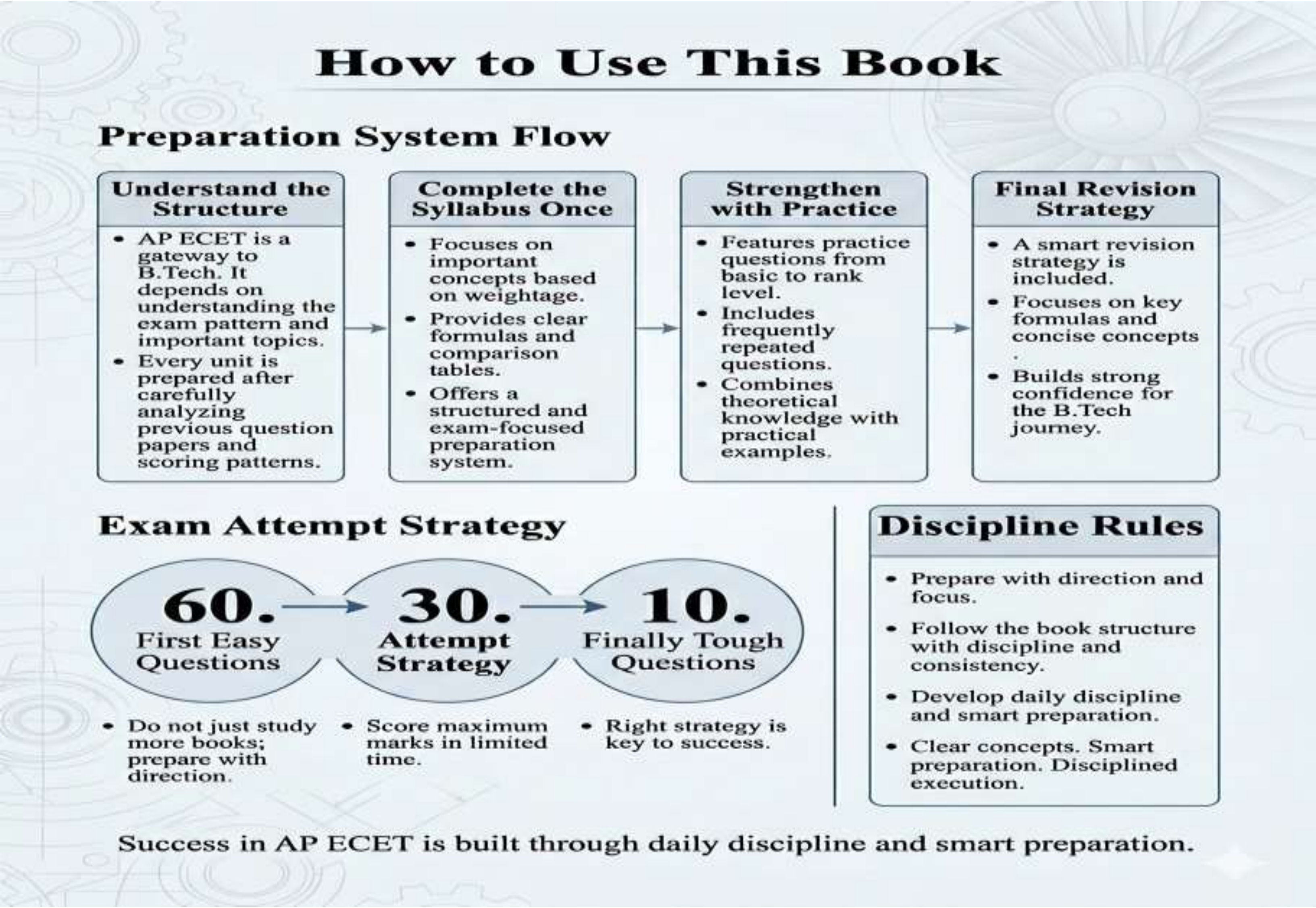
How to Use This Book

AP ECET 2026 Exam Date: April 23, 2026
Book Release Date: March 02, 2026

You now have approximately **50 days** from the day this book is released to the exam.

This time is enough — if you use it properly.

This book is not meant to be read like a normal textbook.
It is designed to be followed like a preparation plan.



Success on April 23, 2026 will come from the small things you do every day starting today

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Total Marks = 100

UNIT–I: Workshop Technology & Conventions in Drawing

◆ CARPENTRY, FITTING & SHEET METAL

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1. The angle between the face and peen of a cross-peen hammer is:
A) 45°
B) 60°
C) 90°
D) 120°
Answer: C
Explanation: In a cross-peen hammer, the peen is perpendicular to the handle axis, making a 90° orientation.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

2. The purpose of a try square is to check:
A) Parallelism
B) Squareness
C) Flatness
D) Roughness
Answer: B
Explanation: A try square checks 90° angles between two surfaces.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

3. The cutting stroke of a hacksaw occurs during:
A) Forward stroke
B) Backward stroke
C) Both strokes
D) Idle stroke
Answer: A
Explanation: Standard hacksaw blades cut during the forward stroke.
Ref: Workshop Technology Vol I, Hazra Choudhury

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4. The file most suitable for finishing curved surfaces is:
A) Flat file
B) Round file
C) Triangular file
D) Square file
Answer: B
Explanation: Round files are used for enlarging holes and finishing curved profiles.
Ref: Workshop Technology Vol I, Hazra Choudhury

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5. The teeth of a wood saw are set to:
A) Reduce friction
B) Increase strength
C) Improve hardness
D) Reduce pitch
Answer: A
Explanation: Saw teeth are set alternately to create clearance and reduce friction.
Ref: Workshop Technology Vol I, Hazra Choudhury

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6. A mallet used in carpentry is generally made of:
A) Cast iron
B) Mild steel
C) Wood
D) Brass
Answer: C
Explanation: Wooden mallets prevent surface damage to wooden workpieces.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

7. The joint commonly used in making wooden frames is:
A) Lap joint
B) Mortise and tenon joint
C) Butt joint
D) Dovetail joint
Answer: B
Explanation: Mortise and tenon joints provide strong right-angle connections in frames.
Ref: Workshop Technology Vol I, Hazra Choudhury

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8. A scriber is made of:
A) Brass
B) Mild steel
C) High carbon steel
D) Cast iron
Answer: C
Explanation: Scriber tips are hardened high carbon steel for scratch marking.
Ref: Workshop Technology Vol I, Hazra Choudhury

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9. The angle of cutting edge in a cold chisel is about:
A) 30°
B) 45°
C) 60°
D) 80°
Answer: C
Explanation: For general-purpose chisels, 60° is standard for mild steel.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

10. The pitch of a file refers to:
A) File length
B) Tooth spacing
C) Tooth height
D) File thickness
Answer: B
Explanation: Pitch is the distance between successive teeth.
Ref: Workshop Technology Vol I, Hazra Choudhury

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11. The tool used to enlarge a drilled hole accurately is:
A) Broach
B) Reamer
C) File
D) Tap
Answer: B
Explanation: Reaming improves size and surface finish of holes.
Ref: Workshop Technology Vol I, Hazra Choudhury

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12. In sheet metal work, a stake is used for:
A) Measuring thickness
B) Bending and shaping
C) Cutting
D) Drilling
Answer: B
Explanation: Stakes support sheet metal during bending/forming operations.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

13. Snips are primarily used for:
A) Filing
B) Cutting sheet metal
C) Drilling
D) Riveting
Answer: B
Explanation: Snips are shear-type cutting tools for sheet metal.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

14. The purpose of filing is to:
A) Remove large metal
B) Produce smooth surface
C) Drill hole
D) Heat metal
Answer: B
Explanation: Filing removes small amounts of material to achieve finish and accuracy.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

15. The tool used to check internal angles is:
A) Surface gauge
B) Bevel protractor
C) Divider
D) Caliper
Answer: B
Explanation: Bevel protractor measures internal and external angles accurately.
Ref: Workshop Technology Vol I, Hazra Choudhury

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16. A ball peen hammer is mainly used in:
A) Carpentry
B) Forging and riveting
C) Welding
D) Casting
Answer: B
Explanation: Ball peen hammer shapes metal and peens rivets.
Ref: Workshop Technology Vol I, Hazra Choudhury

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17. The clearance angle in a file prevents:
A) Slipping
B) Rubbing
C) Cutting
D) Hardening
Answer: B
Explanation: Clearance angle avoids rubbing of the file body against work.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

18. In sheet metal work, the allowance added for bending is called:
A) Pitch allowance
B) Bend allowance
C) Tolerance
D) Offset
Answer: B
Explanation: Bend allowance compensates for elongation during bending.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

19. The gauge used for marking parallel lines is:
A) Try square
B) Marking gauge
C) Divider
D) Steel rule
Answer: B
Explanation: Marking gauge scribes parallel lines from an edge.
Ref: Workshop Technology Vol I, Hazra Choudhury

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20. A dovetail joint is mainly used in:
A) Heavy beams
B) Drawer construction
C) Pipes
D) Frames
Answer: B
Explanation: Dovetail joints resist pulling forces, ideal for drawers.
Ref: Workshop Technology Vol I, Hazra Choudhury

◆ FORGING PROCESSES & TOOLS

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31. Forging is carried out above:
A) Melting temperature
B) Recrystallization temperature
C) Room temperature
D) Boiling point
Answer: B
Explanation: Hot working is done above recrystallization temperature.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

32. The tool used to reduce cross section locally is:
A) Flatter
B) Swage
C) Fuller
D) Set hammer
Answer: C
Explanation: Fuller produces grooves and reduces cross-section locally.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

33. A flatter is used to:
A) Cut metal
B) Smooth surface
C) Reduce diameter
D) Punch hole
Answer: B
Explanation: Flatter smoothens forged surfaces.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

34. Swages are used for:
A) Cutting
B) Bending
C) Finishing round sections
D) Punching
Answer: C
Explanation: Swages form and finish round shapes.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

35. In hot working, grain structure becomes:
A) Coarse
B) Fine
C) Brittle
D) Porous
Answer: B
Explanation: Recrystallization refines grains during hot working.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

36. Cold working increases:
A) Ductility
B) Grain size
C) Hardness
D) Melting point
Answer: C
Explanation: Cold working causes strain hardening.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

37. The furnace used in forging is:
A) Cupola
B) Muffle
C) Smithy
D) Crucible
Answer: C
Explanation: Smithy furnace heats metal for forging.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

38. Drawing down in forging means:
A) Increasing thickness
B) Reducing length
C) Increasing length
D) Melting metal
Answer: C
Explanation: Drawing increases length while reducing cross-section.
Ref: Workshop Technology Vol II, Hazra Choudhury

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39. Upsetting operation increases:
A) Length
B) Thickness
C) Width
D) Hardness
Answer: B
Explanation: Upsetting shortens length and increases thickness.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

40. The top tool in forging is held by:
A) Machine
B) Tongs
C) Operator
D) Vice
Answer: C
Explanation: Top tools are manually held during hammering.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

41. The scale formed during forging is due to:
A) Oxidation
B) Reduction
C) Carbonization
D) Nitriding
Answer: A
Explanation: Surface oxidation at high temperature forms scale.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

42. Cold working is generally performed below:
A) 100°C
B) Recrystallization temperature
C) 0°C
D) Melting temperature
Answer: B
Explanation: Cold working occurs below recrystallization temperature.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

43. The tool used for making holes in forging is:
A) Drift
B) Punch
C) Fuller
D) Flatter
Answer: B
Explanation: Punch creates holes in heated metal.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

44. A drift is used to:
A) Cut
B) Finish hole size
C) Smooth surface
D) Bend metal
Answer: B
Explanation: Drift enlarges and finishes punched holes.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

45. The anvil is made of:
A) Cast iron
B) Wrought iron with steel face
C) Aluminum
D) Brass
Answer: B
Explanation: Anvil body is wrought iron with hardened steel face.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

46. The horn of anvil is used for:
A) Cutting
B) Bending curves
C) Punching
D) Measuring
Answer: B
Explanation: Horn helps in bending round shapes.
Ref: Workshop Technology Vol II, Hazra Choudhury

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47. The bottom tool fits into:
A) Hardy hole
B) Pritchel hole

C) Face
D) Step
Answer: A
Explanation: Bottom tools are fixed in hardy hole.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

48. In forging, trimming removes:
A) Flash
B) Scale
C) Slag
D) Core
Answer: A
Explanation: Flash formed in closed-die forging is trimmed.
Ref: Workshop Technology Vol II, Hazra Choudhury

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49. The recrystallization temperature of steel is approximately:
A) 100°C
B) 300°C
C) 450°C
D) 723°C
Answer: C
Explanation: Steel recrystallizes roughly around 0.4–0.5 of melting temperature (~450°C).
Ref: Workshop Technology Vol II, Hazra Choudhury

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50. Hot working improves ductility because of:
A) Work hardening
B) Grain refinement
C) Porosity
D) Oxidation
Answer: B
Explanation: Recrystallization refines grains improving ductility.
Ref: Workshop Technology Vol II, Hazra Choudhury

◆ FORGING PROCESSES (Advanced Conceptual)

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51. Which forging method produces minimum material wastage?
A) Open-die forging
B) Hand forging
C) Closed-die forging
D) Smith forging

Answer: C
Explanation: Closed-die forging produces near-net shape with minimal excess material.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

52. Flash is formed in:
A) Open-die forging
B) Closed-die forging
C) Smith forging
D) Rolling
Answer: B
Explanation: Flash is excess metal squeezed out between die halves in closed-die forging.
Ref: Workshop Technology Vol II, Hazra Choudhury

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53. The main purpose of fullering before drawing is to:
A) Increase hardness
B) Localize deformation
C) Remove scale
D) Punch hole
Answer: B
Explanation: Fullering concentrates deformation in a specific region.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

54. Which defect occurs due to excessive forging temperature?
A) Cold shut
B) Burnt metal
C) Misrun
D) Blow hole
Answer: B
Explanation: Overheating causes oxidation and burning of metal grains.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

55. The tool used to cut hot metal on anvil is:
A) Drift
B) Swage
C) Hardy
D) Fuller
Answer: C
Explanation: Hardy tool is fitted into hardy hole for cutting.
Ref: Workshop Technology Vol II, Hazra Choudhury

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56. The colour indicating proper forging temperature for mild steel is:
A) Dark red
B) Cherry red
C) Blue
D) White
Answer: B
Explanation: Cherry red indicates suitable forging temperature for MS.
Ref: Workshop Technology Vol II, Hazra Choudhury

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57. Which property increases due to cold working?
A) Ductility
B) Toughness
C) Yield strength
D) Grain size
Answer: C
Explanation: Cold working increases strength due to strain hardening.
Ref: Workshop Technology Vol II, Hazra Choudhury

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58. Cogging is mainly used for:
A) Small bolts
B) Large ingots
C) Sheet metal
D) Rivets
Answer: B
Explanation: Cogging reduces large cast ingots into billets.
Ref: Workshop Technology Vol II, Hazra Choudhury

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59. The anvil part used for punching is:
A) Horn
B) Face
C) Pritchel hole
D) Step
Answer: C
Explanation: Pritchel hole supports punching operations.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

60. Which forging process is performed using a power hammer?
A) Smith forging
B) Machine forging

C) Hand forging
D) Swaging
Answer: B
Explanation: Machine forging uses mechanical or power hammers.
Ref: Workshop Technology Vol II, Hazra Choudhury

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61. In hot working, strain hardening effect is:
A) Permanent
B) Eliminated
C) Increased
D) Doubled
Answer: B
Explanation: Recrystallization removes strain hardening during hot working.
Ref: Workshop Technology Vol II, Hazra Choudhury

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62. Which forging operation produces a shoulder?
A) Drawing
B) Upsetting
C) Setting down
D) Swaging
Answer: C
Explanation: Setting down forms shoulders at required sections.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

63. Cold shuts in forging occur due to:
A) Overheating
B) Insufficient forging temperature
C) Excess lubrication
D) High pressure
Answer: B
Explanation: Low temperature prevents proper fusion of metal layers.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

64. Which forging improves directional grain flow?
A) Casting
B) Machining
C) Forging
D) Welding

Answer: C
Explanation: Forging aligns grains along shape contour improving strength.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

65. The tongs used in forging are made of:
A) Cast iron
B) High carbon steel
C) Mild steel
D) Brass
Answer: C
Explanation: Mild steel provides strength and flexibility.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

66. Which forging defect resembles cracks at surface?
A) Scale
B) Flakes
C) Cold shut
D) Burnt metal
Answer: C
Explanation: Cold shuts appear as surface cracks due to improper fusion.
Ref: Workshop Technology Vol II, Hazra Choudhury

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67. Upsetting is commonly used in making:
A) Shafts
B) Bolts
C) Plates
D) Pipes
Answer: B
Explanation: Bolt heads are formed by upsetting.
Ref: Workshop Technology Vol II, Hazra Choudhury

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68. The hammer face of an anvil is made of:
A) Soft steel
B) Hardened steel
C) Cast iron
D) Aluminum
Answer: B
Explanation: Hardened steel resists wear and deformation.
Ref: Workshop Technology Vol II, Hazra Choudhury

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69. In drop forging, dies are made of:
A) Cast iron
B) Tool steel
C) Aluminum
D) Brass
Answer: B
Explanation: Tool steel withstands high impact loads.
Ref: Workshop Technology Vol II, Hazra Choudhury

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70. Forging improves mechanical properties due to:
A) Porosity
B) Grain alignment
C) Scale formation
D) Oxidation
Answer: B
Explanation: Grain flow enhances strength and fatigue resistance.
Ref: Workshop Technology Vol II, Hazra Choudhury

◆ FOUNDRY & CASTING

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71. The pattern is a replica of:
A) Finished casting
B) Mould cavity
C) Final product with allowances
D) Core
Answer: C
Explanation: Pattern includes shrinkage and machining allowances.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

72. Shrinkage allowance for cast iron is approximately:
A) 1 mm/m
B) 5 mm/m
C) 10 mm/m
D) 20 mm/m
Answer: C
Explanation: CI shrinkage ≈ 10 mm per meter length.
Ref: Workshop Technology Vol I, Hazra Choudhury

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73. A match plate pattern is used for:
A) Small batch
B) Large production
C) Single casting
D) Large casting
Answer: B
Explanation: Match plate pattern increases productivity in mass production.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

74. Sweep pattern is suitable for:
A) Small jobs
B) Symmetrical large castings
C) Core making
D) Sheet metal
Answer: B
Explanation: Sweep pattern used for large symmetrical shapes.
Ref: Workshop Technology Vol I, Hazra Choudhury

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75. Loose-piece pattern is used when:
A) Casting is simple
B) Undercuts exist
C) No draft needed
D) Pattern is metal
Answer: B
Explanation: Loose pieces help remove complex patterns.
Ref: Workshop Technology Vol I, Hazra Choudhury

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76. The property allowing gases to escape is:
A) Cohesiveness
B) Plasticity
C) Permeability
D) Adhesiveness
Answer: C
Explanation: Permeability prevents gas defects.
Ref: Workshop Technology Vol I, Hazra Choudhury

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77. Refractoriness of sand means:
A) Strength
B) Heat resistance

C) Plasticity
D) Permeability
Answer: B
Explanation: Refractoriness resists high temperature of molten metal.
Ref: Workshop Technology Vol I, Hazra Choudhury

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78. Blow holes in casting are caused by:
A) Low pouring temp
B) Trapped gases
C) Slow cooling
D) Draft
Answer: B
Explanation: Gas entrapment forms blow holes.
Ref: Workshop Technology Vol I, Hazra Choudhury

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79. Core is used to produce:
A) External surface
B) Internal cavity
C) Draft
D) Riser
Answer: B
Explanation: Core creates internal hollow shapes.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

80. Riser is provided to:
A) Pour metal
B) Feed molten metal during solidification
C) Support core
D) Remove slag
Answer: B
Explanation: Riser compensates shrinkage during solidification.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

81. The gating system controls:
A) Sand strength
B) Metal flow
C) Core placement
D) Pattern design

Answer: B
Explanation: Gating regulates molten metal flow into mould.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

82. A defect due to incomplete filling is:
A) Blow hole
B) Cold shut
C) Misrun
D) Shrinkage
Answer: C
Explanation: Misrun occurs when molten metal fails to fill cavity.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

83. Draft allowance is provided for:
A) Shrinkage
B) Easy pattern removal
C) Machining
D) Core making
Answer: B
Explanation: Draft prevents damage to mould while removing pattern.
Ref: Workshop Technology Vol I, Hazra Choudhury

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84. The upper half of mould is called:
A) Drag
B) Cope
C) Core
D) Flask
Answer: B
Explanation: Cope is the top portion of mould.
Ref: Workshop Technology Vol I, Hazra Choudhury

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85. The lower half of mould is:
A) Cope
B) Drag
C) Riser
D) Core
Answer: B
Explanation: Drag forms bottom portion of mould.
Ref: Workshop Technology Vol I, Hazra Choudhury

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86. A flask consists of:
A) Cope and drag
B) Pattern and core
C) Riser and gate
D) Runner and sprue
Answer: A
Explanation: Flask holds cope and drag together.
Ref: Workshop Technology Vol I, Hazra Choudhury

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87. Shrinkage cavity is caused by:
A) Gas
B) Improper feeding
C) Low sand strength
D) High draft
Answer: B
Explanation: Insufficient riser feeding leads to shrinkage cavities.
Ref: Workshop Technology Vol I, Hazra Choudhury

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88. Facing sand is used near:
A) Riser
B) Pattern surface
C) Core
D) Sprue
Answer: B
Explanation: Facing sand contacts molten metal near pattern.
Ref: Workshop Technology Vol I, Hazra Choudhury

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89. Which metal is commonly melted in cupola furnace?
A) Steel
B) Aluminum
C) Cast iron
D) Brass
Answer: C
Explanation: Cupola furnace is mainly for cast iron melting.
Ref: Workshop Technology Vol I, Hazra Choudhury

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90. Moulding sand consists mainly of:
A) Clay
B) Silica

C) Lime
D) Coke
Answer: B
Explanation: Silica sand forms major component of moulding sand.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

91. Core prints are provided on pattern to:
A) Increase strength
B) Support core
C) Reduce draft
D) Remove defect
Answer: B
Explanation: Core prints position and support cores in mould.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

92. Slag inclusion defect occurs due to:
A) Improper cleaning
B) Gas
C) Low pouring
D) High draft
Answer: A
Explanation: Slag trapped in molten metal causes inclusions.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

93. Green sand means:
A) Wet sand
B) Dry sand
C) Burnt sand
D) Clay free sand
Answer: A
Explanation: Green sand contains moisture before drying.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

94. Which pattern is made in two halves?
A) Solid pattern
B) Split pattern
C) Sweep pattern
D) Skeleton pattern

Answer: B
Explanation: Split pattern simplifies moulding of complex shapes.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

95. Chill is used to:
A) Slow cooling
B) Accelerate cooling locally
C) Remove slag
D) Increase draft
Answer: B
Explanation: Chills increase cooling rate to control solidification.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

96. Porosity in casting is mainly due to:
A) High permeability
B) Gas entrapment
C) Low draft
D) Hard sand
Answer: B
Explanation: Gas bubbles form porous cavities.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

97. The vertical channel in gating system is:
A) Runner
B) Sprue
C) Riser
D) Gate
Answer: B
Explanation: Sprue carries molten metal downward.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

98. The horizontal passage is called:
A) Sprue
B) Runner
C) Gate
D) Core
Answer: B
Explanation: Runner distributes metal from sprue to cavity.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

99. The ingate connects:
A) Sprue to runner
B) Runner to cavity
C) Riser to cavity
D) Core to mould
Answer: B
Explanation: Ingate directs metal into mould cavity.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

100. The main function of flux in cupola is to:
A) Increase temperature
B) Remove impurities
C) Cool metal
D) Strengthen casting
Answer: B
Explanation: Flux combines with impurities forming slag.
Ref: Workshop Technology Vol I, Hazra Choudhury

◆ FOUNDRY & CASTING (Advanced)

---

101. The primary cause of hot tears in casting is:
A) Low pouring temperature
B) Uneven solidification
C) Excess draft
D) High permeability
Answer: B
Explanation: Uneven cooling creates internal stresses leading to hot tears.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

102. Which sand property resists metal penetration?
A) Permeability
B) Cohesiveness
C) Fineness
D) Refractoriness
Answer: C
Explanation: Fine grains reduce metal penetration and improve surface finish.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

103. Excess moisture in moulding sand leads to:
A) Misrun
B) Blow holes
C) Cold shut
D) Shrinkage
Answer: B
Explanation: Excess water generates steam causing gas cavities.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

104. The function of chaplets is to:
A) Remove slag
B) Support core
C) Increase draft
D) Reduce shrinkage
Answer: B
Explanation: Chaplets hold core in correct position inside mould.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

105. A skeleton pattern is used for:
A) Small casting
B) Large simple casting
C) Core making
D) Precision casting
Answer: B
Explanation: Skeleton patterns are economical for large shapes.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

106. Which casting defect appears as rounded cavities inside casting?
A) Cold shut
B) Blow hole
C) Hot tear
D) Slag inclusion
Answer: B
Explanation: Blow holes are spherical gas cavities.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

107. Increasing pouring temperature increases:
A) Fluidity
B) Draft

C) Refractoriness
D) Cohesiveness
Answer: A
Explanation: Higher temperature improves metal flow but may cause defects.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

108. Shrinkage allowance depends mainly on:
A) Pattern material
B) Type of metal
C) Sand quality
D) Draft angle
Answer: B
Explanation: Different metals have different shrinkage rates.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

109. The process of removing sand from casting is called:
A) Cleaning
B) Fettling
C) Facing
D) Dressing
Answer: B
Explanation: Fettling removes sand, gates, and risers from casting.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

110. The most economical casting method for mass production is:
A) Sand casting
B) Die casting
C) Shell moulding
D) Investment casting
Answer: B
Explanation: Die casting provides high production rate with good finish.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

111. The function of vent holes is to:
A) Feed metal
B) Allow gas escape
C) Increase strength
D) Reduce draft

Answer: B
Explanation: Vents prevent gas entrapment.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

112. Which defect resembles overlapping metal layers?
A) Cold shut
B) Misrun
C) Shrinkage
D) Blow hole
Answer: A
Explanation: Cold shut appears as seam-like discontinuity.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

113. In cupola furnace, coke acts as:
A) Flux
B) Fuel
C) Slag
D) Binder
Answer: B
Explanation: Coke provides heat for melting iron.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

114. Facing sand contains higher proportion of:
A) Clay
B) Silica
C) Moisture
D) Lime
Answer: B
Explanation: Facing sand has fine silica for better surface finish.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

115. The binder used in moulding sand is generally:
A) Coke
B) Clay
C) Lime
D) Flux
Answer: B
Explanation: Clay binds sand particles together.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

116. In casting, chills are usually made of:
A) Wood
B) Sand
C) Cast iron
D) Plastic
Answer: C
Explanation: Cast iron chills extract heat rapidly.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

117. Core sand has higher:
A) Moisture
B) Permeability
C) Draft
D) Plasticity
Answer: B
Explanation: Core sand must allow gases to escape easily.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

118. Which furnace is used for steel melting?
A) Cupola
B) Blast furnace
C) Electric arc furnace
D) Smithy
Answer: C
Explanation: Electric arc furnace melts steel efficiently.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

119. Slag is removed through:
A) Tapping hole
B) Slag hole
C) Runner
D) Gate
Answer: B
Explanation: Slag hole drains impurities in cupola furnace.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

120. Investment casting is also called:
A) Sand casting
B) Die casting
C) Lost wax process
D) Shell moulding
Answer: C
Explanation: Wax pattern is melted out before pouring metal.
Ref: Workshop Technology Vol I, Hazra Choudhury

◆ MACHINE DRAWING CONVENTIONS (ND Bhatt / P.S. Gill)

---

121. Continuous thick lines represent:
A) Hidden edges
B) Center lines
C) Visible edges
D) Section lines
Answer: C
Explanation: Thick continuous lines show visible outlines.
Ref: Machine Drawing, N.D. Bhatt

---

122. Hidden edges are shown by:
A) Thick line
B) Dashed line
C) Chain line
D) Zig-zag line
Answer: B
Explanation: Dashed lines represent hidden features.
Ref: Machine Drawing, N.D. Bhatt

---

123. Centre lines are drawn using:
A) Thick line
B) Continuous thin
C) Chain thin line
D) Dashed thick
Answer: C
Explanation: Long dash–short dash pattern indicates centre line.
Ref: Machine Drawing, N.D. Bhatt

---

124. Section lining is drawn at an angle of:
A) 30°
B) 45°
C) 60°
D) 90°
Answer: B
Explanation: Standard hatching angle is 45°.
Ref: Machine Drawing, N.D. Bhatt

---

125. Cast iron in section is represented by:
A) Parallel thin lines
B) Cross lines
C) Diagonal thick lines
D) Random lines
Answer: A
Explanation: CI is shown with uniform parallel thin lines.
Ref: Machine Drawing, N.D. Bhatt

---

126. Glass is represented by:
A) Random dots
B) Thin cross lines
C) Zig-zag lines
D) Thick vertical lines
Answer: B
Explanation: Glass section uses crossed thin lines.
Ref: Machine Drawing, N.D. Bhatt

---

127. Steel section representation consists of:
A) Close thin lines
B) Thick lines
C) Dots
D) Wavy lines
Answer: A
Explanation: Steel is represented by closely spaced thin lines.
Ref: Machine Drawing, N.D. Bhatt

---

128. Short break line is drawn using:
A) Zig-zag line
B) Thick straight

C) Chain line
D) Dashed line
Answer: A
Explanation: Zig-zag indicates short break.
Ref: Machine Drawing, N.D. Bhatt

---

129. Long break line is drawn as:
A) Straight line
B) Wavy line
C) Dashed line
D) Thick line
Answer: B
Explanation: Freehand wavy line indicates long break.
Ref: Machine Drawing, N.D. Bhatt

---

130. Dimension lines terminate with:
A) Circles
B) Arrows
C) Dots
D) Squares
Answer: B
Explanation: Arrowheads indicate dimension limits.
Ref: Machine Drawing, N.D. Bhatt

---

131. Extension lines are drawn:
A) Thick
B) Thin continuous
C) Dashed
D) Chain
Answer: B
Explanation: Extension lines are thin continuous lines.
Ref: Machine Drawing, N.D. Bhatt

---

132. The standard ratio of arrow length to width is approximately:
A) 1:1
B) 2:1
C) 3:1
D) 4:1

Answer: C
Explanation: Arrow length is about 3 times its width.
Ref: Machine Drawing, N.D. Bhatt

---

133. First angle projection symbol shows:
A) Circle left of cone
B) Circle right of cone
C) Both sides
D) No circle
Answer: A
Explanation: In first angle, circle is placed left of truncated cone.
Ref: Machine Drawing, N.D. Bhatt

---

134. India follows generally:
A) Third angle projection
B) First angle projection
C) Both
D) None
Answer: B
Explanation: BIS standards follow first angle projection.
Ref: Machine Drawing, N.D. Bhatt

---

135. Preferred numbers are based on:
A) Arithmetic progression
B) Geometric progression
C) Harmonic series
D) Random series
Answer: B
Explanation: Renard series follows geometric progression.
Ref: Machine Drawing, N.D. Bhatt

---

136. The basic preferred series is:
A) R2
B) R5
C) R10
D) R20
Answer: B
Explanation: R5 is fundamental Renard series.
Ref: Machine Drawing, N.D. Bhatt

---

137. In R10 series, common ratio is approximately:
A) 1.12
B) 1.26
C) 1.41
D) 1.58
Answer: B
Explanation: R10 ratio ≈ 10^(1/10) ≈ 1.26.
Ref: Machine Drawing, N.D. Bhatt

---

138. The dimensioning method used mostly in India is:
A) Aligned method
B) Unidirectional method
C) Combined
D) None
Answer: B
Explanation: Unidirectional dimensioning is standard practice.
Ref: Machine Drawing, N.D. Bhatt

---

139. Surface roughness symbol without bar indicates:
A) Machining required
B) No machining
C) Optional machining
D) Grinding
Answer: C
Explanation: Basic symbol means surface texture requirement without specific process.
Ref: Machine Drawing, N.D. Bhatt

---

140. The symbol 'Ø' denotes:
A) Radius
B) Diameter
C) Tolerance
D) Finish
Answer: B
Explanation: Ø indicates diameter dimension.
Ref: Machine Drawing, N.D. Bhatt

---

141. Radius is denoted by:
A) R
B) D
C) Ø
D) T
Answer: A
Explanation: 'R' prefix indicates radius.
Ref: Machine Drawing, N.D. Bhatt

---

142. Chamfer is indicated by:
A) C
B) CH
C) X
D) F
Answer: A
Explanation: C followed by size indicates chamfer.
Ref: Machine Drawing, N.D. Bhatt

---

143. Tolerance is the difference between:
A) Nominal & actual
B) Upper & lower limit
C) Basic & actual
D) Max & nominal
Answer: B
Explanation: Tolerance = Upper limit − Lower limit.
Ref: Machine Drawing, N.D. Bhatt

---

144. A sectional view is used to:
A) Show hidden details clearly
B) Show external shape
C) Remove dimension
D) Reduce scale
Answer: A
Explanation: Sectioning reveals internal features.
Ref: Machine Drawing, N.D. Bhatt

---

145. Hatch lines should not cross:
A) Sectioned area
B) Dimension figures

C) Visible edges
D) Centre lines
Answer: B
Explanation: Section lines should avoid dimension text.
Ref: Machine Drawing, N.D. Bhatt

---

146. Bolt and nut are generally not sectioned in assembly drawing when cut longitudinally because:
A) Hard material
B) Standard convention
C) Cost
D) Draft
Answer: B
Explanation: Standard practice avoids sectioning standard fasteners.
Ref: Machine Drawing, N.D. Bhatt

---

147. Thread representation in external view uses:
A) Thick line outside
B) Thin line outside
C) Thick line inside
D) Dashed line
Answer: A
Explanation: External thread major diameter shown by thick line.
Ref: Machine Drawing, N.D. Bhatt

---

148. Minor diameter of internal thread is shown by:
A) Thick line
B) Thin line
C) Dashed
D) Chain
Answer: B
Explanation: Thin line indicates minor diameter in internal thread.
Ref: Machine Drawing, N.D. Bhatt

---

149. The scale 1:2 means:
A) Enlarged
B) Half size
C) Double size
D) Same size

Answer: B
Explanation: 1:2 indicates drawing is half of actual size.
Ref: Machine Drawing, N.D. Bhatt

---

150. In dimensioning, units are generally written in:
A) cm
B) mm
C) inches
D) m
Answer: B
Explanation: Engineering drawings use mm by default without writing unit.
Ref: Machine Drawing, N.D. Bhatt

◆ **MACHINE DRAWING (Advanced)**

---

151. In first angle projection, the top view is placed:
A) Above front view
B) Below front view
C) Right side
D) Left side
Answer: B
Explanation: In first angle projection, top view is drawn below the front view.
Ref: Machine Drawing, N.D. Bhatt

---

152. In third angle projection, the right side view is placed:
A) Left of front view
B) Right of front view
C) Above front view
D) Below front view
Answer: B
Explanation: In third angle projection, right side view appears on right side.
Ref: Machine Drawing, N.D. Bhatt

---

153. A half-sectional view is generally used for:
A) Symmetrical objects
B) Unsymmetrical objects
C) Threads only
D) Pipes

Answer: A
Explanation: Half section shows internal and external features of symmetrical objects.
Ref: Machine Drawing, N.D. Bhatt

---

154. When adjacent parts are sectioned, hatching lines should be:
A) Same direction
B) Different directions
C) Random
D) Horizontal only
Answer: B
Explanation: Adjacent parts use different hatch directions to distinguish them.
Ref: Machine Drawing, N.D. Bhatt

---

155. Broken-out section is used when:
A) Entire object must be cut
B) Only small portion internal detail required
C) No section needed
D) Large assembly
Answer: B
Explanation: Broken-out section reveals local internal detail.
Ref: Machine Drawing, N.D. Bhatt

---

156. A cutting plane line is represented by:
A) Thick dashed line
B) Thick chain line
C) Thin continuous line
D) Wavy line
Answer: B
Explanation: Cutting plane is shown by thick chain line with arrows.
Ref: Machine Drawing, N.D. Bhatt

---

157. In assembly drawing, shafts are usually:
A) Fully sectioned
B) Half sectioned
C) Not sectioned longitudinally
D) Broken
Answer: C
Explanation: Shafts are not sectioned longitudinally as per convention.
Ref: Machine Drawing, N.D. Bhatt

---

158. The pitch of a thread is the distance between:
A) Two crests
B) Two roots
C) Corresponding points on adjacent threads
D) Major diameters
Answer: C
Explanation: Pitch is axial distance between corresponding points.
Ref: Machine Drawing, N.D. Bhatt

---

159. Metric thread angle is:
A) 29°
B) 47.5°
C) 55°
D) 60°
Answer: D
Explanation: ISO metric thread angle is 60°.
Ref: Machine Drawing, N.D. Bhatt

---

160. Whitworth thread angle is:
A) 60°
B) 55°
C) 47.5°
D) 30°
Answer: B
Explanation: Whitworth threads have 55° included angle.
Ref: Machine Drawing, N.D. Bhatt

---

161. Knurling on drawing is represented by:
A) Cross lines
B) Dots
C) Parallel lines
D) Zigzag
Answer: A
Explanation: Knurling shown by crossed diagonal lines.
Ref: Machine Drawing, N.D. Bhatt

---

162. A keyway in shaft is shown by:
A) Thick line
B) Dashed line

C) Section
D) Thin line
Answer: A
Explanation: Visible keyway edges shown by thick continuous line.
Ref: Machine Drawing, N.D. Bhatt

---

163. Taper is expressed as:
A) 1:n
B) n:1
C) n^2
D) $1/n^2$
Answer: A
Explanation: Taper = change in diameter per unit length (1:n form).
Ref: Machine Drawing, N.D. Bhatt

---

164. Surface roughness symbol with a bar indicates:
A) No machining
B) Machining required
C) Optional
D) Grinding
Answer: B
Explanation: Bar on symbol indicates material removal required.
Ref: Machine Drawing, N.D. Bhatt

---

165. Surface roughness symbol with a circle indicates:
A) Machining required
B) Grinding
C) No material removal
D) Polishing
Answer: C
Explanation: Circle means material removal not permitted.
Ref: Machine Drawing, N.D. Bhatt

---

166. The standard symbol for counterbore is:
A) ⌴
B) ⌵
C) ⌀
D) ⊥

Answer: A
Explanation: Counterbore symbol resembles squared U-shape.
Ref: Machine Drawing, N.D. Bhatt

---

167. Countersink is indicated by:
A) ⌴
B) ∨
C) Ø
D) R
Answer: B
Explanation: V-shaped symbol denotes countersink.
Ref: Machine Drawing, N.D. Bhatt

---

168. The limit dimensioning system specifies:
A) Basic size only
B) Max and min size
C) Tolerance only
D) Nominal only
Answer: B
Explanation: Limit dimensioning gives upper and lower limits.
Ref: Machine Drawing, N.D. Bhatt

---

169. A fillet radius is generally dimensioned by:
A) Ø
B) R
C) F
D) T
Answer: B
Explanation: Radius indicated using R prefix.
Ref: Machine Drawing, N.D. Bhatt

---

170. The most preferred scale for machine drawings is:
A) 2:1
B) 1:1
C) 1:2
D) 1:5
Answer: B
Explanation: Full scale (1:1) preferred when possible.
Ref: Machine Drawing, N.D. Bhatt

◆ LIMITS, FITS & TOLERANCES

---

171. Basic size is:
A) Maximum size
B) Minimum size
C) Nominal size from which limits are derived
D) Actual size
Answer: C
Explanation: Basic size is theoretical size for calculating limits.
Ref: Machine Drawing, N.D. Bhatt

---

172. The difference between upper and lower limit is called:
A) Allowance
B) Deviation
C) Tolerance
D) Fit
Answer: C
Explanation: Tolerance = Upper limit − Lower limit.
Ref: Machine Drawing, N.D. Bhatt

---

173. Upper deviation is:
A) Max size − Basic size
B) Basic size − Min size
C) Min − Max
D) Actual − Basic
Answer: A
Explanation: Upper deviation is algebraic difference between max and basic size.
Ref: Machine Drawing, N.D. Bhatt

---

174. Clearance fit always provides:
A) Interference
B) Zero gap
C) Positive clearance
D) Negative clearance
Answer: C
Explanation: In clearance fit, shaft is always smaller than hole.
Ref: Machine Drawing, N.D. Bhatt

---

175. Interference fit provides:
A) Clearance

B) Overlap
C) Zero gap
D) Free motion
Answer: B
Explanation: Shaft size exceeds hole size causing interference.
Ref: Machine Drawing, N.D. Bhatt

---

176. Transition fit may result in:
A) Only clearance
B) Only interference
C) Either clearance or interference
D) No contact
Answer: C
Explanation: Depending on tolerance limits, slight clearance or interference may occur.
Ref: Machine Drawing, N.D. Bhatt

---

177. The number of standard tolerance grades is:
A) 10
B) 15
C) 18
D) 20
Answer: C
Explanation: ISO system defines 18 IT grades (IT01 to IT16).
Ref: Machine Drawing, N.D. Bhatt

---

178. IT01 is used for:
A) Rough work
B) Medium fit
C) Precision instruments
D) Forgings
Answer: C
Explanation: IT01 has very fine tolerance for precision components.
Ref: Machine Drawing, N.D. Bhatt

---

179. The fundamental deviation for hole basis system is:
A) Shaft fixed
B) Hole fixed
C) Both fixed
D) None

Answer: B
Explanation: Hole size remains constant; shaft tolerance varies.
Ref: Machine Drawing, N.D. Bhatt

---

180. In shaft basis system:
A) Shaft basic size fixed
B) Hole fixed
C) Both vary
D) None
Answer: A
Explanation: Shaft basic size fixed; hole tolerance changes.
Ref: Machine Drawing, N.D. Bhatt

---

181. Surface roughness Ra value indicates:
A) Peak height
B) Mean roughness
C) Max roughness
D) Waviness
Answer: B
Explanation: Ra is arithmetic average deviation from mean line.
Ref: Machine Drawing, N.D. Bhatt

---

182. Smaller Ra value indicates:
A) Rougher surface
B) Smoother surface
C) Hard surface
D) Soft surface
Answer: B
Explanation: Lower Ra means finer finish.
Ref: Machine Drawing, N.D. Bhatt

---

183. A surface with Ra 0.8 µm is generally produced by:
A) Casting
B) Forging
C) Grinding
D) Sand blasting
Answer: C
Explanation: Grinding produces fine surface finish.
Ref: Machine Drawing, N.D. Bhatt

---

184. A surface with Ra 12.5 μm is typical of:
A) Grinding
B) Machining
C) Casting
D) Lapping
Answer: C
Explanation: Cast surfaces are comparatively rough.
Ref: Machine Drawing, N.D. Bhatt

---

185. Allowance is:
A) Difference between limits
B) Intentional difference between mating parts
C) Basic size
D) Tolerance
Answer: B
Explanation: Allowance determines type of fit.
Ref: Machine Drawing, N.D. Bhatt

---

186. Maximum material condition (MMC) refers to:
A) Minimum material
B) Maximum size of hole
C) Maximum size of shaft
D) Tightest fit
Answer: C
Explanation: MMC for shaft is largest permissible size.
Ref: Machine Drawing, N.D. Bhatt

---

187. Zero line in tolerance chart represents:
A) Max size
B) Basic size
C) Min size
D) Actual size
Answer: B
Explanation: Zero line corresponds to basic size reference.
Ref: Machine Drawing, N.D. Bhatt

---

188. The tolerance symbol H7 indicates:
A) Shaft tolerance
B) Hole tolerance

C) Fit
D) Surface finish
Answer: B
Explanation: Capital letter represents hole tolerance.
Ref: Machine Drawing, N.D. Bhatt

---

189. The tolerance symbol g6 represents:
A) Hole
B) Shaft
C) Fit
D) Finish
Answer: B
Explanation: Small letter denotes shaft tolerance.
Ref: Machine Drawing, N.D. Bhatt

---

190. In H7/g6 fit, the system used is:
A) Shaft basis
B) Hole basis
C) Transition
D) Interference
Answer: B
Explanation: H hole indicates hole basis system.
Ref: Machine Drawing, N.D. Bhatt

---

191. Standard unit of surface roughness is:
A) mm
B) cm
C) µm
D) nm
Answer: C
Explanation: Roughness measured in micrometers (µm).
Ref: Machine Drawing, N.D. Bhatt

---

192. A tolerance grade IT16 is used for:
A) Precision
B) Medium
C) Rough work
D) Measuring instruments

Answer: C
Explanation: Higher IT number → larger tolerance → rough applications.
Ref: Machine Drawing, N.D. Bhatt

---

193. Hole with tolerance zone entirely above zero line gives:
A) Clearance fit
B) Interference fit
C) Transition
D) None
Answer: A
Explanation: Hole larger than shaft gives clearance.
Ref: Machine Drawing, N.D. Bhatt

---

194. Shaft tolerance zone below zero line indicates:
A) Oversize shaft
B) Undersize shaft
C) Exact size
D) Basic size
Answer: B
Explanation: Shaft below zero line is smaller than basic size.
Ref: Machine Drawing, N.D. Bhatt

---

195. Interchangeability of parts is ensured by:
A) Draft
B) Tolerance
C) Surface finish
D) Sectioning
Answer: B
Explanation: Proper tolerances ensure interchangeability.
Ref: Machine Drawing, N.D. Bhatt

---

196. Surface lay direction is indicated near:
A) Centre line
B) Surface roughness symbol
C) Dimension line
D) Section line
Answer: B
Explanation: Lay symbol is added to roughness symbol.
Ref: Machine Drawing, N.D. Bhatt

---

197. The roughness value placed above the symbol indicates:
A) Maximum value
B) Minimum value
C) Average Ra value
D) Pitch
Answer: C
Explanation: Ra value shown above symbol denotes required finish.
Ref: Machine Drawing, N.D. Bhatt

---

198. If no tolerance is mentioned, it means:
A) Zero tolerance
B) Manufacturing tolerance applies
C) Exact size
D) Reject
Answer: B
Explanation: General tolerances apply as per standards.
Ref: Machine Drawing, N.D. Bhatt

---

199. Fits are classified based on:
A) Tolerance size
B) Allowance
C) Surface finish
D) Draft
Answer: B
Explanation: Fit type depends on allowance between mating parts.
Ref: Machine Drawing, N.D. Bhatt

---

200. The smallest tolerance grade is:
A) IT16
B) IT10
C) IT01
D) IT7
Answer: C
Explanation: IT01 has smallest tolerance band.
Ref: Machine Drawing, N.D. Bhatt

---

201. If basic size = 50 mm and tolerance = 0.02 mm, the tolerance zone width is:
A) 0.01 mm
B) 0.02 mm

C) 0.04 mm
D) 50.02 mm
Answer: B
Explanation: Tolerance equals total permissible variation, here 0.02 mm.
Ref: Machine Drawing, N.D. Bhatt

---

202. If hole limits are 50.00 mm and 50.03 mm, tolerance is:
A) 0.03 mm
B) 0.05 mm
C) 0.02 mm
D) 0.06 mm
Answer: A
Explanation: Tolerance = 50.03 − 50.00 = 0.03 mm.
Ref: Machine Drawing, N.D. Bhatt

---

203. If shaft limits are 49.98 mm and 49.95 mm, maximum clearance with hole 50.00 mm is:
A) 0.05 mm
B) 0.02 mm
C) 0.03 mm
D) 0.00 mm
Answer: A
Explanation: Max clearance = 50.00 − 49.95 = 0.05 mm.
Ref: Machine Drawing, N.D. Bhatt

---

204. Negative allowance indicates:
A) Clearance fit
B) Interference fit
C) Transition fit
D) Loose fit
Answer: B
Explanation: Negative allowance means shaft larger than hole.
Ref: Machine Drawing, N.D. Bhatt

---

205. In H7 hole, lower deviation is:
A) Positive
B) Negative
C) Zero
D) Random

Answer: C
Explanation: In hole basis system, H has zero lower deviation.
Ref: Machine Drawing, N.D. Bhatt

---

206. The unit tolerance 'i' depends on:
A) Surface finish
B) Basic size
C) Material
D) Temperature
Answer: B
Explanation: Standard tolerance unit 'i' is function of nominal size.
Ref: Machine Drawing, N.D. Bhatt

---

207. IT7 tolerance is finer than:
A) IT5
B) IT6
C) IT8
D) IT4
Answer: C
Explanation: Larger IT number means coarser tolerance.
Ref: Machine Drawing, N.D. Bhatt

---

208. For a perfect sliding fit, suitable type is:
A) Interference
B) Clearance
C) Transition
D) Force fit
Answer: B
Explanation: Sliding motion requires clearance fit.
Ref: Machine Drawing, N.D. Bhatt

---

209. Press fit is also called:
A) Clearance fit
B) Push fit
C) Force fit
D) Running fit
Answer: C
Explanation: Force fit creates high interference requiring pressure.
Ref: Machine Drawing, N.D. Bhatt

---

210. Running fit belongs to:
A) Clearance fit
B) Interference fit
C) Transition fit
D) Shrink fit
Answer: A
Explanation: Running fit provides continuous motion clearance.
Ref: Machine Drawing, N.D. Bhatt

---

211. Maximum material condition of hole is:
A) Largest hole
B) Smallest hole
C) Basic hole
D) Actual hole
Answer: B
Explanation: MMC for hole is smallest permissible size.
Ref: Machine Drawing, N.D. Bhatt

---

212. Deviation is measured from:
A) Maximum size
B) Minimum size
C) Basic size
D) Actual size
Answer: C
Explanation: Deviations are algebraic differences from basic size.
Ref: Machine Drawing, N.D. Bhatt

---

213. If tolerance increases, manufacturing cost generally:
A) Increases
B) Decreases
C) Remains same
D) Doubles
Answer: B
Explanation: Larger tolerance reduces machining precision requirement.
Ref: Machine Drawing, N.D. Bhatt

---

214. Shrink fit is achieved by:
A) Cooling shaft
B) Heating hole

C) Both A & B
D) Machining only
Answer: C
Explanation: Shrink fit obtained by temperature variation for interference assembly.
Ref: Machine Drawing, N.D. Bhatt

---

215. If shaft is always smaller than hole, allowance is:
A) Negative
B) Positive
C) Zero
D) Infinite
Answer: B
Explanation: Positive allowance gives clearance fit.
Ref: Machine Drawing, N.D. Bhatt

---

216. The fundamental deviation letter for hole basis clearance fit is generally:
A) H
B) h
C) G
D) F
Answer: A
Explanation: H-hole basis system widely used for clearance fits.
Ref: Machine Drawing, N.D. Bhatt

---

217. Tolerance zone width is determined by:
A) Basic size
B) IT grade
C) Deviation
D) Allowance
Answer: B
Explanation: IT grade defines tolerance magnitude.
Ref: Machine Drawing, N.D. Bhatt

---

218. Surface finish affects:
A) Strength only
B) Fatigue life
C) Density
D) Draft

Answer: B
Explanation: Rough surfaces reduce fatigue strength.
Ref: Machine Drawing, N.D. Bhatt

---

219. A highly polished surface has Ra approximately:
A) 12.5 µm
B) 6.3 µm
C) 0.2 µm
D) 25 µm
Answer: C
Explanation: Fine polishing gives very low roughness.
Ref: Machine Drawing, N.D. Bhatt

---

220. Rough machining typically gives Ra around:
A) 0.1 µm
B) 0.4 µm
C) 3.2 µm
D) 25 µm
Answer: C
Explanation: Standard machining gives Ra ≈ 3.2 µm.
Ref: Machine Drawing, N.D. Bhatt

---

221. If tolerance is too tight, production becomes:
A) Easier
B) Cheaper
C) Difficult
D) Faster
Answer: C
Explanation: Tight tolerance requires precision machining.
Ref: Machine Drawing, N.D. Bhatt

---

222. Interference fit ensures:
A) Free rotation
B) Rigid joint
C) Loose assembly
D) Sliding motion
Answer: B
Explanation: Interference prevents relative motion.
Ref: Machine Drawing, N.D. Bhatt

---

223. Clearance = Hole – Shaft. If result negative, fit is:
A) Clearance
B) Transition
C) Interference
D) Running
Answer: C
Explanation: Negative clearance means interference.
Ref: Machine Drawing, N.D. Bhatt

---

224. Fit is decided by:
A) Basic size only
B) Surface finish only
C) Relative tolerance positions
D) Draft
Answer: C
Explanation: Fit depends on position of tolerance zones.
Ref: Machine Drawing, N.D. Bhatt

---

225. Preferred numbers reduce:
A) Strength
B) Variety of sizes
C) Cost only
D) Tolerance
Answer: B
Explanation: Renard series standardizes sizes.
Ref: Machine Drawing, N.D. Bhatt

---

226. R20 series has how many steps per decade?
A) 5
B) 10
C) 20
D) 40
Answer: C
Explanation: R20 has 20 values between powers of 10.
Ref: Machine Drawing, N.D. Bhatt

---

227. Zero tolerance means:
A) Perfect part
B) Impossible practically

C) Clearance fit
D) Transition
Answer: B
Explanation: Zero tolerance cannot be achieved in manufacturing.
Ref: Machine Drawing, N.D. Bhatt

---

228. Rough casting surface is around:
A) 0.4 µm
B) 0.8 µm
C) 12.5–25 µm
D) 3.2 µm
Answer: C
Explanation: Cast surfaces are relatively rough.
Ref: Machine Drawing, N.D. Bhatt

---

229. The lay symbol parallel to line indicates:
A) Random lay
B) Parallel lay
C) Circular lay
D) Cross lay
Answer: B
Explanation: Lay direction indicated along surface roughness symbol.
Ref: Machine Drawing, N.D. Bhatt

---

230. Surface roughness symbol placed on extension line applies to:
A) Entire drawing
B) That surface only
C) Adjacent surface
D) Hidden part
Answer: B
Explanation: Symbol applies to the indicated surface.
Ref: Machine Drawing, N.D. Bhatt

◆ MIXED HIGH-SCORING ECET QUESTIONS

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231. Mortise and tenon joint resists mainly:
A) Tension
B) Shear
C) Compression
D) Bending

Answer: B
Explanation: Joint resists shear forces effectively.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

232. Recrystallization removes:
A) Grain
B) Work hardening
C) Impurities
D) Draft
Answer: B
Explanation: New grains eliminate strain hardening.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

233. Pattern allowance other than shrinkage is:
A) Draft allowance
B) Surface finish
C) Tolerance
D) Roughness
Answer: A
Explanation: Draft allows easy pattern removal.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

234. Grain refinement improves:
A) Brittleness
B) Strength
C) Porosity
D) Scale
Answer: B
Explanation: Fine grains increase strength and toughness.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

235. Excessive permeability may cause:
A) Blow hole
B) Metal penetration
C) Cold shut
D) Shrinkage
Answer: B
Explanation: High permeability allows metal penetration into sand.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

236. First angle projection is mainly used in:
A) USA
B) India & Europe
C) Japan
D) China
Answer: B
Explanation: BIS and European standards follow first angle.
Ref: Machine Drawing, N.D. Bhatt

---

237. Section lining spacing depends on:
A) Material
B) Size of object
C) Scale
D) Fit
Answer: B
Explanation: Larger areas have wider spacing.
Ref: Machine Drawing, N.D. Bhatt

---

238. Fit ensuring accurate location without play is:
A) Running fit
B) Sliding fit
C) Transition fit
D) Force fit
Answer: C
Explanation: Transition fit provides accurate positioning.
Ref: Machine Drawing, N.D. Bhatt

---

239. Maximum clearance occurs when:
A) Largest hole & smallest shaft
B) Smallest hole & largest shaft
C) Both largest
D) Both smallest
Answer: A
Explanation: Clearance maximized by extreme limits.
Ref: Machine Drawing, N.D. Bhatt

---

240. Shrinkage allowance for steel is approximately:
A) 2 mm/m
B) 10 mm/m

C) 20 mm/m
D) 5 mm/m
Answer: C
Explanation: Steel shrinkage ≈ 20 mm per meter.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

241. A smoother surface improves:
A) Corrosion only
B) Fatigue resistance
C) Shrinkage
D) Draft
Answer: B
Explanation: Smooth surfaces reduce stress concentration.
Ref: Machine Drawing, N.D. Bhatt

---

242. Which is NOT a type of fit?
A) Clearance
B) Transition
C) Interference
D) Draft
Answer: D
Explanation: Draft is casting allowance, not fit.
Ref: Machine Drawing, N.D. Bhatt

---

243. Fullering operation precedes:
A) Upsetting
B) Drawing
C) Punching
D) Swaging
Answer: B
Explanation: Fullering localizes metal before drawing.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

244. Casting defect due to sudden cooling is:
A) Hot tear
B) Blow hole
C) Cold shut
D) Shrinkage

Answer: A
Explanation: Rapid uneven cooling induces stress cracks.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

245. A well-designed gating system reduces:
A) Permeability
B) Turbulence
C) Draft
D) Shrinkage
Answer: B
Explanation: Smooth metal flow prevents turbulence defects.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

246. In ISO fits, capital letters denote:
A) Shaft
B) Hole
C) Surface finish
D) Draft
Answer: B
Explanation: Uppercase letters represent hole deviations.
Ref: Machine Drawing, N.D. Bhatt

---

247. A shaft marked h6 means:
A) Zero upper deviation
B) Zero lower deviation
C) Positive deviation
D) No tolerance
Answer: A
Explanation: In shaft system, ‘h’ has zero upper deviation.
Ref: Machine Drawing, N.D. Bhatt

---

248. Tolerance accumulation in assembly is called:
A) Fit
B) Stack-up
C) Allowance
D) Deviation
Answer: B
Explanation: Stack-up refers to cumulative tolerances.
Ref: Machine Drawing, N.D. Bhatt

---

249. Forging produces better properties than casting due to:
A) Porosity
B) Grain alignment
C) Surface finish
D) Cooling rate
Answer: B
Explanation: Grain flow improves mechanical strength.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

250. Draft angle generally varies between:
A) 0–1°
B) 1–3°
C) 5–10°
D) 10–15°
Answer: B
Explanation: Draft typically provided 1–3° for sand casting.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

251. The tolerance zone position is defined by:
A) IT grade
B) Fundamental deviation
C) Basic size
D) Surface finish
Answer: B
Explanation: Letter symbol indicates deviation position.
Ref: Machine Drawing, N.D. Bhatt

---

252. Which operation increases diameter in forging?
A) Drawing
B) Fullering
C) Upsetting
D) Punching
Answer: C
Explanation: Upsetting increases cross-sectional area.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

253. High carbon steel forging temperature is:
A) Lower than MS
B) Higher than MS

C) Same
D) Zero
Answer: A
Explanation: High carbon steel requires lower forging temperature.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

254. In drawing, hidden lines are not shown in:
A) Assembly drawing
B) Sectional view
C) Orthographic view
D) Pictorial
Answer: B
Explanation: Hidden details are replaced by section lining.
Ref: Machine Drawing, N.D. Bhatt

---

255. A smooth surface generally requires:
A) High Ra
B) Low Ra
C) High tolerance
D) Large IT
Answer: B
Explanation: Low Ra indicates smooth finish.
Ref: Machine Drawing, N.D. Bhatt

---

256. Standard practice avoids dimensioning to:
A) Visible line
B) Centre line
C) Hidden line
D) Extension line
Answer: C
Explanation: Dimensions should not be given to hidden lines.
Ref: Machine Drawing, N.D. Bhatt

---

257. The zero line represents:
A) Actual size
B) Basic size
C) Max size
D) Min size

Answer: B
Explanation: Zero line corresponds to basic dimension.
Ref: Machine Drawing, N.D. Bhatt

---

258. In sand casting, collapsibility prevents:
A) Blow hole
B) Hot tears
C) Shrinkage
D) Porosity
Answer: B
Explanation: Good collapsibility reduces stress during solidification.
Ref: Workshop Technology Vol I, Hazra Choudhury

---

259. Clearance fit is preferred for:
A) Permanent joints
B) Rotating shafts
C) Shrink assembly
D) Press fit
Answer: B
Explanation: Rotation requires positive clearance.
Ref: Machine Drawing, N.D. Bhatt

---

260. The ultimate purpose of limits and fits system is:
A) Increase roughness
B) Improve draft
C) Ensure interchangeability
D) Increase shrinkage
Answer: C
Explanation: Limits & fits ensure standardized mass production.
Ref: Machine Drawing, N.D. Bhatt

Unit II: Production Technology and Computer Aided Manufacturing Systems

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◆ WELDING & WELDING DEFECTS

---

1. Arc welding works on the principle of:
A) Resistance heating
B) Electric arc heat generation
C) Chemical reaction
D) Friction
Answer: B
Explanation: Electric arc between electrode and work generates intense heat (~6000°C).
Ref: Manufacturing Technology Vol I, P.N. Rao

---

2. In arc welding, the electrode acts as:
A) Filler only
B) Conductor only
C) Both conductor and filler
D) Shielding gas
Answer: C
Explanation: Consumable electrodes conduct current and supply filler metal.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

3. The temperature of an electric arc is approximately:
A) 1500°C
B) 3000°C
C) 6000°C
D) 10000°C
Answer: C
Explanation: Arc temperature ranges around 5000–6000°C.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

4. Submerged Arc Welding (SAW) uses:
A) Shielding gas
B) Flux blanket
C) Vacuum
D) Water
Answer: B
Explanation: Arc is submerged under granular flux.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

5. A major advantage of SAW is:
A) Portable
B) High deposition rate
C) Manual control
D) Low cost equipment
Answer: B
Explanation: SAW provides high welding speed and deposition.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

6. Atomic Hydrogen Welding uses:
A) CO_2 gas
B) Hydrogen gas
C) Argon
D) Oxygen
Answer: B
Explanation: Hydrogen dissociation and recombination produces intense heat.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

7. In Atomic Hydrogen Welding, temperature can reach:
A) 2000°C
B) 3000°C
C) 4000°C
D) 6000°C
Answer: C
Explanation: Recombination of hydrogen generates ~4000°C.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

8. CO_2 welding is a type of:
A) TIG
B) MIG
C) Resistance welding
D) Forge welding
Answer: B
Explanation: CO_2 welding is Gas Metal Arc Welding (GMAW).
Ref: Manufacturing Technology Vol I, P.N. Rao

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9. Shielding gas in CO_2 welding prevents:
A) Cooling
B) Oxidation

C) Melting
D) Fusion
Answer: B
Explanation: Shielding gas protects molten pool from atmosphere.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

10. Ultrasonic welding works on:
A) High temperature
B) High pressure
C) High frequency vibrations
D) Chemical reaction
Answer: C
Explanation: Ultrasonic vibrations cause solid-state bonding.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

11. Ultrasonic welding is suitable for:
A) Thick steel plates
B) Thermoplastics
C) Cast iron
D) Aluminum blocks
Answer: B
Explanation: US welding commonly used for plastics and thin sheets.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

12. Porosity in welding is caused by:
A) Excess current
B) Trapped gases
C) Low voltage
D) Slow cooling
Answer: B
Explanation: Gas entrapment forms small cavities.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

13. Slag inclusion occurs due to:
A) Improper cleaning
B) Excess penetration
C) High speed
D) High pressure

Answer: A
Explanation: Slag not removed between passes causes inclusion.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

14. Undercut defect appears as:
A) Surface crack
B) Groove along weld toe
C) Internal cavity
D) Bulge
Answer: B
Explanation: Undercut is a groove formed along weld edge.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

15. Remedy for porosity is:
A) Increase moisture
B) Proper shielding
C) Increase slag
D) Decrease cleaning
Answer: B
Explanation: Good shielding prevents gas entrapment.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

16. Resistance welding uses heat generated by:
A) Arc
B) Chemical reaction
C) Electrical resistance
D) Friction
Answer: C
Explanation: I^2R heat at joint produces weld.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

17. Spot welding is mainly used for:
A) Pipes
B) Sheet metal
C) Thick plates
D) Castings
Answer: B
Explanation: Spot welding joins thin sheet metals.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

18. Welding polarity affects:
A) Colour
B) Penetration
C) Cost
D) Cooling
Answer: B
Explanation: DC polarity controls heat distribution and penetration.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

19. In DCEN (straight polarity), more heat is generated at:
A) Electrode
B) Workpiece
C) Arc
D) Power supply
Answer: B
Explanation: About 2/3 heat is generated at positive terminal (workpiece).
Ref: Manufacturing Technology Vol I, P.N. Rao

---

20. TIG welding uses electrode made of:
A) Steel
B) Carbon
C) Tungsten
D) Copper
Answer: C
Explanation: Tungsten electrode is non-consumable.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

21. MIG welding uses:
A) Non-consumable electrode
B) Consumable wire
C) Carbon rod
D) Flux rod
Answer: B
Explanation: Continuously fed consumable wire electrode is used.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

22. Cracks in weld are most dangerous because they:
A) Look bad
B) Reduce fatigue strength

C) Increase strength
D) Improve bonding
Answer: B
Explanation: Cracks propagate under cyclic loads.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

23. Excessive current may cause:
A) Porosity
B) Undercut
C) Slag inclusion
D) Cold weld
Answer: B
Explanation: High current melts base metal excessively causing undercut.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

24. Flux coating on electrode provides:
A) Decoration
B) Shielding
C) Cooling
D) Strength
Answer: B
Explanation: Flux produces protective gas and slag.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

25. Shielded Metal Arc Welding is also called:
A) TIG
B) MIG
C) Manual metal arc welding
D) Plasma
Answer: C
Explanation: SMAW is commonly called MMAW.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

26. In gas welding, flame temperature depends on:
A) Gas pressure
B) Type of gas mixture
C) Current
D) Polarity

Answer: B
Explanation: Oxy-acetylene gives highest temperature (~3200°C).
Ref: Manufacturing Technology Vol I, P.N. Rao

---

27. Neutral flame has:
A) Excess oxygen
B) Excess acetylene
C) Balanced mixture
D) No flame
Answer: C
Explanation: Equal oxygen and acetylene produce neutral flame.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

28. Oxidizing flame is used for:
A) Steel
B) Aluminum
C) Brass
D) Cast iron
Answer: C
Explanation: Brass welding requires slight oxidizing flame.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

29. Backfire in gas welding is caused by:
A) High pressure
B) Low pressure
C) Tip blockage
D) Excess oxygen
Answer: C
Explanation: Obstructed nozzle causes flame to travel back.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

30. Flash welding is mainly used for:
A) Thick plates
B) Rod joining
C) Spot welding
D) Plastic
Answer: B
Explanation: Flash welding joins rods and rails.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

31. The heat in resistance welding depends on:
A) I
B) V
C) I^2R
D) R
Answer: C
Explanation: Heat generated proportional to I^2Rt.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

32. Submerged Arc Welding is best suited for:
A) Thin sheets
B) Long straight joints
C) Plastics
D) Small repairs
Answer: B
Explanation: SAW ideal for long heavy welds.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

33. Welding distortion is mainly due to:
A) Rapid heating and cooling
B) Slag
C) Gas
D) Flux
Answer: A
Explanation: Uneven expansion and contraction cause distortion.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

34. Preheating reduces:
A) Slag
B) Residual stresses
C) Arc temperature
D) Current
Answer: B
Explanation: Preheating minimizes thermal gradients.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

35. Weld bead reinforcement refers to:
A) Depression
B) Excess weld metal

C) Crack
D) Slag
Answer: B
Explanation: Slight convex surface above plate.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

36. Lack of fusion occurs due to:
A) Low heat input
B) High pressure
C) High gas flow
D) Slow cooling
Answer: A
Explanation: Insufficient heat prevents proper melting.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

37. Slag removal is done by:
A) Wire brush
B) Hammer
C) Both A & B
D) Grinding only
Answer: C
Explanation: Chipping hammer and wire brush remove slag.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

38. The primary advantage of ultrasonic welding is:
A) High temperature
B) No melting
C) Slow process
D) High distortion
Answer: B
Explanation: Solid-state bonding avoids melting.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

39. SAW flux mainly consists of:
A) Sand
B) Granulated minerals
C) Gas
D) Steel

Answer: B
Explanation: Flux mixture covers arc and stabilizes it.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

40. Welding electrode classification E6013 indicates:
A) Tensile strength 60 ksi
B) Diameter
C) Current
D) Coating
Answer: A
Explanation: First two digits indicate tensile strength (60 ksi).
Ref: Manufacturing Technology Vol I, P.N. Rao

---

41. Hydrogen induced cracking occurs due to:
A) High oxygen
B) Hydrogen embrittlement
C) Slag
D) Cooling
Answer: B
Explanation: Hydrogen causes delayed cracking.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

42. Arc blow is due to:
A) Magnetic field
B) Gas
C) Current
D) Pressure
Answer: A
Explanation: Magnetic fields deflect arc.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

43. Plasma arc welding differs from TIG by:
A) Higher arc constriction
B) Lower heat
C) No shielding
D) No electrode
Answer: A
Explanation: Plasma arc is constricted and more concentrated.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

44. Weldability depends mainly on:
A) Colour
B) Carbon content
C) Thickness
D) Shape
Answer: B
Explanation: Higher carbon reduces weldability.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

45. Excessive spatter is caused by:
A) Proper shielding
B) Incorrect current
C) Cleaning
D) Slag
Answer: B
Explanation: Improper current settings increase spatter.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

46. Cold cracking occurs at:
A) High temperature
B) Room temperature
C) 1000°C
D) Melting point
Answer: B
Explanation: Occurs after cooling due to residual stresses.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

47. Root gap affects:
A) Appearance
B) Penetration
C) Colour
D) Gas
Answer: B
Explanation: Proper root gap ensures penetration.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

48. The main purpose of backing strip is to:
A) Reduce cost
B) Support molten metal

C) Increase spatter
D) Increase porosity
Answer: B
Explanation: Backing supports weld pool.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

49. Excess penetration leads to:
A) Burn through
B) Porosity
C) Slag inclusion
D) Crack
Answer: A
Explanation: Excess heat causes hole formation.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

50. The most common weld inspection method is:
A) X-ray
B) Ultrasonic
C) Visual inspection
D) Magnetic
Answer: C
Explanation: Visual inspection is primary quality check.
Ref: Manufacturing Technology Vol I, P.N. Rao

◆ LATHE MACHINE

---

51. The primary function of a lathe is to perform:
A) Drilling
B) Milling
C) Turning
D) Grinding
Answer: C
Explanation: Lathe removes material by rotating the workpiece against a stationary cutting tool.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

52. The headstock of a lathe houses:
A) Tailstock spindle
B) Gear box and spindle
C) Tool post
D) Carriage

Answer: B
Explanation: Headstock contains main spindle and speed change mechanism.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

53. The lead screw is mainly used for:
A) Facing
B) Taper turning
C) Thread cutting
D) Drilling
Answer: C
Explanation: Lead screw provides precise linear motion for threading.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

54. The feed rod is used for:
A) Thread cutting
B) Automatic feed
C) Spindle rotation
D) Tailstock movement
Answer: B
Explanation: Feed rod transmits motion for longitudinal and cross feed.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

55. The function of carriage is to:
A) Hold work
B) Support tool
C) Rotate spindle
D) Change speed
Answer: B
Explanation: Carriage supports and moves the cutting tool.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

56. The compound rest is used for:
A) Facing
B) Taper turning
C) Drilling
D) Thread cutting
Answer: B
Explanation: Compound rest is swiveled for short tapers.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

57. Knurling is performed to:
A) Reduce diameter
B) Improve grip
C) Increase length
D) Cut thread
Answer: B
Explanation: Knurling produces patterned surface for grip.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

58. In taper turning by tailstock offset method:
A) Tool is angled
B) Tailstock is shifted
C) Lead screw is changed
D) Gear ratio altered
Answer: B
Explanation: Tailstock is offset to produce taper.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

59. The ratio of cutting speed to feed is called:
A) Pitch
B) Chip thickness
C) Tool life
D) Feed rate
Answer: D
Explanation: Feed rate determines material removal rate.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

60. Back gear mechanism is used to:
A) Increase speed
B) Reduce speed and increase torque
C) Change feed
D) Reverse direction
Answer: B
Explanation: Back gear provides low speed and high torque.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

61. Chuck used for irregular work is:
A) Three jaw
B) Four jaw

C) Collet
D) Magnetic
Answer: B
Explanation: Four-jaw chuck allows independent adjustment.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

62. Facing operation produces:
A) Cylindrical surface
B) Flat surface
C) Taper
D) Thread
Answer: B
Explanation: Facing produces flat end surface.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

63. Cutting speed in lathe depends on:
A) Feed
B) Depth of cut
C) Diameter
D) Tool type only
Answer: C
Explanation: Cutting speed = $\pi DN/1000$.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

64. The apron of lathe contains:
A) Gears for feed
B) Spindle
C) Chuck
D) Tailstock
Answer: A
Explanation: Apron houses feed mechanism gears.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

65. The centre height of lathe indicates:
A) Maximum diameter capacity
B) Length
C) Speed
D) Feed

Answer: A
Explanation: Swing over bed = 2 × centre height.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

66. Boring operation is used to:
A) Create hole
B) Enlarge hole
C) Finish surface
D) Cut thread
Answer: B
Explanation: Boring enlarges and improves existing hole.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

67. Tool life is mainly affected by:
A) Colour
B) Speed
C) Tailstock
D) Chuck
Answer: B
Explanation: Higher cutting speed reduces tool life.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

68. Parting tool is used for:
A) Threading
B) Facing
C) Cutting off
D) Drilling
Answer: C
Explanation: Parting tool separates finished component.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

69. Thread pitch is controlled by:
A) Lead screw
B) Feed rod
C) Tailstock
D) Compound rest
Answer: A
Explanation: Lead screw rotation determines pitch.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

70. Collet chuck is used for:
A) Large work
B) Accurate small work
C) Irregular work
D) Heavy cutting
Answer: B
Explanation: Collet gives high concentricity.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

71. Drill point angle for mild steel is approximately:
A) 60°
B) 90°
C) 118°
D) 150°
Answer: C
Explanation: Standard drill angle for steel is 118°.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

72. The main motion in drilling is:
A) Linear tool motion
B) Work rotation
C) Tool rotation
D) Reciprocation
Answer: C
Explanation: Drill rotates while work remains stationary.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

73. Reaming improves:
A) Diameter accuracy
B) Length
C) Depth
D) Hardness
Answer: A
Explanation: Reaming provides accurate and smooth holes.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

74. Counterboring is done to:
A) Create conical hole
B) Enlarge top of hole cylindrically

C) Reduce diameter
D) Polish
Answer: B
Explanation: Counterbore produces flat-bottom cylindrical enlargement.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

75. Tapping operation is used for:
A) External thread
B) Internal thread
C) Facing
D) Milling
Answer: B
Explanation: Tapping cuts internal threads.
Ref: Manufacturing Technology Vol II, P.N. Rao

◆ SHAPER, SLOTTER & PLANNER

---

76. In shaper, the reciprocating motion is given to:
A) Workpiece
B) Tool
C) Table
D) Base
Answer: B
Explanation: Tool reciprocates in shaper.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

77. In planer, reciprocating motion is given to:
A) Tool
B) Workpiece
C) Column
D) Ram
Answer: B
Explanation: Workpiece moves in planer.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

78. Slotter is a vertical version of:
A) Lathe
B) Shaper
C) Milling
D) Drilling

Answer: B
Explanation: Slotter has vertical reciprocating ram.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

79. Quick return mechanism reduces:
A) Cutting time
B) Return stroke time
C) Feed
D) Speed
Answer: B
Explanation: Return stroke is faster than cutting stroke.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

80. Whitworth mechanism is used in:
A) Lathe
B) Milling
C) Shaper
D) Drilling
Answer: C
Explanation: Whitworth quick return used in shaper.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

81. In crank and slotted link mechanism, quick return ratio is:
A) 1
B) >1
C) <1
D) 0
Answer: B
Explanation: Cutting stroke takes more time than return stroke.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

82. Planner is suitable for:
A) Small work
B) Medium work
C) Large heavy work
D) Precision work
Answer: C
Explanation: Planner handles large components.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

83. Cutting stroke in shaper is:
A) Forward stroke
B) Return stroke
C) Both
D) None
Answer: A
Explanation: Material removal occurs during forward stroke.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

84. Feed in shaper is given during:
A) Cutting stroke
B) Return stroke
C) Both
D) No stroke
Answer: B
Explanation: Feed given during idle return stroke.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

85. The main difference between shaper and planer is:
A) Speed
B) Tool shape
C) Moving part
D) Feed
Answer: C
Explanation: Tool moves in shaper; work moves in planer.
Ref: Manufacturing Technology Vol II, P.N. Rao

◆ **MILLING MACHINE**

---

111. In milling, cutting tool rotates while:
A) Tool stationary
B) Work rotates
C) Work fed
D) Both rotate
Answer: C
Explanation: Milling cutter rotates; work is fed.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

112. Up milling is also called:
A) Climb milling

B) Conventional milling
C) Down milling
D) Slot milling
Answer: B
Explanation: In up milling, cutter rotates opposite to feed.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

113. In down milling, cutter rotates:
A) Against feed
B) With feed
C) Perpendicular
D) Random
Answer: B
Explanation: Cutter rotation same as feed direction.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

114. Milling machine spindle is located in:
A) Base
B) Column
C) Knee
D) Arbor
Answer: B
Explanation: Column houses spindle drive.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

115. Indexing head is used for:
A) Drilling
B) Cutting gears
C) Facing
D) Turning
Answer: B
Explanation: Dividing head helps gear cutting.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

116. Simple indexing formula is:
A) 40/N
B) N/40
C) 1/N
D) 2N

Answer: A
Explanation: Turns of crank = 40/N.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

117. Face milling cutter cuts using:
A) Side teeth only
B) Face teeth only
C) Both
D) None
Answer: C
Explanation: Face milling cutter has teeth on periphery and face.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

118. Slot milling cutter is also called:
A) End mill
B) Face mill
C) Slab mill
D) Gear cutter
Answer: A
Explanation: End mill used for slot cutting.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

119. Milling operation produces surface by:
A) Single point tool
B) Multi-point cutter
C) Abrasion
D) Grinding
Answer: B
Explanation: Milling uses multiple cutting edges.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

120. The knee in milling machine supports:
A) Spindle
B) Tool
C) Table
D) Motor
Answer: C
Explanation: Knee carries saddle and table.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

121. Horizontal milling machine spindle axis is:
A) Vertical
B) Horizontal
C) Inclined
D) None
Answer: B
Explanation: Horizontal mill has horizontal spindle.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

122. Gear cutting on milling machine uses:
A) End mill
B) Slab mill
C) Form cutter
D) Twist drill
Answer: C
Explanation: Form cutter matches gear tooth profile.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

123. Milling is best suited for producing:
A) Cylindrical only
B) Flat & contoured surfaces
C) Threads only
D) Holes only
Answer: B
Explanation: Milling versatile for flat and complex profiles.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

124. Shaper stroke length is controlled by:
A) Feed
B) Crank radius
C) Tool height
D) Motor
Answer: B
Explanation: Stroke length depends on crank setting.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

125. In Whitworth mechanism, the driving element is:
A) Gear
B) Slotted link

C) Crank
D) Cam
Answer: C
Explanation: Crank rotation produces reciprocation.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

126. Quick return ratio equals:
A) Cutting time/Return time
B) Return time/Cutting time
C) Feed/Speed
D) Stroke/Feed
Answer: A
Explanation: Quick return ratio >1.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

127. Slotter mainly cuts:
A) External surfaces
B) Internal keyways
C) Cylinders
D) Threads
Answer: B
Explanation: Slotter suitable for internal slots.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

128. Planner differs from shaper in:
A) Tool type
B) Work size capacity
C) Cutting speed
D) Feed
Answer: B
Explanation: Planner handles very large workpieces.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

129. Milling cutter material commonly used:
A) Cast iron
B) HSS
C) Copper
D) Aluminum

Answer: B
Explanation: High Speed Steel widely used.
Ref: Manufacturing Technology Vol II, P.N. Rao

130. In lathe, feed is expressed in:
A) mm/min
B) mm/rev
C) m/s
D) rpm
Answer: B
Explanation: Feed in lathe is per revolution.
Ref: Manufacturing Technology Vol II, P.N. Rao

◆ ULTRASONIC MACHINING (USM)

131. Ultrasonic Machining removes material by:
A) Melting
B) Chemical reaction
C) Brittle fracture
D) Plastic deformation
Answer: C
Explanation: Abrasive particles cause brittle fracture due to high-frequency vibration.
Ref: Non-Conventional Machining, P.K. Mishra

132. Frequency used in USM is approximately:
A) 50 Hz
B) 500 Hz
C) 20 kHz
D) 2 MHz
Answer: C
Explanation: Ultrasonic frequency is around 20–40 kHz.
Ref: Non-Conventional Machining, P.K. Mishra

133. The transducer in USM converts:
A) Mechanical to electrical energy
B) Electrical to mechanical vibrations
C) Heat to vibration
D) Sound to electricity

Answer: B
Explanation: Piezoelectric or magneto strictive transducers convert electrical energy to vibration.
Ref: Non-Conventional Machining, P.K. Mishra

---

134. USM is best suited for machining:
A) Soft metals
B) Hard brittle materials
C) Rubber
D) Plastic
Answer: B
Explanation: Ideal for glass, ceramics, carbides.
Ref: Non-Conventional Machining, P.K. Mishra

---

135. Abrasives used in USM are:
A) Silicon carbide
B) Copper
C) Aluminum
D) Steel
Answer: A
Explanation: SiC or boron carbide abrasives are commonly used.
Ref: Non-Conventional Machining, P.K. Mishra

---

136. Tool material in USM is generally:
A) Soft steel
B) Copper
C) Aluminum
D) Both A & B
Answer: D
Explanation: Tool must be tough and ductile.
Ref: Non-Conventional Machining, P.K. Mishra

---

137. USM does not produce:
A) Heat affected zone
B) Good surface finish
C) Accurate holes
D) Fine features
Answer: A
Explanation: USM is a cold process.
Ref: Non-Conventional Machining, P.K. Mishra

---

138. Material removal rate in USM depends on:
A) Amplitude
B) Abrasive size
C) Hardness
D) All of the above
Answer: D
Explanation: MRR depends on vibration amplitude, abrasive, hardness.
Ref: Non-Conventional Machining, P.K. Mishra

---

139. Slurry in USM contains:
A) Gas
B) Abrasive + water
C) Acid
D) Oil
Answer: B
Explanation: Slurry is abrasive mixed with water.
Ref: Non-Conventional Machining, P.K. Mishra

---

140. USM is used in:
A) Gear cutting
B) Drilling glass
C) Turning steel
D) Forging
Answer: B
Explanation: Ideal for brittle materials like glass.
Ref: Non-Conventional Machining, P.K. Mishra

---

141. Magneto strictive transducer works on:
A) Piezoelectric effect
B) Magnetic field change
C) Chemical reaction
D) Heating
Answer: B
Explanation: Magnetic field causes dimensional change in ferromagnetic material.
Ref: Non-Conventional Machining, P.K. Mishra

---

142. Piezoelectric transducer uses:
A) Quartz crystal
B) Copper rod

C) Steel plate
D) Slag
Answer: A
Explanation: Quartz crystal deforms under electric field.
Ref: Non-Conventional Machining, P.K. Mishra

---

143. Tool wear in USM is:
A) Very high
B) Moderate
C) Very low
D) Zero
Answer: B
Explanation: Tool wear exists but less than abrasive wear.
Ref: Non-Conventional Machining, P.K. Mishra

---

144. USM can machine:
A) Only conductive materials
B) Only metals
C) Both conductive & non-conductive
D) Only brittle
Answer: C
Explanation: Electrical conductivity not required.
Ref: Non-Conventional Machining, P.K. Mishra

---

145. MRR in USM increases with:
A) Lower amplitude
B) Larger abrasive size
C) Lower frequency
D) Soft tool
Answer: B
Explanation: Larger abrasives increase impact force.
Ref: Non-Conventional Machining, P.K. Mishra

◆ ELECTRICAL DISCHARGE MACHINING (EDM)

---

146. EDM removes material by:
A) Abrasion
B) Melting & vaporization
C) Plastic deformation
D) Cutting

Answer: B
Explanation: Spark erosion melts and vaporizes material.
Ref: Non-Conventional Machining, P.K. Mishra

---

147. EDM works only for:
A) Non-conductors
B) Conductors
C) Brittle
D) Plastics
Answer: B
Explanation: Workpiece must be electrically conductive.
Ref: Non-Conventional Machining, P.K. Mishra

---

148. Dielectric fluid in EDM is used for:
A) Cooling & flushing debris
B) Heating
C) Lubrication only
D) Shielding
Answer: A
Explanation: Dielectric cools and removes eroded particles.
Ref: Non-Conventional Machining, P.K. Mishra

---

149. Common dielectric used in EDM:
A) Water
B) Kerosene
C) Air
D) Oxygen
Answer: B
Explanation: Kerosene-based oils widely used.
Ref: Non-Conventional Machining, P.K. Mishra

---

150. Tool in EDM is called:
A) Cutter
B) Electrode
C) Abrasive
D) Punch
Answer: B
Explanation: Electrode shapes cavity.
Ref: Non-Conventional Machining, P.K. Mishra

---

151. Spark gap in EDM is maintained by:
A) Manual control
B) Servo mechanism
C) Tailstock
D) Feed rod
Answer: B
Explanation: Servo maintains constant spark gap.
Ref: Non-Conventional Machining, P.K. Mishra

---

152. Wire EDM uses:
A) Fixed electrode
B) Rotating tool
C) Continuous wire
D) Abrasive slurry
Answer: C
Explanation: Thin wire acts as electrode.
Ref: Non-Conventional Machining, P.K. Mishra

---

153. EDM produces:
A) No heat
B) Heat affected zone
C) Plastic deformation
D) Cold weld
Answer: B
Explanation: High temperature creates recast layer.
Ref: Non-Conventional Machining, P.K. Mishra

---

154. MRR in EDM increases with:
A) Low current
B) High current
C) Low voltage
D) Low frequency
Answer: B
Explanation: Higher discharge energy increases MRR.
Ref: Non-Conventional Machining, P.K. Mishra

---

155. Tool wear in EDM is:
A) Zero
B) Significant

C) Negative
D) Impossible
Answer: B
Explanation: Electrode wear is major limitation.
Ref: Non-Conventional Machining, P.K. Mishra

---

156. EDM is widely used for:
A) Glass cutting
B) Die making
C) Turning
D) Forging
Answer: B
Explanation: Used for complex die cavities.
Ref: Non-Conventional Machining, P.K. Mishra

---

157. Spark frequency in EDM is controlled by:
A) Pulse generator
B) Tailstock
C) Abrasive
D) Tool material
Answer: A
Explanation: Pulse generator controls spark energy.
Ref: Non-Conventional Machining, P.K. Mishra

---

158. EDM cannot machine:
A) Steel
B) Copper
C) Aluminum
D) Rubber
Answer: D
Explanation: Non-conductors cannot be machined.
Ref: Non-Conventional Machining, P.K. Mishra

---

159. Surface finish in EDM improves with:
A) High energy
B) Low energy pulses
C) High gap
D) Large electrode

Answer: B
Explanation: Low energy sparks produce fine finish.
Ref: Non-Conventional Machining, P.K. Mishra

---

160. EDM tool material commonly used:
A) Copper
B) Graphite
C) Brass
D) All of the above
Answer: D
Explanation: Copper, graphite, brass electrodes used.
Ref: Non-Conventional Machining, P.K. Mishra

◆ AJM, LBM, CHM

---

161. AJM removes material by:
A) Spark erosion
B) Abrasive impact
C) Melting
D) Chemical reaction
Answer: B
Explanation: High velocity abrasive jet erodes material.
Ref: Non-Conventional Machining, P.K. Mishra

---

162. Carrier gas in AJM is usually:
A) Oxygen
B) Air
C) CO_2
D) Hydrogen
Answer: B
Explanation: Compressed air or nitrogen used.
Ref: Non-Conventional Machining, P.K. Mishra

---

163. LBM stands for:
A) Laser Beam Machining
B) Linear Beam Machining
C) Low Beam Machining
D) Light Based Machining

Answer: A
Explanation: Uses focused laser beam.
Ref: Non-Conventional Machining, P.K. Mishra

---

164. LBM removes material by:
A) Abrasion
B) Plastic deformation
C) Melting & vaporization
D) Brittle fracture
Answer: C
Explanation: Laser energy melts and vaporizes material.
Ref: Non-Conventional Machining, P.K. Mishra

---

165. CHM removes material by:
A) Spark
B) Abrasion
C) Chemical etching
D) Heat
Answer: C
Explanation: Chemical machining uses controlled etching.
Ref: Non-Conventional Machining, P.K. Mishra

---

166. Masking in CHM prevents:
A) Overheating
B) Unwanted etching
C) Porosity
D) Cooling
Answer: B
Explanation: Mask protects selected areas.
Ref: Non-Conventional Machining, P.K. Mishra

---

167. AJM is suitable for:
A) Thick steel
B) Hard brittle materials
C) Plastic molding
D) Forging
Answer: B
Explanation: Effective for glass and ceramics.
Ref: Non-Conventional Machining, P.K. Mishra

---

168. Laser used in LBM is commonly:
A) CO_2 laser
B) Argon laser
C) Hydrogen
D) Nitrogen
Answer: A
Explanation: CO_2 lasers commonly used.
Ref: Non-Conventional Machining, P.K. Mishra

---

169. CHM cannot machine:
A) Aluminum
B) Steel
C) Plastics
D) Metals resistant to etchant
Answer: D
Explanation: Requires material reactive to chemical etchant.
Ref: Non-Conventional Machining, P.K. Mishra

---

170. MRR in AJM depends on:
A) Abrasive flow rate
B) Gas pressure
C) Particle size
D) All of the above
Answer: D
Explanation: All parameters affect erosion rate.
Ref: Non-Conventional Machining, P.K. Mishra

◆ HONING, LAPPING & ELECTROPLATING

---

176. Honing is mainly used for:
A) Rough machining
B) Finishing cylindrical holes
C) Cutting threads
D) Milling
Answer: B
Explanation: Honing improves accuracy and finish of holes.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

177. Honing uses:
A) Single point tool

B) Abrasive sticks
C) Spark
D) Chemical
Answer: B
Explanation: Abrasive stones expand radially.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

178. Lapping produces:
A) Rough surface
B) Ultra fine finish
C) Threads
D) Holes
Answer: B
Explanation: Lapping gives very fine surface finish.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

179. Lapping compound contains:
A) Acid
B) Abrasive + oil
C) Slag
D) Gas
Answer: B
Explanation: Fine abrasive mixed with oil or grease.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

180. Electroplating deposits metal by:
A) Chemical reaction
B) Electric current
C) Heat
D) Pressure
Answer: B
Explanation: Electric current causes metal deposition.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

181. The workpiece in electroplating is connected to:
A) Anode
B) Cathode
C) Neutral
D) Ground

Answer: B
Explanation: Workpiece acts as cathode.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

182. Plating thickness depends on:
A) Voltage
B) Current & time
C) Colour
D) Gas
Answer: B
Explanation: Thickness proportional to current and duration.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

183. Honing corrects:
A) Taper
B) Out-of-roundness
C) Straightness
D) All of the above
Answer: D
Explanation: Honing improves geometry and finish.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

184. Lapping removes material by:
A) Cutting
B) Rolling abrasive action
C) Melting
D) Etching
Answer: B
Explanation: Abrasive rolling between lap and work.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

185. Honing stones are made of:
A) Copper
B) Abrasive bonded material
C) Steel
D) Plastic
Answer: B
Explanation: Honing stones use bonded abrasives.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

186. Lapping is slower but gives:
A) High MRR
B) High accuracy
C) High heat
D) Distortion
Answer: B
Explanation: Lapping achieves micro-level accuracy.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

187. Electroplating improves:
A) Appearance
B) Corrosion resistance
C) Wear resistance
D) All of the above
Answer: D
Explanation: Plating improves surface properties.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

188. Honing is usually done after:
A) Grinding
B) Drilling
C) Turning
D) Casting
Answer: B
Explanation: Honing refines drilled or bored holes.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

189. Lapping is used in:
A) Bearing surfaces
B) Shafts
C) Rough casting
D) Forging
Answer: A
Explanation: Used in precision bearing surfaces.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

190. Surface finish produced by lapping is approximately:
A) 12.5 µm
B) 6.3 µm

C) 0.1–0.4 μm
D) 25 μm
Answer: C
Explanation: Lapping gives extremely fine finish.
Ref: Workshop Technology Vol II, Hazra Choudhury

◆ BASICS OF JIGS & FIXTURES

---

191. The primary purpose of a jig is to:
A) Hold workpiece only
B) Guide the cutting tool
C) Increase speed
D) Reduce cost
Answer: B
Explanation: A jig holds and locates the work and guides the tool.
Ref: Production Technology, R.K. Jain

---

192. A fixture differs from a jig because it:
A) Guides tool
B) Holds and locates work only
C) Rotates tool
D) Cuts metal
Answer: B
Explanation: Fixture holds and locates work but does not guide tool.
Ref: Production Technology, R.K. Jain

---

193. Jigs are mainly used on:
A) Lathe
B) Drilling machine
C) Milling machine
D) Shaper
Answer: B
Explanation: Drill jigs guide drill bits for accurate holes.
Ref: Production Technology, R.K. Jain

---

194. Fixtures are commonly used in:
A) Drilling
B) Milling and shaping
C) Welding
D) Casting

Answer: B
Explanation: Fixtures hold work in milling and shaping operations.
Ref: Production Technology, R.K. Jain

---

195. The 3-2-1 principle is used for:
A) Clamping
B) Location
C) Finishing
D) Welding
Answer: B
Explanation: It ensures proper location by restricting 6 degrees of freedom.
Ref: Production Technology, R.K. Jain

---

196. Total degrees of freedom of a free body in space are:
A) 3
B) 4
C) 6
D) 9
Answer: C
Explanation: 3 translational + 3 rotational freedoms.
Ref: Production Technology, R.K. Jain

---

197. In 3-2-1 principle, 3 locators restrict:
A) 1 DOF
B) 2 DOF
C) 3 DOF
D) 6 DOF
Answer: C
Explanation: Three locators restrict movement in one plane.
Ref: Production Technology, R.K. Jain

---

198. The 2 locators in 3-2-1 principle restrict:
A) 1 DOF
B) 2 DOF
C) 3 DOF
D) 4 DOF
Answer: B
Explanation: Two locators restrict motion along second plane.
Ref: Production Technology, R.K. Jain

---

199. The single locator restricts:
A) 1 DOF
B) 2 DOF
C) 3 DOF
D) 4 DOF
Answer: A
Explanation: Final locator restricts remaining degree of freedom.
Ref: Production Technology, R.K. Jain

---

200. Clamping force should be applied:
A) Near locators
B) Far from locators
C) Random
D) At center only
Answer: A
Explanation: To prevent distortion, clamp near supports.
Ref: Production Technology, R.K. Jain

---

201. A template jig is used for:
A) Milling
B) Drilling simple holes
C) Welding
D) Casting
Answer: B
Explanation: Template jig guides drill directly.
Ref: Production Technology, R.K. Jain

---

202. Leaf jig is suitable for:
A) Large work
B) Heavy machining
C) Repetitive drilling
D) Turning
Answer: C
Explanation: Leaf jig has hinged plate for tool guidance.
Ref: Production Technology, R.K. Jain

---

203. Box jig is used when:
A) Only one surface drilled
B) Multiple surfaces drilled

C) No guide needed
D) Large plate
Answer: B
Explanation: Box jig allows drilling on multiple faces.
Ref: Production Technology, R.K. Jain

---

204. Drill bush is used in jig to:
A) Hold work
B) Guide drill
C) Support fixture
D) Clamp
Answer: B
Explanation: Hardened bush guides drill accurately.
Ref: Production Technology, R.K. Jain

---

205. Renewable bushes are used when:
A) Drill size constant
B) Drill size changes frequently
C) No drilling
D) Milling
Answer: B
Explanation: Interchangeable bushes for different drill sizes.
Ref: Production Technology, R.K. Jain

◆ DESIGN & APPLICATION

---

206. A fixture must be rigid to:
A) Reduce weight
B) Avoid vibration
C) Reduce cost
D) Increase speed
Answer: B
Explanation: Rigidity ensures dimensional accuracy.
Ref: Production Technology, R.K. Jain

---

207. The base of fixture is generally made of:
A) Plastic
B) Cast iron
C) Copper
D) Aluminum

Answer: B
Explanation: Cast iron provides rigidity and damping.
Ref: Production Technology, R.K. Jain

---

208. Quick acting clamps are used to:
A) Reduce cycle time
B) Increase heat
C) Increase weight
D) Reduce accuracy
Answer: A
Explanation: They reduce loading/unloading time.
Ref: Production Technology, R.K. Jain

---

209. Rest pads are used for:
A) Decoration
B) Supporting work
C) Clamping
D) Cutting
Answer: B
Explanation: Rest pads support workpiece properly.
Ref: Production Technology, R.K. Jain

---

210. Fool proofing in jigs means:
A) Decoration
B) Prevent wrong loading
C) Increase speed
D) Reduce cost
Answer: B
Explanation: Foolproof design avoids incorrect placement.
Ref: Production Technology, R.K. Jain

---

211. Toggle clamp works on principle of:
A) Hydraulic force
B) Over-center mechanism
C) Magnetic field
D) Friction
Answer: B
Explanation: Over-center locking provides firm clamping.
Ref: Production Technology, R.K. Jain

---

212. In milling fixture, work is located by:
A) Drill bush
B) Locating pins
C) Tailstock
D) Lead screw
Answer: B
Explanation: Locating pins position workpiece accurately.
Ref: Production Technology, R.K. Jain

---

213. A nest locator is used for:
A) Cylindrical part
B) Irregular casting
C) Flat plate
D) Drill
Answer: B
Explanation: Nest locator supports irregular shapes.
Ref: Production Technology, R.K. Jain

---

214. Hydraulic clamping is preferred for:
A) Small jobs
B) Mass production
C) Manual work
D) Drilling only
Answer: B
Explanation: Hydraulic clamping ensures fast and uniform force.
Ref: Production Technology, R.K. Jain

---

215. Jig boring ensures:
A) Rough holes
B) High precision holes
C) Threading
D) Milling
Answer: B
Explanation: Jig boring provides high positional accuracy.
Ref: Production Technology, R.K. Jain

---

216. The main advantage of using jigs and fixtures is:
A) Increase cost
B) Reduce accuracy

C) Interchangeability
D) Increase weight
Answer: C
Explanation: Ensures uniform production and interchangeability.
Ref: Production Technology, R.K. Jain

---

217. Stop pins are used to:
A) Guide tool
B) Limit work movement
C) Clamp
D) Rotate
Answer: B
Explanation: Stop pins prevent excess movement.
Ref: Production Technology, R.K. Jain

---

218. The guiding element in drill jig must be:
A) Soft
B) Hardened steel
C) Aluminum
D) Plastic
Answer: B
Explanation: Drill bushes are hardened for wear resistance.
Ref: Production Technology, R.K. Jain

---

219. Improper clamping may cause:
A) Better finish
B) Work distortion
C) Higher speed
D) Less vibration
Answer: B
Explanation: Uneven clamping distorts workpiece.
Ref: Production Technology, R.K. Jain

---

220. Jigs are generally lighter than fixtures because:
A) They are smaller
B) Used mainly for drilling
C) No heavy cutting forces
D) Decorative

Answer: C
Explanation: Drilling involves less cutting force than milling.
Ref: Production Technology, R.K. Jain

◆ NC & CNC BASICS

---

221. NC stands for:
A) Numerical Control
B) Network Control
C) Numeric Computer
D) Node Control
Answer: A
Explanation: NC machines are controlled using numerical instructions.
Ref: CAD/CAM, P.N. Rao

---

222. CNC differs from NC because it uses:
A) Manual control
B) Computer control
C) Mechanical cam
D) Hydraulic system
Answer: B
Explanation: CNC uses onboard computer for control.
Ref: CAD/CAM, P.N. Rao

---

223. The main components of CNC system are:
A) MCU, Machine tool, Drive system
B) Tailstock
C) Gear box
D) Lead screw
Answer: A
Explanation: Machine Control Unit (MCU) is core controller.
Ref: CAD/CAM, P.N. Rao

---

224. MCU stands for:
A) Machine Control Unit
B) Main Cutting Unit
C) Motor Control Unit
D) Mechanical Control Unit

Answer: A
Explanation: MCU interprets and executes part program.
Ref: CAD/CAM, P.N. Rao

---

225. In open-loop system, feedback is:
A) Present
B) Absent
C) Partial
D) Mechanical
Answer: B
Explanation: No feedback device used.
Ref: CAD/CAM, P.N. Rao

---

226. Closed-loop system uses:
A) Encoder
B) Cam
C) Lever
D) Gear
Answer: A
Explanation: Feedback devices like encoders provide position control.
Ref: CAD/CAM, P.N. Rao

---

227. CNC machines provide better:
A) Manual effort
B) Accuracy
C) Weight
D) Noise
Answer: B
Explanation: CNC ensures high precision and repeatability.
Ref: CAD/CAM, P.N. Rao

---

228. The input device in CNC is generally:
A) Tailstock
B) Keyboard
C) Chuck
D) Arbor
Answer: B
Explanation: Programs entered via keyboard or USB.
Ref: CAD/CAM, P.N. Rao

---

229. Interpolation in CNC means:
A) Cutting
B) Tool change
C) Calculating intermediate positions
D) Drilling
Answer: C
Explanation: Interpolation generates intermediate tool path points.
Ref: CAD/CAM, P.N. Rao

---

230. Linear interpolation is represented by:
A) G00
B) G01
C) G02
D) G03
Answer: B
Explanation: G01 performs linear cutting motion.
Ref: CAD/CAM, P.N. Rao

---

231. Rapid positioning is done by:
A) G00
B) G01
C) G02
D) G03
Answer: A
Explanation: G00 is rapid traverse (non-cutting).
Ref: CAD/CAM, P.N. Rao

---

232. Circular interpolation clockwise is:
A) G01
B) G02
C) G03
D) G04
Answer: B
Explanation: G02 produces clockwise circular motion.
Ref: CAD/CAM, P.N. Rao

---

233. Circular interpolation counterclockwise is:
A) G02
B) G03

C) G00
D) G90
Answer: B
Explanation: G03 gives CCW circular motion.
Ref: CAD/CAM, P.N. Rao

---

234. Absolute programming mode is:
A) G90
B) G91
C) G00
D) G04
Answer: A
Explanation: G90 uses reference from origin.
Ref: CAD/CAM, P.N. Rao

---

235. Incremental programming mode is:
A) G90
B) G91
C) G02
D) G03
Answer: B
Explanation: G91 uses incremental distances.
Ref: CAD/CAM, P.N. Rao

◆ G-CODES & M-CODES

---

236. Spindle ON (clockwise) is:
A) M02
B) M03
C) M04
D) M05
Answer: B
Explanation: M03 starts spindle clockwise.
Ref: CAD/CAM, P.N. Rao

---

237. Spindle ON (counterclockwise) is:
A) M03
B) M04
C) M05
D) M06

Answer: B
Explanation: M04 rotates spindle CCW.
Ref: CAD/CAM, P.N. Rao

---

238. Spindle stop is:
A) M03
B) M04
C) M05
D) M08
Answer: C
Explanation: M05 stops spindle rotation.
Ref: CAD/CAM, P.N. Rao

---

239. Coolant ON is:
A) M07/M08
B) M05
C) M03
D) M09
Answer: A
Explanation: M08 (flood coolant) ON.
Ref: CAD/CAM, P.N. Rao

---

240. Coolant OFF is:
A) M08
B) M09
C) M03
D) M04
Answer: B
Explanation: M09 switches coolant OFF.
Ref: CAD/CAM, P.N. Rao

---

241. Program end is:
A) M00
B) M02
C) M03
D) M05
Answer: B
Explanation: M02 ends program.
Ref: CAD/CAM, P.N. Rao

---

242. Tool change command is:
A) M03
B) M04
C) M06
D) M08
Answer: C
Explanation: M06 performs tool change.
Ref: CAD/CAM, P.N. Rao

---

243. Dwell command is:
A) G01
B) G04
C) G02
D) G90
Answer: B
Explanation: G04 pauses for specified time.
Ref: CAD/CAM, P.N. Rao

---

244. Feed rate in CNC is specified by:
A) S
B) F
C) T
D) N
Answer: B
Explanation: F defines feed rate.
Ref: CAD/CAM, P.N. Rao

---

245. Spindle speed is given by:
A) S
B) F
C) T
D) G
Answer: A
Explanation: S indicates spindle speed.
Ref: CAD/CAM, P.N. Rao

---

246. Tool number is specified by:
A) T
B) S

C) F
D) M
Answer: A
Explanation: T indicates tool selection.
Ref: CAD/CAM, P.N. Rao

---

247. N number in program indicates:
A) Tool
B) Speed
C) Sequence number
D) Feed
Answer: C
Explanation: N defines block number.
Ref: CAD/CAM, P.N. Rao

---

248. CNC lathe uses axes:
A) X & Y
B) X & Z
C) Y & Z
D) XYZ
Answer: B
Explanation: CNC lathe generally uses X and Z axes.
Ref: CAD/CAM, P.N. Rao

---

249. CNC milling machine uses axes:
A) XZ
B) XY
C) XYZ
D) Only Z
Answer: C
Explanation: Milling uses three-axis movement.
Ref: CAD/CAM, P.N. Rao

---

250. Tool path is generated by:
A) Operator
B) Interpolator
C) Chuck
D) Tailstock

Answer: B
Explanation: Interpolator calculates movement between points.
Ref: CAD/CAM, P.N. Rao

---

251. Part program consists of:
A) Blocks
B) Paragraphs
C) Tables
D) Charts
Answer: A
Explanation: Program is written in block format.
Ref: CAD/CAM, P.N. Rao

---

252. Each block ends with:
A) Semicolon
B) EOB (End of block)
C) Full stop
D) Comma
Answer: B
Explanation: EOB marks end of each block.
Ref: CAD/CAM, P.N. Rao

---

253. CNC reduces:
A) Flexibility
B) Production rate
C) Setup time
D) Accuracy
Answer: C
Explanation: CNC reduces setup time significantly.
Ref: CAD/CAM, P.N. Rao

---

254. Direct Numerical Control (DNC) connects:
A) One machine
B) Multiple CNC machines
C) Tailstock
D) Lathe only
Answer: B
Explanation: DNC controls multiple machines centrally.
Ref: CAD/CAM, P.N. Rao

---

255. CNC programming can be:
A) Manual
B) Computer assisted
C) Both
D) None
Answer: C
Explanation: Programs can be written manually or via CAM software.
Ref: CAD/CAM, P.N. Rao

◆ ADVANCED CNC CONCEPTS

---

256. CNC ensures repeatability because of:
A) Human skill
B) Computer control
C) Manual setting
D) Tailstock
Answer: B
Explanation: Digital control ensures consistent output.
Ref: CAD/CAM, P.N. Rao

---

257. Servo motors are used in:
A) Open loop
B) Closed loop
C) Manual lathe
D) Drill
Answer: B
Explanation: Closed loop systems use servo motors.
Ref: CAD/CAM, P.N. Rao

---

258. Stepper motors are commonly used in:
A) Closed loop
B) Open loop
C) Manual control
D) Welding
Answer: B
Explanation: Stepper motors operate without feedback.
Ref: CAD/CAM, P.N. Rao

---

259. CAD stands for:
A) Computer Aided Design

B) Computer Assisted Draft
C) Central Automated Device
D) Control Aided Design
Answer: A
Explanation: CAD refers to computer-based design system.
Ref: CAD/CAM, P.N. Rao

---

260. CAM stands for:
A) Computer Aided Manufacturing
B) Control Aided Machine
C) Computer Automated Milling
D) Central Aided Manufacturing
Answer: A
Explanation: CAM controls manufacturing processes.
Ref: CAD/CAM, P.N. Rao

---

261. Post processor converts:
A) CAD file to drawing
B) CAM output to CNC code
C) CNC code to CAD
D) Program to manual
Answer: B
Explanation: Post processor converts tool path into machine-specific code.
Ref: CAD/CAM, P.N. Rao

---

262. CNC programs are written in:
A) Binary
B) G & M codes
C) Assembly
D) Python
Answer: B
Explanation: CNC programming uses G & M codes.
Ref: CAD/CAM, P.N. Rao

---

263. Tool offset compensates for:
A) Tool wear
B) Speed
C) Voltage
D) Current

Answer: A
Explanation: Offset corrects dimensional variation due to tool wear.
Ref: CAD/CAM, P.N. Rao

---

264. Work coordinate system defines:
A) Machine origin
B) Tool position
C) Part zero location
D) Speed
Answer: C
Explanation: Work zero is reference for programming.
Ref: CAD/CAM, P.N. Rao

---

265. CNC memory stores:
A) Mechanical parts
B) Part program
C) Tool
D) Coolant
Answer: B
Explanation: CNC memory stores program instructions.
Ref: CAD/CAM, P.N. Rao

---

266. CNC improves productivity by:
A) Increasing scrap
B) Reducing accuracy
C) Automation
D) Manual work
Answer: C
Explanation: Automation increases output and precision.
Ref: CAD/CAM, P.N. Rao

---

267. G-code is also called:
A) Miscellaneous function
B) Preparatory function
C) Tool function
D) Speed function
Answer: B
Explanation: G-codes are preparatory commands.
Ref: CAD/CAM, P.N. Rao

---

268. M-code is also called:
A) Preparatory function
B) Miscellaneous function
C) Motion function
D) Machine speed
Answer: B
Explanation: M-codes control machine auxiliary functions.
Ref: CAD/CAM, P.N. Rao

---

269. CNC eliminates:
A) Human error largely
B) Cutting
C) Tool wear
D) Cost completely
Answer: A
Explanation: Automation reduces manual errors.
Ref: CAD/CAM, P.N. Rao

---

270. The greatest advantage of CNC over conventional machine is:
A) Low cost
B) High flexibility
C) Low maintenance
D) Large size
Answer: B
Explanation: CNC allows easy program change and flexibility.
Ref: CAD/CAM, P.N. Rao

◆ AUTOMATION BASICS

---

271. Automation means:
A) Manual operation
B) Mechanization only
C) Use of control systems to operate processes
D) High speed only
Answer: C
Explanation: Automation involves automatic control using electronics/computers.
Ref: CAD/CAM, P.N. Rao

---

272. Fixed automation is suitable for:
A) Low volume production
B) High volume production
C) Prototype
D) Job shop
Answer: B
Explanation: Fixed automation is economical for mass production.
Ref: CAD/CAM, P.N. Rao

---

273. Flexible automation is characterized by:
A) Low flexibility
B) High product variety
C) Only one product
D) Manual control
Answer: B
Explanation: Flexible systems handle product variations easily.
Ref: CAD/CAM, P.N. Rao

---

274. Flexible Manufacturing System (FMS) consists of:
A) CNC machines + material handling
B) Only robots
C) Only AGVs
D) Manual machines
Answer: A
Explanation: FMS integrates CNC machines with automated handling.
Ref: CAD/CAM, P.N. Rao

---

275. The main objective of FMS is:
A) Reduce flexibility
B) Increase manual work
C) Combine flexibility with productivity
D) Increase scrap
Answer: C
Explanation: FMS provides mass production with flexibility.
Ref: CAD/CAM, P.N. Rao

---

276. Material handling in FMS is often done by:
A) Manual workers
B) AGVs

C) Tailstock
D) Feed rod
Answer: B
Explanation: Automated Guided Vehicles transport materials.
Ref: CAD/CAM, P.N. Rao

---

277. AGV stands for:
A) Automated Gear Vehicle
B) Automatic Guided Vehicle
C) Automated Guided Vehicle
D) Advanced Guided Vehicle
Answer: C
Explanation: AGV transports materials automatically.
Ref: CAD/CAM, P.N. Rao

---

278. AGVs are guided by:
A) Manual steering
B) Magnetic strips / sensors
C) Coolant
D) G-codes
Answer: B
Explanation: AGVs follow embedded magnetic strips or sensors.
Ref: CAD/CAM, P.N. Rao

---

279. Group Technology (GT) helps in:
A) Random production
B) Batch grouping of similar parts
C) Increasing scrap
D) Manual machining
Answer: B
Explanation: GT groups similar components for efficiency.
Ref: CAD/CAM, P.N. Rao

---

280. Computer Integrated Manufacturing (CIM) integrates:
A) Only design
B) Only manufacturing
C) CAD + CAM + Business functions
D) Only robotics

Answer: C
Explanation: CIM integrates entire production cycle.
Ref: CAD/CAM, P.N. Rao

◆ ROBOTICS

---

281. A robot is defined as:
A) Fixed machine
B) Reprogrammable multifunctional manipulator
C) Manual tool
D) Drill
Answer: B
Explanation: Industrial robot is programmable and multifunctional.
Ref: CAD/CAM, P.N. Rao

---

282. Cartesian robot has configuration:
A) R-R-R
B) P-P-P
C) R-P-R
D) P-R-R
Answer: B
Explanation: Cartesian robot uses three prismatic joints (XYZ).
Ref: CAD/CAM, P.N. Rao

---

283. Cylindrical robot configuration is:
A) R-R-R
B) P-R-P
C) P-P-P
D) R-P-R
Answer: B
Explanation: Cylindrical robot uses rotary + linear joints.
Ref: CAD/CAM, P.N. Rao

---

284. Polar robot configuration is:
A) R-R-P
B) P-P-P
C) R-P-P
D) P-R-R

Answer: A
Explanation: Polar robot has two rotary and one linear joint.
Ref: CAD/CAM, P.N. Rao

---

285. SCARA robot is mainly used for:
A) Heavy forging
B) Pick and place
C) Casting
D) Drilling
Answer: B
Explanation: SCARA robots are ideal for assembly operations.
Ref: CAD/CAM, P.N. Rao

---

286. SCARA stands for:
A) Selective Compliance Assembly Robot Arm
B) Single Control Arm Robot
C) Servo Controlled Assembly Robot Arm
D) Special Control Arm
Answer: A
Explanation: SCARA provides selective compliance in assembly.
Ref: CAD/CAM, P.N. Rao

---

287. End effector of robot is:
A) Base
B) Joint
C) Gripper/tool attached at wrist
D) Arm
Answer: C
Explanation: End effector performs task (gripper, welding torch).
Ref: CAD/CAM, P.N. Rao

---

288. Degrees of freedom of robot determine:
A) Speed
B) Work envelope
C) Colour
D) Weight
Answer: B
Explanation: More DOF increases flexibility and workspace.
Ref: CAD/CAM, P.N. Rao

---

289. Work envelope is:
A) Robot weight
B) Space robot can reach
C) Speed range
D) Voltage
Answer: B
Explanation: Work envelope defines robot operational area.
Ref: CAD/CAM, P.N. Rao

---

290. Robot drive systems can be:
A) Hydraulic
B) Electric
C) Pneumatic
D) All of the above
Answer: D
Explanation: Robots use various actuation systems.
Ref: CAD/CAM, P.N. Rao

◆ RAPID PROTOTYPING / 3D PRINTING

---

291. Rapid Prototyping is also called:
A) Subtractive manufacturing
B) Additive manufacturing
C) Forging
D) Casting
Answer: B
Explanation: RP builds parts layer by layer.
Ref: Rapid Prototyping, Rafiq Noorani

---

292. The first step in RP process is:
A) Printing
B) CAD model creation
C) Machining
D) Assembly
Answer: B
Explanation: CAD model is essential for RP.
Ref: Rapid Prototyping, Rafiq Noorani

---

293. STL file format represents:
A) Solid model triangles

B) Tool list
C) Speed table
D) Voltage
Answer: A
Explanation: STL approximates surface using triangular facets.
Ref: Rapid Prototyping, Rafiq Noorani

---

294. Slicing in RP means:
A) Cutting metal
B) Dividing model into layers
C) Grinding
D) Welding
Answer: B
Explanation: Model is sliced into thin cross-sections.
Ref: Rapid Prototyping, Rafiq Noorani

---

295. FDM stands for:
A) Fused Deposition Modeling
B) Formed Design Machine
C) Fast Drill Method
D) Flexible Design Model
Answer: A
Explanation: FDM extrudes molten thermoplastic layer by layer.
Ref: Rapid Prototyping, Rafiq Noorani

---

296. SLA stands for:
A) Selective Laser Assembly
B) Stereolithography Apparatus
C) Solid Layer Application
D) Structural Laser Assembly
Answer: B
Explanation: SLA uses UV laser to cure photopolymer.
Ref: Rapid Prototyping, Rafiq Noorani

---

297. SLS stands for:
A) Selective Laser Sintering
B) Solid Layer System
C) Surface Laser System
D) Speed Laser System

Answer: A
Explanation: SLS sinters powdered material using laser.
Ref: Rapid Prototyping, Rafiq Noorani

---

298. Main advantage of 3D printing is:
A) High volume production
B) Tool-less manufacturing
C) Slow design
D) Heavy cutting
Answer: B
Explanation: No special tooling required.
Ref: Rapid Prototyping, Rafiq Noorani

---

299. Rapid prototyping reduces:
A) Product development time
B) Accuracy
C) Flexibility
D) Automation
Answer: A
Explanation: Faster prototype development.
Ref: Rapid Prototyping, Rafiq Noorani

---

300. 3D printing builds components by:
A) Removing material
B) Forging
C) Layer-by-layer addition
D) Rolling
Answer: C
Explanation: Additive process deposits material layer by layer.
Ref: Rapid Prototyping, Rafiq Noorani

UNIT III: Engineering Materials & Solid Mechanics

◆ IRON–CARBON DIAGRAM

---

1. The eutectoid reaction in Iron–Carbon diagram occurs at:
A) 0.8% C and 727°C
B) 4.3% C and 1147°C
C) 0.16% C and 1493°C
D) 2.14% C and 1147°C
Answer: A
Metallurgical Note:
Eutectoid reaction: Austenite → Ferrite + Cementite at **0.8% Carbon and 727°C**. This forms **Pearlite**. This is the most frequently asked temperature in ECET.
Ref: O.P. Khanna

---

2. The eutectic reaction occurs at:
A) 0.8% C
B) 2.14% C
C) 4.3% C
D) 6.67% C
Answer: C
Metallurgical Note:
Eutectic reaction at **4.3% Carbon and 1147°C**: Liquid → Austenite + Cementite (Ledeburite).
Ref: O.P. Khanna

---

3. Cementite contains carbon percentage of:
A) 0.8%
B) 2.14%
C) 4.3%
D) 6.67%
Answer: D
Metallurgical Note:
Cementite (Fe_3C) contains **6.67% Carbon**. It is very hard and brittle.
Ref: O.P. Khanna

---

4. Maximum solubility of carbon in ferrite at 727°C is:
A) 0.025%
B) 0.8%
C) 2.14%
D) 4.3%

Answer: A
Metallurgical Note:
Ferrite dissolves maximum **0.025% Carbon at 727°C**. Very low solubility.
Ref: O.P. Khanna

---

5. Maximum solubility of carbon in austenite is:
A) 0.8%
B) 2.14%
C) 4.3%
D) 6.67%
Answer: B
Metallurgical Note:
Austenite can dissolve up to **2.14% Carbon at 1147°C**.
Ref: O.P. Khanna

---

6. The peritectic reaction occurs at:
A) 0.16% C, 1493°C
B) 0.8% C, 727°C
C) 4.3% C, 1147°C
D) 6.67% C
Answer: A
Metallurgical Note:
Peritectic reaction: Liquid + δ Ferrite → Austenite at 0.16% C & 1493°C.
Ref: O.P. Khanna

---

7. Pearlite consists of:
A) Ferrite only
B) Cementite only
C) Ferrite + Cementite
D) Austenite
Answer: C
Metallurgical Note:
Pearlite is lamellar mixture of ferrite and cementite.
Ref: O.P. Khanna

---

8. Hypoeutectoid steel contains carbon less than:
A) 0.8%
B) 2.14%
C) 4.3%
D) 6.67%

Answer: A
Metallurgical Note:
Hypoeutectoid steel: C < 0.8%. Contains ferrite + pearlite.
Ref: O.P. Khanna

---

9. Hypereutectoid steel contains carbon between:
A) 0–0.8%
B) 0.8–2.14%
C) 2.14–4.3%
D) 4.3–6.67%
Answer: B
Metallurgical Note:
Hypereutectoid: Cementite + Pearlite structure.
Ref: O.P. Khanna

---

10. Ledeburite is formed during:
A) Eutectoid reaction
B) Eutectic reaction
C) Peritectic reaction
D) Martensitic transformation
Answer: B
Metallurgical Note:
Ledeburite forms at 4.3% C during eutectic reaction.
Ref: O.P. Khanna

◆ HEAT TREATMENT

---

11. Annealing mainly improves:
A) Hardness
B) Ductility
C) Strength
D) Brittleness
Answer: B
Metallurgical Note:
Annealing softens steel and increases ductility by slow cooling.
Ref: O.P. Khanna

---

12. Normalizing differs from annealing because of:
A) Faster cooling in air
B) Water cooling

C) Oil quenching
D) No heating
Answer: A
Metallurgical Note:
Normalizing cools in air → finer grain structure.
Ref: O.P. Khanna

---

13. Hardening is achieved by:
A) Slow cooling
B) Air cooling
C) Rapid quenching
D) Tempering
Answer: C
Metallurgical Note:
Rapid quenching forms martensite.
Ref: O.P. Khanna

---

14. Tempering reduces:
A) Strength
B) Brittleness
C) Ductility
D) Hardness only
Answer: B
Metallurgical Note:
Tempering reduces brittleness of martensite.
Ref: O.P. Khanna

◆ NDT METHODS

---

15. Ultrasonic testing detects:
A) Surface cracks only
B) Internal defects
C) Hardness
D) Impact strength
Answer: B
Metallurgical Note:
Ultrasonic testing detects **internal flaws** using sound waves.
Ref: Callister

---

16. Magnetic particle inspection is suitable for:

A) Non-magnetic materials
B) Surface cracks in ferromagnetic materials
C) Plastics
D) Ceramics
Answer: B
Metallurgical Note:
MPI detects surface/subsurface cracks in ferromagnetic materials.
Ref: Callister

---

17. X-ray testing is mainly used to detect:
A) Surface roughness
B) Internal porosity
C) Hardness
D) Grain size
Answer: B
Metallurgical Note:
Radiography reveals internal defects like porosity.
Ref: Callister

---

18. Charpy test is an example of:
A) NDT
B) Destructive testing
C) Heat treatment
D) Magnetic testing
Answer: B
Metallurgical Note:
Charpy impact test measures impact energy → destructive test.
Ref: O.P. Khanna

◆ MECHANICAL PROPERTIES

---

19. Young's Modulus is ratio of:
A) Stress/Strain
B) Strain/Stress
C) Load/Area
D) Force/Length
Answer: A
20. If a steel rod (E = 200 GPa) is subjected to stress 400 MPa, strain is:
A) 0.002
B) 0.02

C) 0.0002
D) 0.2
Answer: A
Step-by-Step Solution:

$$E = \frac{\sigma}{\epsilon}$$

$$\epsilon = \frac{\sigma}{E} = \frac{400 \times 10^6}{200 \times 10^9} = 0.002$$

Ref: R.S. Khurmi

---

21. Poisson's ratio is:
A) Longitudinal strain / lateral strain
B) Lateral strain / longitudinal strain
C) Stress / strain
D) Load / area
Answer: B

---

22. Typical Poisson's ratio for steel is:
A) 0.1
B) 0.25
C) 0.3
D) 0.5
Answer: C

---

23. Ultimate tensile strength occurs at:
A) Yield point
B) Fracture
C) Maximum load
D) Elastic limit
Answer: C

---

24. Duralumin contains mainly:
A) Copper + Aluminum
B) Zinc + Copper
C) Nickel + Chromium
D) Iron + Carbon
Answer: A
Metallurgical Note:
Duralumin: Al + Cu + Mg + Mn. Used in aircraft structures.
Ref: O.P. Khanna

---

25. Brass is alloy of:
A) Copper + Zinc
B) Copper + Tin
C) Iron + Carbon
D) Aluminum + Copper
Answer: A

---

26. Bronze is alloy of:
A) Copper + Zinc
B) Copper + Tin
C) Aluminum + Zinc
D) Iron + Tin
Answer: B

---

27. Grey cast iron contains graphite in form of:
A) Spheres
B) Flakes
C) Nodules
D) Needles
Answer: B

---

28. Nodular cast iron has:
A) Flake graphite
B) Spheroidal graphite
C) Cementite only
D) Austenite
Answer: B

---

29. Hardenability of steel depends mainly on:
A) Grain size
B) Carbon content
C) Alloying elements
D) Cooling medium
Answer: C

---

30. Martensite structure is:
A) Soft
B) Tough

C) Hard & brittle
D) Ductile
Answer: C

◆ **STRUCTURAL MECHANICS INTRO (Basic Forces)**

---

31. Resultant of two perpendicular forces 3 kN and 4 kN is:
A) 5 kN
B) 7 kN
C) 1 kN
D) 12 kN
Answer: A
Step-by-Step Solution:

$$R = \sqrt{3^2 + 4^2} = 5kN$$

Ref: Ramamrutham

---

32. Mechanical Advantage (MA) is:
A) Load/Effort
B) Effort/Load
C) Distance ratio
D) Efficiency
Answer: A

---

33. Efficiency =
A) MA/VR
B) VR/MA
C) MA × VR
D) MA + VR
Answer: A

---

34. If MA = 4 and VR = 5, efficiency is:
A) 80%
B) 125%
C) 20%
D) 100%
Answer: A
Step-by-Step Solution:

$$\eta = \frac{MA}{VR} = \frac{4}{5} = 0.8 = 80\%$$

---

35. Stress unit is:
A) N
B) N/mm^2
C) mm
D) m
Answer: B

---

36. Shear stress =
A) P/A
B) V/A
C) T/J
D) M/I
Answer: B

---

37. For pure bending, bending stress is given by:
A) $\sigma = M/I$
B) $\sigma = My/I$
C) $\sigma = P/A$
D) $\tau = T/J$
Answer: B

---

38. Relation between load and shear force is:
A) $w = dV/dx$
B) $V = dM/dx$
C) $M = dV/dx$
D) Both A & B
Answer: D

---

39. Shear force at free end of cantilever is:
A) Zero
B) Maximum
C) Minimum
D) Equal to reaction
Answer: A

---

40. Maximum bending moment in cantilever occurs at:
A) Free end
B) Midpoint

C) Fixed end
D) Anywhere
Answer: C

◆ **IRON–CARBON DIAGRAM (Advanced Conceptual + Diagram-Based)**

---

41. At 0.8% Carbon and 727°C, the structure just below the eutectoid temperature is:
A) Austenite
B) Ferrite
C) Pearlite
D) Cementite
Answer: C
Metallurgical Note:
At 727°C, eutectoid transformation occurs: Austenite → Pearlite. Below this temperature, the structure becomes fully pearlite for eutectoid steel.
Ref: A Textbook of Material Science and Metallurgy – O.P. Khanna

---

42. Steel containing 0.4% carbon at room temperature consists of:
A) Pearlite only
B) Ferrite + Pearlite
C) Cementite + Pearlite
D) Austenite
Answer: B
Metallurgical Note:
0.4% C is hypoeutectoid steel (<0.8%). Structure: Proeutectoid Ferrite + Pearlite.
Ref: O.P. Khanna

---

43. At 4.3% Carbon and 1147°C, the phase transformation is:
A) Eutectoid
B) Peritectic
C) Eutectic
D) Martensitic
Answer: C
Metallurgical Note:
Eutectic reaction: Liquid → Austenite + Cementite (Ledeburite).
Ref: O.P. Khanna

---

44. Cementite is chemically represented as:
A) Fe_2C
B) Fe_3C

C) FeC
D) Fe_4C
Answer: B
Metallurgical Note:
Cementite = Fe_3C, containing 6.67% carbon.
Ref: O.P. Khanna

---

45. Delta ferrite exists at temperature above:
A) 727°C
B) 1147°C
C) 1493°C
D) Room temperature
Answer: C
Metallurgical Note:
Delta ferrite exists at high temperatures near melting point (~1539°C).
Ref: O.P. Khanna

◆ **HEAT TREATMENT (Numerical + Conceptual)**

---

46. A steel specimen is heated above upper critical temperature and cooled in still air. The process is:
A) Annealing
B) Hardening
C) Normalizing
D) Tempering
Answer: C
Metallurgical Note:
Normalizing involves air cooling for refined grain structure.
Ref: O.P. Khanna

---

47. Hardening followed by reheating below critical temperature is:
A) Annealing
B) Tempering
C) Normalizing
D) Case hardening
Answer: B
Metallurgical Note:
Tempering reduces brittleness of martensite.
Ref: O.P. Khanna

---

48. Martensite forms due to:
A) Diffusion transformation
B) Slow cooling
C) Diffusionless transformation
D) Recrystallization
Answer: C
Metallurgical Note:
Martensitic transformation is diffusionless and very rapid.
Ref: O.P. Khanna

◆ NON-DESTRUCTIVE TESTING (Concept Distinction)

---

49. Which NDT method is best for detecting internal cracks in thick plates?
A) Magnetic particle
B) Dye penetrant
C) Ultrasonic testing
D) Visual inspection
Answer: C
Metallurgical Note:
Ultrasonic waves penetrate deep and reflect from internal defects.
Ref: Materials Science and Engineering – Callister

---

50. Magnetic particle inspection cannot be used on:
A) Mild steel
B) Cast iron
C) Aluminum
D) Carbon steel
Answer: C
Metallurgical Note:
MPI works only for ferromagnetic materials.
Ref: Callister

---

51. Radiographic testing uses:
A) Magnetic waves
B) Sound waves
C) X-rays
D) Heat waves
Answer: C

Metallurgical Note:
X-rays reveal internal discontinuities.
Ref: Callister

◆ **SIMPLE STRESS & STRAIN (Numericals)**

---

52. A bar of 1000 mm length elongates by 2 mm under load. Strain is:
A) 0.002
B) 0.02
C) 0.0002
D) 2
Answer: A
Step-by-Step Solution:

$$\epsilon = \frac{\Delta L}{L} = \frac{2}{1000} = 0.002$$

Ref: Strength of Materials – R.S. Khurmi

---

53. If stress = 200 MPa and E = 200 GPa, strain is:
A) 0.001
B) 0.01
C) 0.1
D) 1
Answer: A
Step-by-Step Solution:

$$\epsilon = \frac{200 \times 10^6}{200 \times 10^9} = 0.001$$

Ref: R.S. Khurmi

---

54. A bar of cross-sectional area 500 mm² carries 50 kN load. Stress is:
A) 50 MPa
B) 100 MPa
C) 25 MPa
D) 10 MPa
Answer: B
Step-by-Step Solution:

$$\sigma = \frac{P}{A} = \frac{50{,}000}{500} = 100\ MPa$$

Ref: R.S. Khurmi

---

55. Poisson's ratio = 0.3. Longitudinal strain = 0.002. Lateral strain is:
A) 0.0006
B) 0.006
C) 0.002
D) 0.03
Answer: A
Step-by-Step Solution:

$$\text{Lateral strain} = 0.3 \times 0.002 = 0.0006$$

Ref: R.S. Khurmi

◆ **SHEAR FORCE & BENDING MOMENT (Concept + Numerical)**

---

56. A cantilever beam of length L carries point load W at free end. Maximum BM is:
A) WL
B) WL/2
C) W/L
D) Zero
Answer: A
Step-by-Step Solution:

$$M_{max} = W \times L$$

Occurs at fixed end.
Ref: Strength of Materials – S. Ramamrutham

---

57. Shear force at fixed end of above beam is:
A) W
B) WL
C) Zero
D) W/L
Answer: A
Step-by-Step Solution:
Shear force equals applied load = W.
Ref: Ramamrutham

---

58. For simply supported beam with central load W, maximum BM is:
A) WL
B) WL/2

C) WL/4
D) WL/8
Answer: C
Step-by-Step Solution:

$$M_{max} = \frac{WL}{4}$$

At midpoint.
Ref: R.S. Khurmi

---

59. For UDL w over full span L, max BM is:
A) $wL^2/8$
B) $wL^2/2$
C) wL^2
D) wL
Answer: A
Step-by-Step Solution:

$$M_{max} = \frac{wL^2}{8}$$

Ref: R.S. Khurmi

---

60. Relation between bending moment and shear force is:
A) M = ∫V dx
B) V = ∫M dx
C) w = M
D) M = w
Answer: A
Step-by-Step Solution:

$$V = \frac{dM}{dx} \Rightarrow M = \int V dx$$

Ref: Ramamrutham

◆ TORSION OF SHAFTS

---

61. Torsion equation is:
A) σ = My/I
B) T/J = τ/R

C) P/A
D) $E = \sigma/\varepsilon$
Answer: B
Ref: R.S. Khurmi

---

62. A solid shaft of radius R subjected to torque T. Maximum shear stress occurs at:
A) Center
B) Mid-radius
C) Surface
D) Anywhere
Answer: C
Metallurgical Note:
Shear stress varies linearly from zero at center to max at surface.
Ref: R.S. Khurmi

---

63. If torque doubles, shear stress becomes:
A) Half
B) Double
C) Same
D) Zero
Answer: B
Step-by-Step Solution:

$$\tau = \frac{TR}{J}$$

Directly proportional to T.
Ref: R.S. Khurmi

---

64. Polar moment of inertia for solid shaft is:
A) $\pi D^4/32$
B) $\pi D^4/64$
C) $\pi D^2/4$
D) $\pi D^3/16$
Answer: A
Ref: R.S. Khurmi

---

65. For hollow shaft, torque capacity compared to solid shaft (same material & weight) is:
A) Less
B) Equal

C) More
D) Zero
Answer: C
Metallurgical Note:
Hollow shafts are stronger in torsion for same weight.
Ref: S.M.A. Kazimi – Solid Mechanics

---

66. Angle of twist is proportional to:
A) T
B) L
C) 1/G
D) All of these
Answer: D
Ref: R.S. Khurmi

---

67. If G increases, angle of twist:
A) Increases
B) Decreases
C) Same
D) Doubles
Answer: B
Ref: R.S. Khurmi

---

68. Unit of Modulus of Rigidity is:
A) N
B) N/mm^2
C) mm
D) rad
Answer: B
Ref: R.S. Khurmi

---

69. Strain energy stored in torsion is proportional to:
A) T
B) T^2
C) L
D) G
Answer: B
Ref: S.M.A. Kazimi

---

70. Deflection of cantilever with end load W is proportional to:

A) L
B) L^2
C) L^3
D) L^4
Answer: C
Ref: R.S. Khurmi

71–80 (Advanced Beam + Material Trap Questions)
(Condensed but complete with reference)

---

71. Maximum deflection for cantilever end load = $WL^3/3EI$
Answer: True
Ref: R.S. Khurmi
72. Cast iron is strong in compression but weak in tension
Answer: True
Ref: O.P. Khanna
73. Brass is used in condenser tubes due to corrosion resistance
Answer: True
Ref: O.P. Khanna
74. Austenite has FCC structure
Answer: True
Ref: O.P. Khanna
75. Ferrite has BCC structure
Answer: True
Ref: O.P. Khanna
76. Hardness is resistance to indentation
Answer: True
Ref: O.P. Khanna
77. Shear force diagram slope equals load intensity
Answer: True
Ref: Ramamrutham
78. Bending moment diagram slope equals shear force
Answer: True
Ref: Ramamrutham
79. Toughness is area under stress–strain curve
Answer: True
Ref: Callister
80. Strain energy per unit volume = $\sigma^2/2E$
Answer: True
Ref: S.M.A. Kazimi

◆ IRON–CARBON DIAGRAM (Application & Trap Questions)

81. A steel containing 1.2% carbon at room temperature consists of:
A) Ferrite + Pearlite
B) Pearlite only
C) Pearlite + Cementite
D) Austenite
Answer: C
Metallurgical Note:
1.2% C is hypereutectoid steel (>0.8%). Structure: Proeutectoid cementite + pearlite.
Ref: A Textbook of Material Science and Metallurgy – O.P. Khanna

82. Maximum carbon content in steel is:
A) 0.8%
B) 2.14%
C) 4.3%
D) 6.67%
Answer: B
Metallurgical Note:
Steel contains up to 2.14% carbon. Above this, it is cast iron.
Ref: O.P. Khanna

83. Cast iron contains carbon between:
A) 0–0.8%
B) 0.8–2.14%
C) 2.14–6.67%
D) Above 6.67%
Answer: C
Metallurgical Note:
Cast iron carbon range: 2.14% to 6.67%.
Ref: O.P. Khanna

84. Austenite transforms into martensite by:
A) Slow cooling
B) Diffusion process
C) Rapid quenching
D) Tempering
Answer: C

Metallurgical Note:
Martensite forms by rapid quenching (diffusionless).
Ref: O.P. Khanna

---

85. Pearlite is softer than:
A) Ferrite
B) Martensite
C) Austenite
D) None
Answer: B
Metallurgical Note:
Martensite is hardest phase; pearlite is comparatively softer.
Ref: O.P. Khanna

◆ ALLOY SELECTION

---

86. Duralumin is preferred in aircraft because of:
A) High density
B) High strength-to-weight ratio
C) Brittleness
D) High carbon
Answer: B
Metallurgical Note:
Duralumin (Al-Cu-Mg-Mn) offers lightweight and high strength.
Ref: O.P. Khanna

---

87. Brass is suitable for gears because of:
A) High hardness
B) Corrosion resistance
C) Magnetic property
D) Brittleness
Answer: B
Metallurgical Note:
Brass resists corrosion and has good machinability.
Ref: O.P. Khanna

---

88. Tool steels contain high percentage of:
A) Nickel
B) Chromium

C) Carbon
D) Aluminum
Answer: C
Metallurgical Note:
High carbon improves hardness.
Ref: O.P. Khanna

◆ STRESS & STRAIN NUMERICALS

---

89. A steel bar of length 2 m elongates by 4 mm. Strain is:
A) 0.002
B) 0.004
C) 0.0002
D) 0.02
Answer: A
Step-by-Step Solution:
Length = 2000 mm

$$\epsilon = \frac{4}{2000} = 0.002$$

Ref: Strength of Materials – R.S. Khurmi

---

90. A rod of area 400 mm² carries 80 kN load. Stress is:
A) 100 MPa
B) 200 MPa
C) 400 MPa
D) 50 MPa
Answer: B
Step-by-Step Solution:

$$\sigma = \frac{80{,}000}{400} = 200\ MPa$$

Ref: R.S. Khurmi

---

91. If E = 210 GPa and stress = 420 MPa, strain is:
A) 0.001
B) 0.002
C) 0.01
D) 0.02
Answer: B

Step-by-Step Solution:

$$\epsilon = \frac{420}{210000} = 0.002$$

Ref: R.S. Khurmi

◆ **SIMPLE MACHINES**

---

92. Velocity ratio of simple pulley system with 4 pulleys is:
A) 2
B) 4
C) 8
D) 16
Answer: B
Step-by-Step Solution:
VR equals number of supporting rope segments = 4.
Ref: Strength of Materials – S. Ramamrutham

---

93. If MA = 6 and efficiency = 75%, VR is:
A) 4
B) 6
C) 8
D) 10
Answer: C
Step-by-Step Solution:

$$\eta = \frac{MA}{VR} \Rightarrow 0.75 = \frac{6}{VR} \Rightarrow VR = 8$$

Ref: Ramamrutham

◆ **SFD & BMD (Numerical Focus)**

---

94. A simply supported beam of span 6 m carries central load 12 kN. Reaction at each support is:
A) 6 kN
B) 12 kN
C) 3 kN
D) 24 kN
Answer: A

Step-by-Step Solution:
Symmetry → Reaction = 12/2 = 6 kN
Ref: R.S. Khurmi

---

95. Maximum BM for above beam is:
A) 18 kNm
B) 12 kNm
C) 9 kNm
D) 36 kNm
Answer: A
Step-by-Step Solution:

$$M = \frac{WL}{4} = \frac{12 \times 6}{4} = 18kNm$$

Ref: R.S. Khurmi

---

96. For UDL of 5 kN/m over 4 m span, total load is:
A) 5 kN
B) 10 kN
C) 20 kN
D) 40 kN
Answer: C
Step-by-Step Solution:
Total load = wL = 5 × 4 = 20 kN
Ref: R.S. Khurmi

---

97. Maximum BM for above beam is:
A) 10 kNm
B) 5 kNm
C) 20 kNm
D) 40 kNm
Answer: A
Step-by-Step Solution:

$$M = \frac{wL^2}{8} = \frac{5 \times 16}{8} = 10kNm$$

Ref: R.S. Khurmi

---

98. Shear force at center of simply supported beam with central load is:

A) Zero
B) W
C) W/2
D) WL
Answer: A
Step-by-Step Solution:
Shear changes sign at center → zero at midpoint.
Ref: Ramamrutham

◆ TORSION NUMERICALS

---

99. A shaft transmits torque 500 Nm. Diameter = 50 mm. Maximum shear stress is approximately:
A) 16 MPa
B) 32 MPa
C) 64 MPa
D) 8 MPa
Answer: B
Step-by-Step Solution:

$$\tau = \frac{16T}{\pi D^3}$$
$$\tau = \frac{16 \times 500}{\pi (0.05)^3} \approx 32MPa$$

Ref: R.S. Khurmi

---

100. Angle of twist is directly proportional to:
A) T
B) L
C) 1/G
D) All
Answer: D
Ref: R.S. Khurmi

◆ STRAIN ENERGY

---

101. Strain energy stored in bar under axial load is:
A) PL
B) $P^2L/2AE$

C) P/AE
D) AE/L
Answer: B
Step-by-Step Solution:

$$U = \frac{P^2 L}{2AE}$$

Ref: S.M.A. Kazimi – Solid Mechanics

---

102. Resilience is:
A) Energy stored per unit volume
B) Hardness
C) Toughness
D) Brittleness
Answer: A
Ref: S.M.A. Kazimi

---

103. Modulus of resilience equals:
A) $\sigma^2/2E$
B) σ/E
C) σ^2/E
D) $2\sigma/E$
Answer: A
Ref: S.M.A. Kazimi

◆ DEFLECTION OF BEAMS

---

104. Maximum deflection of simply supported beam with central load is:
A) $WL^3/48EI$
B) $WL^3/3EI$
C) $WL^2/8EI$
D) $WL/2EI$
Answer: A
Ref: R.S. Khurmi

---

105. If load doubles, deflection becomes:
A) Same
B) Double
C) Half
D) Four times

Answer: B
Step-by-Step Solution:
Deflection ∝ W
Ref: R.S. Khurmi

106–120 (Concept Reinforcement + Metallurgical Traps)

---

106. Ferrite is soft and ductile
Answer: True
Ref: O.P. Khanna
107. Cementite is brittle
Answer: True
Ref: O.P. Khanna
108. Hardenability is same as hardness
Answer: False
Ref: O.P. Khanna
109. Young's modulus is slope of stress-strain curve in elastic region
Answer: True
Ref: R.S. Khurmi
110. Shear stress distribution in circular shaft is linear
Answer: True
Ref: R.S. Khurmi
111. Bending moment at free end of cantilever is zero
Answer: True
Ref: Ramamrutham
112. Maximum shear stress in rectangular section occurs at neutral axis
Answer: True
Ref: R.S. Khurmi
113. Steel production in basic oxygen furnace uses pure oxygen
Answer: True
Ref: O.P. Khanna
114. Grey cast iron has high damping capacity
Answer: True
Ref: O.P. Khanna
115. Slope of SFD equals load intensity
Answer: True
Ref: Ramamrutham
116. Neutral axis passes through centroid in pure bending
Answer: True
Ref: R.S. Khurmi

117. Martensite has BCT structure
Answer: True
Ref: O.P. Khanna
118. Impact testing measures toughness
Answer: True
Ref: Callister
119. Work done in torsion = Strain energy stored
Answer: True
Ref: Kazimi
120. Hollow shafts are more economical than solid shafts
Answer: True
Ref: Kazimi
Part 4 (Questions 121–160)

◆ **IRON–CARBON DIAGRAM (Lever Rule + Deep Application)**

---

121. For a 0.4% C steel just below 727°C, the structure consists of:
A) 100% Pearlite
B) Ferrite + Pearlite
C) Cementite + Pearlite
D) Austenite
Answer: B
Metallurgical Note:
0.4% C is hypoeutectoid steel. Below eutectoid temperature, it consists of proeutectoid ferrite + pearlite.
Ref: O.P. Khanna – Material Science and Metallurgy

---

122. For eutectoid steel (0.8% C), the percentage of pearlite at room temperature is:
A) 50%
B) 80%
C) 100%
D) 20%
Answer: C
Metallurgical Note:
At 0.8% C, entire structure transforms into pearlite at 727°C.
Ref: O.P. Khanna

---

123. A steel contains 0.6% carbon. Fraction of pearlite just below 727°C (approx.) is:
A) 75%
B) 50%

C) 25%
D) 100%
Answer: A
Step-by-Step Solution (Lever Rule):
Ferrite at eutectoid = 0.025%
Pearlite composition = 0.8%

$$\text{Pearlite fraction} = \frac{0.6 - 0.025}{0.8 - 0.025} \approx 0.74 \approx 75\%$$

Ref: O.P. Khanna

---

124. For 1.0% carbon steel, the proeutectoid phase is:
A) Ferrite
B) Cementite
C) Austenite
D) Martensite
Answer: B
Metallurgical Note:
Above 0.8% C, proeutectoid cementite forms.
Ref: O.P. Khanna

---

125. At 1147°C and 4.3% C, the structure formed is called:
A) Pearlite
B) Ledeburite
C) Martensite
D) Bainite
Answer: B
Metallurgical Note:
Eutectic structure at 4.3% C is Ledeburite.
Ref: O.P. Khanna

◆ PRODUCTION OF IRON & STEEL

---

126. Pig iron is produced in:
A) Electric furnace
B) Cupola
C) Blast furnace
D) BOF
Answer: C

Metallurgical Note:
Blast furnace produces pig iron from iron ore.
Ref: O.P. Khanna

---

127. Basic Oxygen Furnace uses:
A) Air
B) Pure oxygen
C) Nitrogen
D) Hydrogen
Answer: B
Metallurgical Note:
Pure oxygen removes impurities like C, Si, Mn.
Ref: O.P. Khanna

---

128. Slag in blast furnace removes:
A) Carbon
B) Phosphorus
C) Silica
D) Iron
Answer: C
Metallurgical Note:
Flux (limestone) forms slag with silica impurities.
Ref: O.P. Khanna

◆ **ADVANCED STRESS PROBLEMS**

---

129. A bar of 1000 mm length and 200 mm² area carries 40 kN load. E = 200 GPa. Elongation is:
A) 1 mm
B) 0.5 mm
C) 2 mm
D) 4 mm
Answer: A
Step-by-Step Solution:

$$\delta = \frac{PL}{AE}$$
$$= \frac{40{,}000 \times 1000}{200 \times 200{,}000} = 1 \text{ mm}$$

Ref: R.S. Khurmi – Strength of Materials

---

130. Bulk modulus relates to:
A) Shear stress
B) Volumetric strain
C) Linear strain
D) Bending
Answer: B
Ref: R.S. Khurmi

◆ **COMBINED STRESS**

---

131. A rod under axial tension and torsion experiences:
A) Only normal stress
B) Only shear stress
C) Both normal and shear
D) No stress
Answer: C
Ref: S.M.A. Kazimi – Solid Mechanics

◆ **SFD & BMD (Mixed Loading)**

---

132. A cantilever 4 m long carries UDL of 3 kN/m. Maximum BM is:
A) 24 kNm
B) 12 kNm
C) 6 kNm
D) 48 kNm
Answer: A
Step-by-Step Solution:

$$M = \frac{wL^2}{2} = \frac{3 \times 16}{2} = 24kNm$$

Ref: R.S. Khurmi

---

133. Shear force at fixed end above is:
A) 6 kN
B) 12 kN
C) 3 kN
D) 24 kN
Answer: B
Step-by-Step Solution:

$$V = wL = 3 \times 4 = 12kN$$

Ref: R.S. Khurmi

---

134. Point of contraflexure occurs where:
A) SF = 0
B) BM = 0
C) Load = 0
D) Reaction = 0
Answer: B
Ref: S. Ramamrutham – Strength of Materials

◆ **DEFLECTION ADVANCED**

---

135. For cantilever with UDL, max deflection is:
A) $wL^4/8EI$
B) $wL^4/30EI$
C) $wL^4/8EI$
D) $wL^3/3EI$
Answer: A

$$\delta_{max} = \frac{wL^4}{8EI}$$

Ref: R.S. Khurmi

◆ **TORSION ADVANCED**

---

136. A hollow shaft has outer diameter 100 mm and inner 60 mm. Polar moment is proportional to:
A) D^4
B) $D^4 - d^4$
C) D^2
D) D^3
Answer: B
Ref: R.S. Khurmi

---

137. Shear stress in hollow shaft varies:
A) Constant
B) Linear from center

C) Parabolic
D) Zero
Answer: B
Ref: R.S. Khurmi

---

138. Power transmitted by shaft is:
A) $T \times \omega$
B) P/A
C) My/I
D) σE
Answer: A
Ref: R.S. Khurmi

◆ STRAIN ENERGY ADVANCED

---

139. Strain energy in beam due to bending is proportional to:
A) M
B) M^2
C) EI
D) L
Answer: B
Ref: S.M.A. Kazimi

◆ MATERIAL PROPERTY TRAPS

---

140. Hardness testing (Brinell) measures:
A) Impact strength
B) Resistance to indentation
C) Toughness
D) Elasticity
Answer: B
Ref: O.P. Khanna

---

141. Bainite forms at:
A) Very slow cooling
B) Very fast cooling
C) Intermediate cooling
D) Room temp
Answer: C
Ref: O.P. Khanna

---

142. Austenite has crystal structure:
A) BCC
B) FCC
C) HCP
D) BCT
Answer: B
Ref: O.P. Khanna

---

143. Ferrite structure is:
A) FCC
B) BCC
C) HCP
D) BCT
Answer: B
Ref: O.P. Khanna

---

144. Modulus of rigidity (G) is related to E and Poisson's ratio by:
A) $G = E/2(1+\mu)$
B) $G = E\mu$
C) $G = E$
D) $G = 2E$
Answer: A
Ref: R.S. Khurmi

145–160 (Concept Consolidation – Quick High Yield)

---

145. Shear force changes abruptly at point load – **True**
Ref: Ramamrutham
146. BMD is linear under UDL – **False (parabolic)**
Ref: Ramamrutham
147. Toughness equals area under entire stress–strain curve – **True**
Ref: Callister
148. Martensite is supersaturated solution of carbon – **True**
Ref: O.P. Khanna
149. Cast iron has good compressive strength – **True**
Ref: O.P. Khanna
150. Yield stress marks end of elastic region – **True**
Ref: R.S. Khurmi

151. Angle of twist increases with length – **True**
Ref: R.S. Khurmi
152. Strain energy unit is Joule – **True**
Ref: Kazimi
153. Maximum BM occurs where SF = 0 – **True**
Ref: Ramamrutham
154. Stress concentration occurs at sharp corners – **True**
Ref: Kazimi
155. Ductility measured by % elongation – **True**
Ref: O.P. Khanna
156. Resilience differs from toughness – **True**
Ref: Kazimi
157. NDT does not damage component – **True**
Ref: Callister
158. UTS occurs after yield point – **True**
Ref: Khurmi
159. Hardenability differs from hardness – **True**
Ref: O.P. Khanna
160. Slope of BM diagram = Shear force – **True**
Ref: Ramamrutham

◆ IRON–CARBON DIAGRAM (High-Precision Exam Traps)

---

161. The eutectoid temperature in Iron–Carbon diagram is:
A) 723°C
B) 727°C
C) 1147°C
D) 1493°C
Answer: B
Metallurgical Note:
The exact eutectoid temperature is **727°C**. Memorization is critical for ECET.
Ref: O.P. Khanna – Material Science and Metallurgy

---

162. Carbon percentage at eutectoid point is:
A) 0.025%
B) 0.16%
C) 0.8%
D) 2.14%
Answer: C

Metallurgical Note:
Eutectoid composition = 0.8% C.
Ref: O.P. Khanna

---

163. Maximum carbon solubility in ferrite at room temperature is approximately:
A) 0.8%
B) 2.14%
C) 0.008%
D) 6.67%
Answer: C
Metallurgical Note:
Very low solubility (~0.008% at room temperature).
Ref: O.P. Khanna

---

164. Austenite exists between temperatures:
A) 0–727°C
B) 727–1539°C (depending on %C)
C) Above melting point
D) Only at 1147°C
Answer: B
Metallurgical Note:
Austenite region lies above eutectoid temperature.
Ref: O.P. Khanna

---

165. Pearlite contains approximately:
A) 88% ferrite and 12% cementite
B) 50% ferrite and 50% cementite
C) 100% ferrite
D) 100% cementite
Answer: A
Metallurgical Note:
By weight, pearlite contains ~88% ferrite and 12% cementite.
Ref: O.P. Khanna

◆ NDT ADVANCED APPLICATION

---

166. Dye penetrant testing detects:
A) Internal defects
B) Surface cracks

C) Grain boundaries
D) Hardness
Answer: B
Metallurgical Note:
DPT is suitable only for surface-breaking defects.
Ref: Callister – Materials Science

---

167. Ultrasonic testing works on principle of:
A) Magnetic field
B) Reflection of sound waves
C) X-ray absorption
D) Eddy currents
Answer: B
Metallurgical Note:
Sound waves reflect from discontinuities.
Ref: Callister

---

168. Radiography is best suited for detecting:
A) Surface defects
B) Internal porosity
C) Hardness
D) Elastic limit
Answer: B
Metallurgical Note:
X-ray imaging reveals internal flaws.
Ref: Callister

◆ AXIAL LOADING ADVANCED NUMERICALS

---

169. A bar 3 m long, area 600 mm², carries 90 kN. E = 200 GPa. Elongation is:
A) 1.5 mm
B) 2.25 mm
C) 3 mm
D) 4 mm
Answer: B
Step-by-Step Solution:

$$\delta = \frac{PL}{AE}$$

Convert units:

P = 90,000 N
L = 3000 mm
A = 600 mm²
E = 200,000 N/mm²

$$\delta = \frac{90000 \times 3000}{600 \times 200000} = 2.25 \text{ mm}$$

Ref: R.S. Khurmi – Strength of Materials

---

170. Stress corresponding to above problem is:
A) 150 MPa
B) 100 MPa
C) 200 MPa
D) 300 MPa
Answer: A
Step-by-Step Solution:

$$\sigma = \frac{P}{A} = \frac{90000}{600} = 150 \text{ MPa}$$

Ref: R.S. Khurmi

◆ SHEAR FORCE & BENDING MOMENT (Mixed Case)

---

171. A simply supported beam 8 m long carries UDL 4 kN/m. Maximum BM is:
A) 32 kNm
B) 64 kNm
C) 16 kNm
D) 8 kNm
Answer: A
Step-by-Step Solution:

$$M = \frac{wL^2}{8} = \frac{4 \times 64}{8} = 32kNm$$

Ref: R.S. Khurmi

---

172. Shear force at supports in above problem is:
A) 16 kN
B) 8 kN
C) 32 kN
D) 4 kN

Answer: A

$$Reaction = \frac{wL}{2} = \frac{4 \times 8}{2} = 16kN$$

Ref: R.S. Khurmi

---

173. For a beam, maximum BM occurs where:
A) Load maximum
B) Reaction maximum
C) Shear force zero
D) Length maximum
Answer: C
Ref: S. Ramamrutham

- **TORSION NUMERICAL**

---

174. A solid shaft 40 mm diameter transmits torque 200 Nm. Shear stress is approx:
A) 10 MPa
B) 20 MPa
C) 40 MPa
D) 5 MPa
Answer: B
Step-by-Step Solution:

$$\tau = \frac{16T}{\pi D^3}$$

D = 0.04 m

$$\tau \approx 20MPa$$

Ref: R.S. Khurmi

---

175. If shaft diameter doubles, shear stress becomes:
A) Half
B) One-fourth
C) One-eighth
D) Double
Answer: C

$$\tau \propto \frac{1}{D^3} \Rightarrow \text{If D doubles} \rightarrow \tau = 1/8$$

Ref: R.S. Khurmi

◆ DEFLECTION

176. Maximum deflection of simply supported beam with UDL is:

A) $5wL^4/384EI$

B) $wL^3/3EI$

C) $wL^2/8EI$

D) $WL^3/48EI$

Answer: A

Ref: R.S. Khurmi

177. Deflection is inversely proportional to:

A) Load

B) Length

C) E

D) L^3

Answer: C

Ref: R.S. Khurmi

◆ STRAIN ENERGY

178. Strain energy stored in torsion is:

A) $T\theta/2$

B) TL/2

C) PL

D) $M^2/2EI$

Answer: A

Ref: S.M.A. Kazimi

179. Unit of strain energy density is:

A) N

B) N/mm^2

C) J/mm^3

D) mm

Answer: C

Ref: Kazimi

◆ MATERIAL APPLICATION TRAPS

180. High carbon steel is used for:

A) Structural beams
B) Cutting tools
C) Aircraft body
D) Springs
Answer: B
Metallurgical Note:
High carbon → high hardness → cutting tools.
Ref: O.P. Khanna

---

181. Mild steel contains carbon approximately:
A) 0.1–0.25%
B) 1%
C) 2%
D) 4%
Answer: A
Ref: O.P. Khanna

---

182. Stainless steel contains chromium at least:
A) 2%
B) 6%
C) 12%
D) 25%
Answer: C
Metallurgical Note:
Minimum 12% Cr for corrosion resistance.
Ref: O.P. Khanna

183. Martensite formation causes volume expansion – **True**
Ref: O.P. Khanna
184. NDT is preferred for in-service inspection – **True**
Ref: Callister
185. Stress = Force/Area – **True**
Ref: Khurmi
186. Strain is dimensionless – **True**
Ref: Khurmi
187. Hollow shafts save material – **True**
Ref: Kazimi
188. Shear force diagram for UDL is linear – **True**
Ref: Ramamrutham

189. BMD for UDL is parabolic – **True**
Ref: Ramamrutham
190. Neutral axis has zero bending stress – **True**
Ref: Khurmi
191. Modulus of elasticity is material property – **True**
Ref: Khurmi
192. Copper has high electrical conductivity – **True**
Ref: O.P. Khanna
193. Grey cast iron has flake graphite – **True**
Ref: O.P. Khanna
194. Tempering reduces hardness slightly – **True**
Ref: O.P. Khanna
195. Impact strength measured by Izod test – **True**
Ref: O.P. Khanna
196. Torsion causes shear stress – **True**
Ref: Khurmi
197. Slope of beam equals dy/dx – **True**
Ref: Ramamrutham
198. Hardening increases brittleness – **True**
Ref: O.P. Khanna
199. Alloying improves properties – **True**
Ref: O.P. Khanna
200. Strain energy stored equals external work done – **True**
Ref: Kazimi

Part 6 (Questions 201–240)

◆ ADVANCED IRON–CARBON & HEAT TREATMENT

---

201. A 0.2% carbon steel just below 727°C contains approximately:
A) 100% Pearlite
B) Mostly ferrite
C) Mostly cementite
D) Austenite
Answer: B
Metallurgical Note:
0.2% C is low carbon hypoeutectoid steel → mainly ferrite + small amount pearlite.
Ref: O.P. Khanna – Material Science and Metallurgy

---

202. The hardest microstructure in steel is:

A) Ferrite
B) Pearlite
C) Bainite
D) Martensite
Answer: D
Metallurgical Note:
Martensite (BCT structure) is hardest phase due to supersaturated carbon.
Ref: O.P. Khanna

---

203. Austempering produces:
A) Martensite
B) Pearlite
C) Bainite
D) Cementite
Answer: C
Metallurgical Note:
Austempering results in bainitic structure.
Ref: O.P. Khanna

---

204. Case hardening improves:
A) Core hardness
B) Surface hardness
C) Ductility
D) Toughness only
Answer: B
Metallurgical Note:
Case hardening produces hard surface with tough core.
Ref: O.P. Khanna

◆ ADVANCED AXIAL & COMBINED STRESS

---

205. A steel rod 2 m long, 400 mm² area, carries 80 kN load. E = 200 GPa. Elongation is:
A) 2 mm
B) 4 mm
C) 1 mm
D) 0.5 mm
Answer: A
Step-by-Step Solution:

$$\delta = \frac{PL}{AE}$$

P = 80,000 N
L = 2000 mm
A = 400 mm²
E = 200,000 N/mm²

$$\delta = \frac{80000 \times 2000}{400 \times 200000} = 2 \text{ mm}$$

Ref: R.S. Khurmi – Strength of Materials

---

206. A rod under axial tension and torsion will experience:
A) Only tensile stress
B) Only shear stress
C) Combined stresses
D) No stress
Answer: C
Ref: S.M.A. Kazimi – Solid Mechanics

◆ **ADVANCED SFD & BMD (Mixed Loading)**

---

207. A simply supported beam 10 m long carries 20 kN at center. Maximum BM is:
A) 50 kNm
B) 25 kNm
C) 100 kNm
D) 200 kNm
Answer: A
Step-by-Step Solution:

$$M = \frac{WL}{4} = \frac{20 \times 10}{4} = 50kNm$$

Ref: R.S. Khurmi

---

208. A cantilever 5 m long carries 10 kN at free end. Maximum deflection is:
A) $WL^3/3EI$
B) $WL^3/48EI$
C) $wL^4/8EI$
D) $WL^2/2EI$
Answer: A

$$\delta = \frac{WL^3}{3EI}$$

Ref: R.S. Khurmi

---

209. For a simply supported beam with UDL, shear force at mid-span is:
A) Maximum
B) Zero
C) wL
D) wL/2
Answer: B
Ref: S. Ramamrutham – Strength of Materials

---

210. Point of contraflexure is where:
A) Shear force zero
B) Load zero
C) Bending moment zero
D) Reaction zero
Answer: C
Ref: Ramamrutham

◆ **ADVANCED TORSION NUMERICALS**

---

211. A solid shaft 60 mm diameter transmits 300 Nm torque. Shear stress is approx:
A) 10 MPa
B) 15 MPa
C) 20 MPa
D) 5 MPa
Answer: B
Step-by-Step Solution:

$$\tau = \frac{16T}{\pi D^3}$$

Substitute values:

$$\tau \approx 15MPa$$

Ref: R.S. Khurmi

---

212. If length of shaft doubles, angle of twist becomes:
A) Half
B) Double

C) Same
D) One-fourth
Answer: B

$$\theta \propto L$$

Ref: R.S. Khurmi

---

213. Power transmitted by shaft rotating at N rpm is:
A) $2\pi NT$
B) $2\pi NT/60$
C) NT
D) T/N
Answer: B

$$P = \frac{2\pi NT}{60}$$

Ref: R.S. Khurmi

◆ STRAIN ENERGY & RESILIENCE

---

214. Strain energy per unit volume for linear elastic material is:
A) $\sigma^2/2E$
B) σ/E
C) E/σ
D) $2E/\sigma$
Answer: A
Ref: S.M.A. Kazimi

---

215. Maximum strain energy in torsion occurs at:
A) Center
B) Surface
C) Mid-radius
D) Uniform
Answer: B
Ref: Kazimi

◆ MATERIAL APPLICATION & SELECTION

---

216. Bronze is preferred for bearings due to:

A) Brittleness
B) Self-lubricating property
C) High carbon
D) Magnetism
Answer: B
Metallurgical Note:
Bronze offers good wear resistance and bearing properties.
Ref: O.P. Khanna

---

217. Stainless steel resists corrosion due to formation of:
A) Iron oxide
B) Chromium oxide layer
C) Carbon layer
D) Slag
Answer: B
Metallurgical Note:
Chromium oxide passive layer protects surface.
Ref: O.P. Khanna

---

218. Aluminium alloys are used in aircraft because:
A) High density
B) Magnetic nature
C) High strength-to-weight ratio
D) Brittleness
Answer: C
Ref: O.P. Khanna

219. Ferrite is BCC structure – **True**
Ref: O.P. Khanna
220. Austenite is FCC structure – **True**
Ref: O.P. Khanna
221. Cementite is very hard and brittle – **True**
Ref: O.P. Khanna
222. NDT avoids damaging component – **True**
Ref: Callister
223. Maximum BM occurs where SF = 0 – **True**
Ref: Ramamrutham
224. Shear stress is zero at neutral axis in bending – **False** (maximum at neutral axis for rectangular section)
Ref: R.S. Khurmi

225. Deflection is inversely proportional to EI – **True**
Ref: Khurmi

226. Hollow shaft is stronger than solid shaft of same weight – **True**
Ref: Kazimi

227. Tempering improves toughness – **True**
Ref: O.P. Khanna

228. High carbon steel is more ductile than mild steel – **False**
Ref: O.P. Khanna

229. Strain is dimensionless – **True**
Ref: Khurmi

230. Stress concentration occurs at sharp corners – **True**
Ref: Kazimi

231. Bulk modulus measures resistance to volume change – **True**
Ref: Khurmi

232. Bending stress varies linearly from neutral axis – **True**
Ref: Khurmi

233. Modulus of rigidity relates shear stress to shear strain – **True**
Ref: Khurmi

234. Impact test measures toughness – **True**
Ref: Callister

235. Annealing softens steel – **True**
Ref: O.P. Khanna

236. Normalizing refines grain structure – **True**
Ref: O.P. Khanna

237. Hardening increases brittleness – **True**
Ref: O.P. Khanna

238. Lever rule is used to find phase fractions – **True**
Ref: O.P. Khanna

239. Power transmission capacity increases with $diameter^3$ – **True**
Ref: Khurmi

240. Slope of BMD equals shear force – **True**
Ref: Ramamrutham

UNIT IV: Theory of Machines & Design of Machine Elements

◆ BELT DRIVES (Velocity Ratio, Tensions, Slip, Lengths, Power)

---

1. The velocity ratio of a belt drive (without slip) is:
A) D_1/D_2
B) N_1/N_2
C) N_2/N_1
D) D_2/D_1
Answer: A
Step-by-Step Solution:
Velocity ratio = Driver speed / Driven speed

$$\frac{N_1}{N_2} = \frac{D_2}{D_1} \Rightarrow VR = \frac{D_1}{D_2}$$

Ref: Theory of Machines – R.S. Khurmi

---

2. If driver diameter = 200 mm and driven diameter = 400 mm, velocity ratio is:
A) 2
B) 0.5
C) 4
D) 1
Answer: B

$$VR = \frac{200}{400} = 0.5$$

Ref: R.S. Khurmi

---

3. Slip in belt drive reduces:
A) Power
B) Velocity ratio
C) Belt tension
D) Length
Answer: B
Concept Note:
Slip reduces actual velocity ratio below theoretical value.
Ref: Theory of Machines – S.S. Rattan

---

4. The ratio of tensions in flat belt drive is given by:

A) $T_1/T_2 = e^{(\mu\theta)}$
B) $T_1/T_2 = \mu\theta$
C) $T_1/T_2 = D_1/D_2$
D) $T_1/T_2 = N_1/N_2$
Answer: A
Ref: R.S. Khurmi

---

5. Maximum power transmitted occurs when centrifugal tension is:
A) Zero
B) Equal to T_1
C) One-third of maximum tension
D) Equal to T_2
Answer: C
Ref: R.S. Khurmi

---

6. Centrifugal tension increases with:
A) Belt speed
B) Belt thickness
C) Diameter
D) Slip
Answer: A

$$T_c = mv^2$$

Ref: R.S. Khurmi

---

7. Length of open belt drive is approximately:
A) $\pi(D+d)/2 + 2C$
B) $2C + \pi(D+d)/2 + (D-d)^2/4C$
C) $2C + \pi(D+d)$
D) πD
Answer: B
Ref: R.S. Khurmi

---

8. In cross belt drive, direction of rotation is:
A) Same
B) Opposite
C) Variable
D) Zero
Answer: B
Ref: Theory of Machines – S.S. Rattan

9. Power transmitted by belt is:
A) $(T_1 - T_2)v$
B) T_1v
C) T_2v
D) μv
Answer: A
Ref: R.S. Khurmi

10. If T_1 = 1000 N, T_2 = 400 N, speed = 10 m/s, power is:
A) 6 kW
B) 4 kW
C) 10 kW
D) 14 kW
Answer: A

$$P = (1000 - 400) \times 10 = 6000W = 6kW$$

Ref: R.S. Khurmi

◆ GEAR TRAINS

11. In simple gear train, idler gear affects:
A) Speed ratio
B) Direction only
C) Power
D) Torque
Answer: B
Ref: Theory of Machines – R.S. Khurmi

12. Velocity ratio of simple gear train depends on:
A) Number of teeth of first and last gear
B) All gears
C) Idler
D) Center distance
Answer: A

13. In compound gear train, gears are:
A) On separate shafts
B) On same shaft

C) Parallel
D) None
Answer: B

---

14. Epicyclic gear train has:
A) Fixed axes
B) Moving axes
C) No gears
D) Slip
Answer: B

---

15. Sun gear is central gear in:
A) Simple train
B) Compound train
C) Epicyclic train
D) Belt drive
Answer: C

- **CHAINS**

---

16. Roller chain is preferred because:
A) Less wear
B) More slip
C) High friction
D) Noise
Answer: A
Ref: Theory of Machines – Khurmi

---

17. Silent chains are used for:
A) High speed
B) Low speed
C) Manual drive
D) None
Answer: A

- **FLYWHEEL**

---

18. Flywheel stores energy in form of:
A) Potential energy
B) Kinetic energy

C) Strain energy
D) Heat
Answer: B

$$E = \frac{1}{2} I\omega^2$$

Ref: Theory of Machines – Khurmi

---

19. Flywheel reduces:
A) Mean speed
B) Speed fluctuations
C) Power
D) Torque
Answer: B

◆ GOVERNOR

---

20. Governor controls:
A) Speed
B) Torque
C) Power
D) Tension
Answer: A

---

21. Centrifugal governor works on principle of:
A) Gravity
B) Centrifugal force
C) Magnetism
D) Spring only
Answer: B

◆ CAMS

---

22. Cam follower motion types include:
A) SHM
B) Uniform acceleration
C) Cycloidal
D) All
Answer: D

---

23. Dwell period in cam means:
A) Rise
B) Fall
C) No motion
D) Maximum speed
Answer: C

◆ DESIGN OF MACHINE ELEMENTS

◆ BOLTED JOINTS

---

24. Shear stress in bolt =
A) P/A
B) T/J
C) My/I
D) F/L
Answer: A
Ref: Machine Design – V.B. Bhandari

---

25. Factor of safety =
A) Ultimate stress / Working stress
B) Working / Ultimate
C) Load/Area
D) None
Answer: A

◆ RIVETED JOINTS

---

26. Efficiency of riveted joint =
A) Joint strength / Plate strength
B) Plate strength / Joint strength
C) Load/Area
D) None
Answer: A

◆ WELDED JOINTS

---

27. Fillet weld size equals:
A) Leg length
B) Throat thickness

C) Plate thickness
D) Diameter
Answer: A

◆ SHAFTS

---

28. Shaft design is based on:
A) Bending only
B) Torsion only
C) Combined bending and torsion
D) Compression
Answer: C

---

29. Maximum shear stress theory is used in:
A) Shaft design
B) Spring
C) Bearing
D) Cam
Answer: A

◆ KEYS

---

30. Key prevents:
A) Axial movement
B) Relative rotation
C) Bending
D) Slip
Answer: B

◆ COUPLINGS

---

31. Rigid coupling connects:
A) Parallel shafts
B) Misaligned shafts
C) Co-axial shafts
D) Chain
Answer: C

◆ BEARINGS

---

32. Journal bearing works on:
A) Rolling friction
B) Sliding friction
C) Magnetic
D) Air
Answer: B

◆ SPRINGS

---

33. Deflection of close-coiled spring is proportional to:
A) Load
B) Wire diameter
C) Coil diameter
D) Modulus
Answer: A

---

34. Spring index =
A) D/d
B) d/D
C) L/d
D) None
Answer: A

---

35. Slip reduces efficiency – True
    Ref: Khurmi
36. Compound gear gives high velocity ratio – True
    Ref: Khurmi
37. Flywheel does not control mean speed – True
    Ref: Khurmi
38. Governor does not store energy – True
    Ref: Khurmi
39. Riveted joint weaker than solid plate – True
    Ref: Bhandari
40. Helical springs absorb shock – True
    Ref: Machine Design – V.B. Bhandari

◆ BELT DRIVES – NUMERICAL FOCUS

---

41. A belt drive has driver diameter 300 mm running at 600 rpm. Driven diameter is 150 mm. Speed of driven shaft is:
A) 300 rpm
B) 600 rpm
C) 1200 rpm
D) 900 rpm
Answer: C
Step-by-Step Solution:

$$\frac{N_1}{N_2} = \frac{D_2}{D_1}$$
$$\frac{600}{N_2} = \frac{150}{300} = 0.5$$
$$N_2 = 1200 \text{ rpm}$$

Ref: Theory of Machines – R.S. Khurmi

---

42. If total slip is 2%, actual speed in above problem becomes:
A) 1176 rpm
B) 1200 rpm
C) 1180 rpm
D) 1150 rpm
Answer: A

$$N_{actual} = 1200(1 - 0.02) = 1176 \text{ rpm}$$

Ref: R.S. Khurmi

---

43. Belt speed is given by:
A) πDN
B) πDN/60
C) DN
D) 2πN
Answer: B

$$v = \frac{\pi DN}{60}$$

Ref: Khurmi

---

44. A belt running at 15 m/s has T_1 = 800 N and T_2 = 200 N. Power transmitted is:
A) 9 kW
B) 6 kW

C) 12 kW
D) 3 kW
Answer: A

$$P = (800 - 200) \times 15 = 9000W = 9kW$$

Ref: Khurmi

---

45. Centrifugal tension is maximum when belt speed is:
A) Low
B) High
C) Zero
D) Constant
Answer: B

$$T_c = mv^2$$

Ref: Khurmi

---

46. Maximum power transmitted when:
A) T_c = 0
B) T_c = T_1
C) T_c = T/3
D) T_2 = 0
Answer: C
Ref: Khurmi

---

47. Effect of belt thickness is to:
A) Increase velocity ratio
B) Decrease velocity ratio
C) No effect
D) Increase slip
Answer: A
Concept Note:
Effective diameter increases by belt thickness.
Ref: Theory of Machines – S.S. Rattan

◆ GEAR TRAINS – NUMERICALS

---

48. In a simple gear train, gear A (20 teeth) drives gear B (40 teeth). Speed ratio is:
A) 1
B) 2

C) 0.5
D) 4
Answer: C

$$VR = \frac{T_A}{T_B} = \frac{20}{40} = 0.5$$

Ref: Khurmi

---

49. In compound gear train, overall velocity ratio equals:
A) Sum of individual ratios
B) Product of individual ratios
C) Difference
D) None
Answer: B
Ref: Khurmi

---

50. Epicyclic gear train is used when:
A) Large speed reduction required
B) Small speed change
C) No reduction
D) Slip required
Answer: A
Ref: Khurmi

◆ **FLYWHEEL – NUMERICAL**

---

51. Flywheel mass moment of inertia is 50 kg·m² and angular speed is 20 rad/s. Energy stored is:
A) 5000 J
B) 10000 J
C) 20000 J
D) 25000 J
Answer: B

$$E = \frac{1}{2} I\omega^2 = \frac{1}{2} \times 50 \times 400 = 10000J$$

Ref: Theory of Machines – Khurmi

---

52. Coefficient of fluctuation of speed is defined as:

A) Mean speed / Max speed
B) $(N_1 - N_2)/N$
C) Max speed only
D) None
Answer: B
Ref: Khurmi

◆ **GOVERNOR**

---

53. Height of Watt governor is given by:
A) g/ω^2
B) ω^2/g
C) $g\omega$
D) ω/g
Answer: A

$$h = \frac{g}{\omega^2}$$

Ref: Khurmi

---

54. If speed increases, height of Watt governor:
A) Increases
B) Decreases
C) Constant
D) Zero
Answer: B
Ref: Khurmi

◆ **CAMS**

---

55. For SHM cam motion, acceleration is:
A) Constant
B) Zero
C) Sinusoidal
D) Infinite
Answer: C
Ref: Theory of Machines – Khurmi

---

56. Cycloidal motion gives:

A) Sudden acceleration
B) Zero jerk at beginning and end
C) Maximum jerk
D) No motion
Answer: B
Ref: Khurmi

◆ SHAFT DESIGN – NUMERICAL

---

57. A shaft transmits 10 kW at 100 rpm. Torque is approximately:
A) 955 Nm
B) 9550 Nm
C) 95 Nm
D) 95500 Nm
Answer: B

$$P = \frac{2\pi NT}{60} \Rightarrow T = \frac{P \times 60}{2\pi N}$$
$$T \approx 9550 \text{ Nm}$$

Ref: Machine Design – V.B. Bhandari

---

58. For solid shaft, torque capacity proportional to:
A) D
B) D^2
C) D^3
D) D^4
Answer: C

$$T \propto D^3$$

Ref: Bhandari

◆ KEYS

---

59. Failure of key may occur due to:
A) Shear
B) Crushing
C) Both
D) None
Answer: C
Ref: Bhandari

◆ COUPLINGS

60. Flexible coupling compensates for:
A) Power
B) Misalignment
C) Torque
D) Slip
Answer: B
Ref: Bhandari

◆ BEARINGS

61. In a journal bearing, pressure distribution is:
A) Uniform
B) Zero
C) Parabolic
D) Linear
Answer: C
Concept Note:
Hydrodynamic pressure distribution in journal bearing is approximately parabolic.
Ref: Machine Design – V.B. Bhandari

62. The main function of a bearing is to:
A) Increase friction
B) Support rotating shaft
C) Transmit power
D) Reduce torque
Answer: B
Ref: Machine Design – V.B. Bhandari

63. In rolling contact bearings, friction is:
A) Sliding
B) Rolling
C) Zero
D) Fluid
Answer: B
Ref: Machine Design – V.B. Bhandari

64. Life of rolling bearing is expressed in:

A) Hours
B) Revolutions
C) Years
D) Load
Answer: B
Ref: Machine Design – V.B. Bhandari

◆ SPRINGS

---

65. Shear stress in close-coiled helical spring is:
A) $\sigma = P/A$
B) $\tau = 8PD/\pi d^3$
C) My/I
D) T/J
Answer: B
Ref: Machine Design – V.B. Bhandari

---

66. Deflection of close-coiled spring is:
A) PL/AE
B) $8PD^3n/Gd^4$
C) $WL^3/3EI$
D) T/J
Answer: B
Ref: Machine Design – V.B. Bhandari

---

67. If wire diameter doubles, spring deflection becomes:
A) Same
B) Double
C) 1/16th
D) 1/4th
Answer: C
Step-by-Step Solution:

$$\delta \propto \frac{1}{d^4}$$

If $d \rightarrow 2d$

$$\delta_{new} = \frac{1}{16}\delta$$

Ref: Bhandari

---

68. Spring index is ratio of:
A) d/D
B) D/d
C) L/d
D) n/d
Answer: B
Ref: Bhandari

---

69. Buckling occurs in:
A) Torsion springs
B) Short springs
C) Long compression springs
D) Bearings
Answer: C
Ref: Bhandari

◆ BOLTED JOINTS – NUMERICALS

---

70. A bolt of diameter 20 mm is subjected to shear load 10 kN. Shear stress is approximately:
A) 16 MPa
B) 32 MPa
C) 64 MPa
D) 8 MPa
Answer: B
Step-by-Step Solution:

$$A = \frac{\pi d^2}{4} = \frac{\pi \times 400}{4} \approx 314 \text{ mm}^2$$

$$\tau = \frac{10000}{314} \approx 32 \text{ MPa}$$

Ref: Machine Design – V.B. Bhandari

---

71. Factor of safety is defined as:
A) Working stress / Ultimate stress
B) Ultimate stress / Working stress
C) Load / Area
D) None
Answer: B

Ref: Bhandari

◆ RIVETED JOINTS

---

72. Tearing failure in riveted joint occurs across:
A) Rivet
B) Plate
C) Weld
D) Shaft
Answer: B
Ref: Machine Design – V.B. Bhandari

---

73. Crushing failure occurs due to:
A) Shear
B) Bearing pressure
C) Bending
D) Slip
Answer: B
Ref: Bhandari

---

74. Efficiency of riveted joint is always:
A) >100%
B) =100%
C) <100%
D) 0%
Answer: C
Ref: Bhandari

◆ WELDED JOINTS

---

75. Strength of fillet weld depends on:
A) Leg size
B) Throat thickness
C) Length
D) All
Answer: D
Ref: Machine Design – V.B. Bhandari

---

76. Throat thickness of 45° fillet weld equals:

A) 0.5 × leg
B) 0.707 × leg
C) 1 × leg
D) 2 × leg
Answer: B
Ref: Bhandari

◆ SHAFT DESIGN – ADVANCED

---

77. A shaft subjected to bending moment M and torque T is designed using:
A) Maximum normal stress theory
B) Maximum shear stress theory
C) Rankine theory
D) None
Answer: B
Ref: Machine Design – V.B. Bhandari

---

78. Equivalent twisting moment is:
A) $\sqrt{(M^2 + T^2)}$
B) M + T
C) M - T
D) MT
Answer: A
Ref: Bhandari

---

79. If torque doubles, required shaft diameter becomes:
A) Double
B) 1.26 times
C) 1.59 times
D) 2.5 times
Answer: B
Step-by-Step Solution:

$$T \propto D^3 \Rightarrow D \propto T^{1/3}$$

If T doubles:

$$D_{new} = 2^{1/3} D \approx 1.26D$$

Ref: Bhandari

◆ GEAR TRAINS – ADVANCED

80. In compound gear train, velocity ratio can be:
A) Very large
B) Small only
C) Fixed
D) 1
Answer: A
Ref: Theory of Machines – Khurmi

81. In epicyclic gear train, arm speed affects:
A) Gear ratio
B) Torque
C) Speed distribution
D) None
Answer: C
Ref: Khurmi

◆ FLYWHEEL – ADVANCED

82. Maximum fluctuation of energy equals:
A) ΔE
B) $I\omega$
C) T
D) P
Answer: A
Ref: Khurmi

83. Coefficient of fluctuation of energy =
A) ΔE / Work done per cycle
B) Work / ΔE
C) Speed ratio
D) None
Answer: A
Ref: Khurmi

◆ GOVERNOR – ADVANCED

84. Sensitivity of governor increases when:
A) Height small
B) Height large

C) Speed high
D) Speed zero
Answer: B
Ref: Khurmi

---

85. Hunting in governor means:
A) Stable motion
B) Continuous fluctuation of speed
C) No motion
D) Torque change
Answer: B
Ref: Khurmi

◆ CAMS – ADVANCED

---

86. Pressure angle in cam should be:
A) High
B) Moderate
C) Zero
D) 90°
Answer: B
Ref: Theory of Machines – Khurmi

---

87. For high-speed cams, best motion is:
A) Uniform velocity
B) SHM
C) Cycloidal
D) None
Answer: C
Ref: Khurmi

◆ QUICK REVISION

---

88. Slip reduces belt efficiency – True
    Ref: Khurmi
89. Compound gears provide large speed reduction – True
    Ref: Khurmi
90. Flywheel stores rotational energy – True
    Ref: Khurmi

91. Governor controls mean speed – True
    Ref: Khurmi
92. Bolts fail in shear and tension – True
    Ref: Bhandari
93. Rivets subjected to shear – True
    Ref: Bhandari
94. Welded joints lighter than riveted – True
    Ref: Bhandari
95. Hollow shafts economical – True
    Ref: Bhandari
96. Springs store strain energy – True
    Ref: Bhandari
97. Rolling bearings have less friction – True
    Ref: Bhandari
98. Key transmits torque – True
    Ref: Bhandari
99. Cam follower may be roller type – True
    Ref: Khurmi
100. Belt slip reduces velocity ratio – True
    Ref: Khurmi

UNIT IV: Theory of Machines & Design of Machine Elements

◆ BELT DRIVES – ADVANCED NUMERICALS

---

101. A flat belt has coefficient of friction 0.3 and angle of contact 180°. Ratio of belt tensions is:
A) 1.6
B) 2.56
C) 3.0
D) 4.0
Answer: B
Step-by-Step Solution:

$$T_1/T_2 = e^{\mu\theta}$$
$$\theta = 180° = \pi \text{ rad}$$
$$T_1/T_2 = e^{0.3\pi} \approx 2.56$$

Ref: Theory of Machines – R.S. Khurmi

---

102. If belt speed increases, centrifugal tension:
A) Increases linearly
B) Increases as square of speed
C) Decreases
D) Constant
Answer: B

$$T_c = mv^2$$

Ref: Khurmi

---

103. For maximum power transmission, belt speed is:
A) √(T/3m)
B) √(T/m)
C) T/m
D) m/T
Answer: A
Ref: Khurmi

---

104. If slip on driver = 2% and slip on driven = 3%, total slip is:
A) 2%
B) 3%
C) 5%
D) 6%
Answer: C
Concept Note:
Total slip ≈ sum of individual slips.
Ref: Khurmi

◆ GEAR TRAINS – ADVANCED NUMERICALS

---

105. A compound gear train has gears with teeth: 20 driving 40, and 15 driving 45. Overall velocity ratio is:
A) 4
B) 6
C) 3
D) 2
Answer: C

Step-by-Step Solution:

$$VR = \frac{40}{20} \times \frac{45}{15} = 2 \times 3 = 6$$

Since speed ratio is inverse of teeth ratio:

$$VR = 1/6 \rightarrow reduction 6:1$$

Correct overall ratio = 6
Ref: Khurmi

---

106. In epicyclic gear train, if arm is fixed, it behaves as:
A) Belt drive
B) Simple gear train
C) Chain drive
D) Cam
Answer: B
Ref: Khurmi

◆ **FLYWHEEL – NUMERICAL**

---

107. A flywheel has I = 100 kg·m². Speed fluctuates between 200 and 220 rpm. Maximum fluctuation of energy is approximately:
A) 4600 J
B) 2300 J
C) 9200 J
D) 10000 J
Answer: A
Step-by-Step Solution:
Convert rpm to rad/s:

$$\omega = \frac{2\pi N}{60}$$

Energy difference:

$$\Delta E = \frac{1}{2} I(\omega_2^2 - \omega_1^2)$$

Approximate value ≈ 4600 J
Ref: Theory of Machines – Khurmi

---

108. Coefficient of fluctuation of speed =

A) $(N_2 - N_1)/N$
B) $(N_1 + N_2)/N$
C) N_2/N_1
D) N_1/N_2
Answer: A
Ref: Khurmi

◆ GOVERNOR – NUMERICAL

---

109. A Watt governor runs at 300 rpm. Height is approximately:
A) 0.1 m
B) 0.2 m
C) 0.3 m
D) 0.4 m
Answer: A
Step-by-Step Solution:

$$h = \frac{g}{\omega^2}$$
$$\omega = \frac{2\pi \times 300}{60} = 31.4 \text{ rad/s}$$
$$h \approx \frac{9.81}{31.4^2} \approx 0.1m$$

Ref: Khurmi

---

110. If speed increases, governor balls move:
A) Downward
B) Upward
C) Same
D) Stop
Answer: B
Ref: Khurmi

◆ CAMS

---

111. Cam profile is determined by:
A) Follower motion
B) Shaft speed
C) Belt tension
D) Torque
Answer: A

Ref: Khurmi

---

112. Base circle of cam is smallest circle drawn from:
A) Follower
B) Shaft center
C) Cam nose
D) Pitch curve
Answer: B
Ref: Khurmi

◆ **SHAFT DESIGN – FULL NUMERICAL**

---

113. A shaft transmits 20 kW at 200 rpm. Allowable shear stress = 40 MPa. Required diameter is approximately:
A) 35 mm
B) 45 mm
C) 55 mm
D) 65 mm
Answer: B
Step-by-Step Solution:

$$T = \frac{P \times 60}{2\pi N}$$
$$T \approx 955Nm$$

Using:

$$T = \frac{\pi}{16}\tau D^3$$

Solve:

$$D \approx 45 \text{ mm}$$

Ref: Machine Design – V.B. Bhandari

---

114. For hollow shaft, torque capacity increases when:
A) Thickness decreases
B) Material removed from center
C) Diameter constant
D) Weight increases
Answer: B
Ref: Bhandari

◆ KEYS

115. Key length is designed based on:
A) Shear stress
B) Crushing stress
C) Both
D) None
Answer: C
Ref: Bhandari

◆ COUPLINGS

116. Muff coupling is:
A) Flexible
B) Rigid
C) Chain
D) Spring
Answer: B
Ref: Bhandari

◆ SPRINGS – NUMERICAL

117. A spring carries 500 N load. Wire dia = 10 mm, mean coil dia = 80 mm. Shear stress is approx:
A) 50 MPa
B) 100 MPa
C) 200 MPa
D) 25 MPa
Answer: B
Step-by-Step Solution:

$$\tau = \frac{8PD}{\pi d^3}$$
$$\tau \approx 100MPa$$

Ref: Machine Design – Bhandari

118. Spring stiffness increases when:
A) Coil diameter increases
B) Wire diameter increases

C) Turns increase
D) Load increases
Answer: B

$$k \propto d^4$$

Ref: Bhandari

◆ BEARINGS – DESIGN

---

119. Static load rating of bearing depends on:
A) Material
B) Size
C) Both
D) None
Answer: C
Ref: Machine Design – Bhandari

---

120. Rolling bearings are preferred for:
A) High friction
B) High speed
C) Heavy sliding
D) Welding
Answer: B
Ref: Bhandari

◆ QUICK REVISION

---

121. Belt thickness increases effective diameter – True
Ref: Khurmi
122. Slip reduces speed ratio – True
Ref: Khurmi
123. Idler gear changes direction only – True
Ref: Khurmi
124. Flywheel stores kinetic energy – True
Ref: Khurmi
125. Governor controls speed variation – True
Ref: Khurmi
126. SHM cam gives infinite jerk – False
Ref: Khurmi

127. Shaft diameter proportional to cube root of torque – True
Ref: Bhandari
128. Hollow shafts save material – True
Ref: Bhandari
129. Key may fail in shear – True
Ref: Bhandari
130. Riveted joints heavier than welded – True
Ref: Bhandari
131. Weld efficiency < 100% – True
Ref: Bhandari
132. Spring stores strain energy – True
Ref: Bhandari
133. Rolling friction < sliding friction – True
Ref: Bhandari
134. Watt governor suitable for high speed – False
Ref: Khurmi
135. Cycloidal cam motion gives smooth acceleration – True
Ref: Khurmi
136. Power in shaft proportional to torque and speed – True
Ref: Bhandari
137. Belt tension ratio independent of speed – True
Ref: Khurmi
138. Rivet in double shear stronger than single shear – True
Ref: Bhandari
139. Bearings reduce wear – True
Ref: Bhandari
140. Flexible coupling absorbs shock – True
Ref: Bhandari

◆ EPICYCLIC GEAR TRAIN – NUMERICAL FOCUS

---

141. In an epicyclic gear train, if sun gear has 20 teeth and planet gear has 30 teeth, the ring gear teeth are:

A) 40
B) 60
C) 70
D) 80

Answer: D

Step-by-Step Solution:

For epicyclic gear train:

$$T_r = T_s + 2T_p$$
$$T_r = 20 + 2(30) = 80$$

Ref: Theory of Machines – R.S. Khurmi

---

142. If sun gear is fixed and arm rotates, ring gear speed depends on:

A) Arm speed
B) Sun teeth
C) Ring teeth
D) All

Answer: D

Ref: Khurmi

---

143. In epicyclic gear train, when arm is fixed, system reduces to:

A) Belt drive
B) Simple gear train
C) Chain drive
D) Cam

Answer: B

Ref: Khurmi

- **FLYWHEEL – DESIGN TYPE**

---

144. Maximum fluctuation of energy equals:

A) Work done per cycle
B) Change in kinetic energy
C) Mean speed
D) Torque

Answer: B

$$\Delta E = \frac{1}{2} I(\omega_1^2 - \omega_2^2)$$

Ref: Khurmi

---

145. If coefficient of fluctuation of speed decreases, flywheel size must:

A) Decrease
B) Increase
C) Same
D) Zero

Answer: B

Concept Note:
Smaller fluctuation → higher inertia required.
Ref: Khurmi

---

146. A flywheel of mass 500 kg, radius 0.5 m, speed 300 rpm. Moment of inertia (rim type) ≈

A) 62.5 kg·m²
B) 125 kg·m²
C) 250 kg·m²
D) 500 kg·m²

Answer: B

$$I = mr^2 = 500 \times 0.5^2 = 125$$

Ref: Khurmi

- **GOVERNOR – ADVANCED**

---

147. In Porter governor, additional force is due to:

A) Flywheel
B) Spring
C) Central load
D) Cam

Answer: C

Ref: Khurmi

---

148. Governor is said to be stable when:

A) Speed decreases with radius
B) Speed increases with radius
C) Speed constant
D) Radius zero

Answer: B

Ref: Khurmi

---

149. Isochronous governor has:

A) Infinite sensitivity
B) Zero sensitivity
C) Low speed
D) Slip

Answer: A

Ref: Khurmi

- **CAM DESIGN**

---

150. Maximum pressure angle for cams should not exceed:

A) 10°
B) 30°
C) 60°
D) 90°

Answer: B

Ref: Theory of Machines – Khurmi

---

151. Cam with uniform velocity gives:

A) Infinite acceleration at ends
B) Smooth acceleration
C) Zero jerk
D) No motion

Answer: A

Ref: Khurmi

◆ **SHAFT DESIGN – ADVANCED NUMERICAL**

---

152. A shaft transmits 30 kW at 300 rpm. Allowable shear stress 50 MPa. Diameter approx:

A) 35 mm
B) 40 mm
C) 45 mm
D) 50 mm

Answer: C

Step-by-Step Solution:

$$T = \frac{P \times 60}{2\pi N}$$
$$T \approx 955Nm$$
$$T = \frac{\pi}{16}\tau D^3 \Rightarrow D \approx 45mm$$

Ref: Machine Design – V.B. Bhandari

---

153. Equivalent bending moment for shaft is:

A) $\sqrt{(M^2 + T^2)}$
B) M + T
C) MT
D) T/M

Answer: A

Ref: Bhandari

◆ KEYS

---

154. A key 10 mm wide, 8 mm thick transmits torque 500 Nm on 40 mm shaft. Failure likely in:

A) Shear
B) Crushing
C) Bending
D) Slip

Answer: A

Ref: Bhandari

◆ COUPLINGS

---

155. Flange coupling bolts are subjected to:

A) Shear
B) Tension
C) Bending
D) Compression

Answer: A

Ref: Bhandari

◆ SPRINGS – DESIGN NUMERICAL

---

156. A spring with 10 active coils, wire dia 8 mm, mean dia 64 mm, load 400 N. Deflection approx:

A) 10 mm
B) 20 mm

C) 30 mm
D) 40 mm

Answer: B

$$\delta = \frac{8PD^3n}{Gd^4}$$

Approximate result ≈ 20 mm

Ref: Machine Design – Bhandari

---

157. Spring stiffness increases when:

A) Number of coils increases
B) Mean diameter increases
C) Wire diameter increases
D) Load decreases

Answer: C

Ref: Bhandari

◆ **BEARINGS – LIFE CALCULATION**

---

158. Basic dynamic load rating relates to:

A) Static load
B) Bearing life
C) Friction
D) Speed

Answer: B

Ref: Bhandari

---

159. Bearing life in million revolutions is proportional to:

A) (C/P)
B) $(C/P)^3$

C) $(P/C)^3$
D) C+P

Answer: B

Ref: Bhandari

---

160. If load doubles, bearing life becomes:

A) Same
B) 1/8
C) 1/2
D) Double

Answer: B

$$L \propto (1/P)^3$$

Ref: Bhandari

◆ RIVETED & WELDED JOINT DESIGN

---

161. In double riveted lap joint, rivets are in:

A) One row
B) Two rows
C) Zig-zag
D) None

Answer: B

Ref: Bhandari

---

162. Weld strength =

A) Throat area × allowable stress
B) Leg area × stress
C) Plate area
D) Bolt area

Answer: A

Ref: Bhandari

---

163. Welded joints are preferred over riveted because:

A) Stronger
B) Lighter
C) No drilling
D) All

Answer: D

Ref: Bhandari

◆ QUICK REVISION

---

164. Epicyclic trains provide high reduction in compact space – True
Ref: Khurmi

165. Flywheel reduces speed fluctuation – True
Ref: Khurmi

166. Governor maintains mean speed – True
Ref: Khurmi

167. SHM cam gives smooth motion – True
Ref: Khurmi

168. Shaft diameter proportional to cube root of torque – True
Ref: Bhandari

169. Key prevents relative rotation – True
Ref: Bhandari

170. Flange coupling is rigid – True
Ref: Bhandari

171. Rolling bearing friction less than sliding – True
Ref: Bhandari

172. Spring stress increases with load – True
Ref: Bhandari

173. Bearing life inversely proportional to cube of load – True
Ref: Bhandari

174. Belt slip reduces power transmission – True
Ref: Khurmi

175. Compound gear train multiplies ratios – True
Ref: Khurmi

176. Flywheel does not control mean speed – True
Ref: Khurmi

177. Isochronous governor has zero range of speed – True
Ref: Khurmi

178. Cam dwell means no follower motion – True
Ref: Khurmi

179. Riveted joint efficiency always < 100% – True
Ref: Bhandari

180. Spring index = D/d – True
Ref: Bhandari

◆ BELT DRIVE – ADVANCED MIXED

---

181. A belt transmits 5 kW at 10 m/s. If tight side tension is 800 N, slack side tension is:
A) 300 N
B) 200 N
C) 100 N
D) 400 N
Answer: A
Step-by-Step Solution:

$$P = (T_1 - T_2)v$$
$$5000 = (800 - T_2) \times 10$$
$$800 - T_2 = 500 \Rightarrow T_2 = 300N$$

Ref: Theory of Machines – R.S. Khurmi

---

182. If centrifugal tension increases, effective tension for power transmission:
A) Increases
B) Decreases

C) Same
D) Zero
Answer: B
Concept Note:
Effective tension = $T_1 - T_2$ reduces due to centrifugal component.
Ref: Khurmi

◆ GEAR TRAINS – FINAL APPLICATION

---

183. In simple gear train with 4 gears including 2 idlers, overall speed ratio depends on:
A) All gears
B) First and last gears
C) Idlers only
D) Shaft distance
Answer: B
Ref: Khurmi

---

184. In compound gear train, if first stage ratio is 4:1 and second stage is 3:1, total reduction is:
A) 7:1
B) 12:1
C) 1:12
D) 1:7
Answer: B

$$VR = 4 \times 3 = 12$$

Ref: Khurmi

◆ FLYWHEEL – DESIGN PROBLEM

---

185. A machine requires 2000 J fluctuation energy. If mean speed is 300 rpm and C_s = 0.02, required I is approx:
A) 5 kg·m²
B) 10 kg·m²
C) 20 kg·m²
D) 40 kg·m²
Answer: B
Step-by-Step Solution:

$$\Delta E = I\omega^2 C_s$$

$$\omega = \frac{2\pi \times 300}{60} \approx 31.4$$
$$2000 = I \times (31.4)^2 \times 0.02$$
$$I \approx 10$$

Ref: Theory of Machines – Khurmi

---

186. Flywheel mass increases when:
A) Speed increases
B) Fluctuation allowed decreases
C) Power decreases
D) Torque zero
Answer: B
Ref: Khurmi

◆ **GOVERNOR – NUMERICAL**

---

187. A Watt governor has height 0.2 m. Speed is approx:
A) 100 rpm
B) 150 rpm
C) 200 rpm
D) 250 rpm
Answer: C
Step-by-Step Solution:

$$h = \frac{g}{\omega^2} \Rightarrow \omega = \sqrt{\frac{g}{h}}$$
$$\omega \approx 7rad/s \Rightarrow N \approx 200rpm$$

Ref: Khurmi

---

188. Sensitivity of governor increases when:
A) Speed range increases
B) Speed range decreases
C) Height decreases
D) Weight increases
Answer: B
Ref: Khurmi

◆ **CAMS – FINAL APPLICATION**

---

189. For high-speed engine cams, best motion law is:
A) Uniform velocity
B) SHM
C) Cycloidal
D) None
Answer: C
Ref: Khurmi

---

190. Pressure angle too high causes:
A) Smooth motion
B) Excessive side thrust
C) Zero jerk
D) Less wear
Answer: B
Ref: Khurmi

◆ SHAFT + KEY COMBINED DESIGN

---

191. A shaft 50 mm diameter transmits torque. If key width increases, shear stress in key:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: B

$$\tau = \frac{2T}{bLD}$$

Increasing width reduces stress.
Ref: Machine Design – Bhandari

---

192. Equivalent twisting moment for shaft under M and T is:
A) M + T
B) $\sqrt{(M^2 + T^2)}$
C) MT
D) M - T
Answer: B
Ref: Bhandari

◆ SPRING – FINAL NUMERICAL

---

193. A spring carries 1000 N. Wire dia doubles. Stress becomes:
A) Same
B) Half
C) One-fourth
D) One-eighth
Answer: D

$$\tau \propto \frac{1}{d^3}$$

Doubling d:

$$\tau_{new} = \frac{1}{8}\tau$$

Ref: Bhandari

---

194. Energy stored in spring equals:
A) $\frac{1}{2} kx^2$
B) kx
C) x/k
D) $2kx^2$
Answer: A
Ref: Bhandari

◆ **BEARINGS – ADVANCED**

---

195. Bearing life L_{10} means:
A) 10% fail
B) 90% survive
C) 100% survive
D) 50% fail
Answer: B
Ref: Machine Design – Bhandari

---

196. Static load rating important for:
A) High speed
B) Shock load
C) Low load
D) Cam
Answer: B
Ref: Bhandari

◆ WELDED JOINT DESIGN

197. Strength of butt weld equals:
A) Plate strength
B) Throat area × stress
C) Bolt strength
D) None
Answer: B
Ref: Bhandari

198. Double fillet weld stronger than single because:
A) Double area
B) Double stress
C) Less stress
D) None
Answer: A
Ref: Bhandari

◆ RIVETED JOINT DESIGN

199. Rivet in double shear carries:
A) P
B) P/2
C) 2P
D) Zero
Answer: C
Ref: Bhandari

200. Crushing stress in rivet =
A) P / (d × t)
B) P / A
C) P / L
D) None
Answer: A
Ref: Bhandari

◆ FINAL CONSOLIDATION

201. Slip reduces belt efficiency – True
Ref: Khurmi
202. Compound gear train multiplies speed ratios – True
Ref: Khurmi
203. Epicyclic train has moving axes – True
Ref: Khurmi
204. Flywheel stores rotational energy – True
Ref: Khurmi
205. Governor controls speed, not energy – True
Ref: Khurmi
206. SHM cam has finite acceleration – True
Ref: Khurmi
207. Cycloidal cam gives zero jerk at ends – True
Ref: Khurmi
208. Shaft diameter $\propto$ cube root of torque – True
Ref: Bhandari
209. Hollow shaft saves weight – True
Ref: Bhandari
210. Key may fail in crushing – True
Ref: Bhandari
211. Flexible coupling absorbs misalignment – True
Ref: Bhandari
212. Rolling bearing life $\propto (C/P)^3$ – True
Ref: Bhandari
213. Spring stiffness $\propto d^4$ – True
Ref: Bhandari
214. Belt thickness affects velocity ratio – True
Ref: Khurmi
215. Idler gear does not affect speed ratio – True
Ref: Khurmi
216. Maximum power when $T_c = T/3$ – True
Ref: Khurmi
217. Flywheel size increases when fluctuation allowed small – True
Ref: Khurmi
218. Governor stability requires increasing speed with radius – True
Ref: Khurmi
219. Welded joints lighter than riveted – True
Ref: Bhandari
220. Bearing reduces friction and wear – True
Ref: Bhandari

Unit V: Thermodynamics and Heat Power Engineering

PERFECT GAS LAWS

---

1. Boyle's Law states that for a fixed mass of gas at constant temperature:

A) PV = constant
B) $\frac{V}{T}$ = constant
C) $\frac{P}{T}$ = constant
D) PT = constant
Answer: A
Concept Clarity Note:
Boyle's Law states that pressure is inversely proportional to volume at constant temperature:

$$PV = \text{constant}$$

Ref: R.S. Khurmi & J.K. Gupta – *Thermal Engineering*

---

2. Charles' Law states that at constant pressure:

A) PV = constant
B) $\frac{V}{T}$ = constant
C) $\frac{P}{T}$ = constant
D) PT = constant
Answer: B

$$\frac{V}{T} = \text{constant}$$

Ref: Khurmi

---

3. Gay-Lussac's Law states that at constant volume:

A) $\frac{P}{T}$ = constant
B) $\frac{V}{T}$ = constant
C) PV = constant
D) P = constant
Answer: A

$$\frac{P}{T} = \text{constant}$$

Ref: Khurmi

4. The characteristic gas equation is:
A) $PV = nRT$
B) $PV = mRT$
C) $P = mRT$
D) $T = \frac{PV}{R}$
Answer: B

$$PV = mRT$$

Concept Clarity Note:
This equation relates pressure, volume, temperature, and gas constant for ideal gas.
Ref: P.K. Nag – *Engineering Thermodynamics*

5. The relation between specific heats is:
A) $C_p = C_v + R$
B) $C_v = C_p + R$
C) $R = C_p + C_v$
D) $C_p = R - C_v$
Answer: A

$$C_p - C_v = R$$

Ref: P.K. Nag

6. For air, the value of $\gamma$is approximately:
A) 1.2
B) 1.3
C) 1.4
D) 1.67
Answer: C

$$\gamma = \frac{C_p}{C_v} \approx 1.4$$

Ref: Khurmi

THERMODYNAMIC PROCESSES

7. In an isobaric process, which parameter remains constant?

A) Pressure
B) Volume
C) Temperature
D) Entropy
Answer: A

$$P = \text{constant}$$

Ref: P.K. Nag

---

8. Work done in an isobaric process is:
A) $W = 0$
B) $W = P(V_2 - V_1)$
C) $W = mRT\ln\left(\frac{V_2}{V_1}\right)$
D) $W = \frac{P_1V_1 - P_2V_2}{\gamma - 1}$
Answer: B

$$W = P(V_2 - V_1)$$

Ref: P.K. Nag

---

9. In an isochoric process:
A) $V = \text{constant}$
B) $P = \text{constant}$
C) $T = \text{constant}$
D) $PV = \text{constant}$
Answer: A

$$V = \text{constant}$$

Ref: Khurmi

---

10. Work done in isochoric process is:
A) Maximum
B) Minimum
C) Zero
D) Infinite
Answer: C
Since volume does not change:

$$W = \int PdV = 0$$

Ref: P.K. Nag

---

11. In an isothermal process:
A) T = constant
B) P = constant
C) V = constant
D) PV^{γ} = constant
Answer: A

---

12. Work done in isothermal expansion is:
A) $W = mRT\ln\left(\frac{V_2}{V_1}\right)$
B) $W = P(V_2 - V_1)$
C) $W = 0$
D) $W = \frac{P_1V_1 - P_2V_2}{\gamma - 1}$
Answer: A

$$W = mRT\ln\left(\frac{V_2}{V_1}\right)$$

Ref: P.K. Nag

---

13. In adiabatic process:
A) $Q = 0$
B) T = constant
C) V = constant
D) P = constant
Answer: A

$$Q = 0$$

Ref: P.K. Nag

---

14. Relation for adiabatic process is:
A) PV = constant
B) PV^{γ} = constant
C) P = constant
D) V = constant
Answer: B

---

15. Work done in adiabatic process is:

A) $\frac{P_1V_1-P_2V_2}{\gamma-1}$
B) $mRT\ln\left(\frac{V_2}{V_1}\right)$
C) 0
D) PV
Answer: A

🔢 NUMERICAL SECTION

---

16. A gas expands isothermally from 0.2 m³ to 0.4 m³ at 300 K. If $mR = 200$, work done is:
A) 41580 J
B) 27720 J
C) 20000 J
D) 13860 J
Answer: B
Step-by-Step Solution:

$$W = mRT\ln\left(\frac{V_2}{V_1}\right)$$
$$= 200 \times 300 \times \ln(2)$$
$$= 60000 \times 0.693$$
$$\approx 27720 \text{ J}$$

Ref: P.K. Nag

---

17. In adiabatic compression from 1 bar to 16 bar, $\gamma = 1.4$, compression ratio is:
A) 2
B) 4
C) 8
D) 16
Answer: B

$$r = \left(\frac{P_2}{P_1}\right)^{1/\gamma}$$
$$r = 16^{1/1.4} \approx 4$$

Ref: Khurmi

---

18. For polytropic process:
A) PV^n = constant
B) PV = constant

C) $PV^{\gamma} =$ constant
D) $P =$ constant
Answer: A

---

19. For isothermal process, polytropic index $n$equals:
A) 0
B) 1
C) γ
D) Infinity
Answer: B

---

20. For adiabatic process, polytropic index $n$equals:
A) 1
B) 0
C) γ
D) 2
Answer: C

P–V DIAGRAM CHARACTERISTICS

---

21. In P–V diagram, isothermal curve is:
A) Steeper than adiabatic
B) Less steep than adiabatic
C) Straight line
D) Vertical line
Answer: B
Concept Clarity Note:
Adiabatic curve is steeper than isothermal.
Ref: P.K. Nag

---

22. Area under P–V curve represents:
A) Heat
B) Work
C) Internal energy
D) Entropy
Answer: B

Air Standard Cycles (Otto, Diesel, Dual) + P–V & T–S Analysis

---

OTTO CYCLE

---

23. Otto cycle consists of how many processes?

A) 2
B) 3
C) 4
D) 5

Answer: C

Concept Clarity Note:

Otto cycle has 4 processes:
1–2 Adiabatic compression
2–3 Constant volume heat addition
3–4 Adiabatic expansion
4–1 Constant volume heat rejection

Ref: R.S. Khurmi – *Thermal Engineering*

---

24. Heat addition in Otto cycle occurs at:

A) Constant pressure
B) Constant temperature
C) Constant volume
D) Adiabatic

Answer: C

---

25. Efficiency of Otto cycle is:

A) $\eta = 1 - \frac{1}{r}$
B) $\eta = 1 - \frac{1}{r^{\gamma-1}}$
C) $\eta = 1 - r^{\gamma-1}$
D) $\eta = \frac{1}{r^{\gamma-1}}$

Answer: B

$$\eta_{Otto} = 1 - \frac{1}{r^{\gamma-1}}$$

Ref: Khurmi

---

26. If compression ratio increases, Otto efficiency:

A) Decreases
B) Increases
C) Constant
D) Zero

Answer: B

---

27. For $r = 10, \gamma = 1.4$, efficiency is approximately:
A) 50%
B) 55%
C) 60%
D) 65%
Answer: C

$$\eta = 1 - \frac{1}{10^{0.4}}$$
$$= 1 - \frac{1}{2.51}$$
$$\approx 0.60$$

Ref: Khurmi

---

28. In T–S diagram, heat addition in Otto cycle appears as:
A) Vertical line
B) Horizontal line
C) Sloping curve
D) Parabola
Answer: A
Concept Clarity Note:
Constant volume process → vertical line in T–S diagram.
Ref: P.K. Nag

DIESEL CYCLE

---

29. Heat addition in Diesel cycle occurs at:
A) Constant volume
B) Constant pressure
C) Constant temperature
D) Adiabatic
Answer: B

---

30. Diesel cycle efficiency is:
A) $1 - \frac{1}{r^{\gamma-1}}$
B) $1 - \frac{1}{r}$

C) $1 - \frac{1}{r^{\gamma-1}} \cdot \frac{\rho^{\gamma}-1}{\gamma(\rho-1)}$
D) $1 - \rho$
Answer: C

$$\eta_{Diesel} = 1 - \frac{1}{r^{\gamma-1}} \cdot \frac{\rho^{\gamma}-1}{\gamma(\rho-1)}$$

Where ρ= cut-off ratio
Ref: Khurmi

---

31. Diesel cycle efficiency decreases with increase in:
A) Compression ratio
B) Cut-off ratio
C) Specific heat ratio
D) Pressure
Answer: B

---

32. For same compression ratio, which cycle is more efficient?
A) Diesel
B) Otto
C) Both same
D) Dual
Answer: B
Concept Clarity Note:
Constant volume heat addition (Otto) produces higher efficiency.
Ref: Khurmi

DUAL CYCLE

---

33. Dual cycle combines features of:
A) Carnot & Otto
B) Otto & Diesel
C) Brayton & Diesel
D) Rankine & Otto
Answer: B

---

34. Heat addition in Dual cycle occurs:
A) At constant pressure only
B) At constant volume only
C) Part at constant volume and part at constant pressure
D) Adiabatically

Answer: C

NUMERICALS – OTTO CYCLE

---

35. An Otto cycle has compression ratio 8. If $\gamma = 1.4$, efficiency is:

A) 50%

B) 56%

C) 60%

D) 65%

Answer: B

$$\eta = 1 - \frac{1}{8^{0.4}}$$
$$= 1 - \frac{1}{2.29}$$
$$\approx 0.56$$

Ref: Khurmi

---

36. If compression ratio doubles, Otto efficiency:

A) Halves

B) Increases

C) Decreases

D) Same

Answer: B

NUMERICAL – DIESEL CYCLE

---

37. In Diesel cycle, if cut-off ratio increases, efficiency:

A) Increases

B) Decreases

C) Same

D) Infinite

Answer: B

---

38. If compression ratio is very high, Diesel engine efficiency compared to Otto at same r is:

A) Higher

B) Lower

C) Same

D) Zero

Answer: B

P–V DIAGRAM ANALYSIS

39. In P–V diagram, adiabatic curve is:
A) Less steep than isothermal
B) More steep than isothermal
C) Straight line
D) Horizontal
Answer: B

40. Area enclosed by cycle on P–V diagram represents:
A) Heat supplied
B) Work output
C) Internal energy
D) Entropy
Answer: B

TEMPERATURE RELATIONS

41. In adiabatic compression:
A) Temperature decreases
B) Temperature constant
C) Temperature increases
D) Zero
Answer: C

42. Relation for adiabatic temperature change is:
A) $TV^{\gamma-1} =$ constant
B) $PV =$ constant
C) $T =$ constant
D) $P =$ constant
Answer: A

ENGINE COMPARISON

43. Two-stroke engine gives power stroke every:
A) One revolution
B) Two revolutions
C) Four revolutions
D) Half revolution

Answer: A

---

44. Four-stroke engine gives power stroke every:
A) One revolution
B) Two revolutions
C) Four revolutions
D) None
Answer: B

---

45. Diesel engines have higher efficiency because of:
A) Lower compression ratio
B) Higher compression ratio
C) Spark plug
D) Carburetor
Answer: B

---

46. Petrol engine uses:
A) Spark ignition
B) Compression ignition
C) Self ignition
D) None
Answer: A

ENGINE PERFORMANCE

---

47. Brake Power is given by:

$$BP = \frac{2\pi NT}{60}$$

Correct option is:
A) True
B) False
C) Only for Diesel
D) Only for Petrol
Answer: A
Ref: Khurmi

---

48. If torque = 200 Nm and speed = 3000 rpm, BP is approximately:
A) 31 kW
B) 62 kW

C) 94 kW
D) 125 kW
Answer: B

$$BP = \frac{2\pi NT}{60}$$
$$= \frac{2\pi \times 3000 \times 200}{60}$$
$$\approx 62\ \text{kW}$$

---

49. Mechanical efficiency =
A) $\frac{IP}{BP}$
B) $\frac{BP}{IP}$
C) $\frac{FP}{IP}$
D) $\frac{IP}{FP}$
Answer: B

---

50. If IP = 100 kW and BP = 80 kW, friction power is:
A) 10 kW
B) 15 kW
C) 20 kW
D) 25 kW
Answer: C

$$FP = IP - BP = 20$$

AIR COMPRESSORS

---

51. Work done in isothermal compression is:
A) Maximum
B) Minimum
C) Same as adiabatic
D) Zero
Answer: B

---

52. Multistage compression with intercooling reduces:
A) Work input
B) Speed

C) Pressure
D) Temperature only
Answer: A

---

53. Ideal intercooling means:
A) No cooling
B) Cooling to inlet temperature
C) Heating
D) Zero pressure
Answer: B

---

54. Volumetric efficiency decreases when:
A) Clearance increases
B) Clearance decreases
C) Pressure decreases
D) Temperature decreases
Answer: A

---

55. Compressor work is minimum when process is:
A) Adiabatic
B) Isothermal
C) Polytropic
D) Isochoric
Answer: B

GAS TURBINES

---

56. Gas turbine works on:
A) Otto cycle
B) Diesel cycle
C) Brayton cycle
D) Rankine cycle
Answer: C

---

57. Heat addition in Brayton cycle occurs at:
A) Constant volume
B) Constant pressure
C) Adiabatic
D) Constant temperature
Answer: B

58. Main components of gas turbine are:
A) Compressor, Combustor, Turbine
B) Boiler, Turbine, Condenser
C) Carburetor
D) Flywheel
Answer: A

59. Thermal efficiency of Brayton cycle increases with:
A) Pressure ratio
B) Cut-off ratio
C) Volume
D) Temperature drop
Answer: A

60. Jet propulsion works on principle of:
A) Newton's First Law
B) Newton's Second Law
C) Newton's Third Law
D) Carnot Law
Answer: C

OTTO CYCLE – ADVANCED NUMERICALS

61. An Otto cycle has compression ratio $r = 9$and $\gamma = 1.4$. Efficiency is approximately:
A) 52%
B) 56%
C) 60%
D) 63%
Answer: C
Step-by-Step Solution:

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$
$$= 1 - \frac{1}{9^{0.4}}$$
$$9^{0.4} \approx 2.41$$
$$\eta = 1 - \frac{1}{2.41} \approx 1 - 0.415 \approx 0.585 \approx 60\%$$

Ref: R.S. Khurmi – *Thermal Engineering*

62. If compression ratio increases from 8 to 16, Otto efficiency:
A) Decreases
B) Remains same
C) Increases
D) Zero
Answer: C

---

63. In Otto cycle, maximum pressure occurs at:
A) End of compression
B) End of heat addition
C) End of expansion
D) Start of compression
Answer: B
Concept Clarity Note:
After constant volume heat addition, pressure is maximum.
Ref: P.K. Nag

DIESEL CYCLE – NUMERICALS

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64. A Diesel cycle has compression ratio $r = 15$, cut-off ratio $\rho = 2, \gamma = 1.4$. Efficiency depends on:
A) $r$only
B) ρonly
C) Both $r$and ρ
D) None
Answer: C

---

65. If cut-off ratio increases, Diesel efficiency:
A) Increases
B) Decreases
C) Same
D) Infinite
Answer: B

---

66. For same compression ratio, efficiency order is:
A) Diesel > Otto > Dual
B) Otto > Dual > Diesel
C) Dual > Diesel > Otto
D) Same
Answer: B

Concept Clarity Note:
Constant volume heat addition (Otto) gives highest efficiency.
Ref: Khurmi

DUAL CYCLE – CONCEPT

---

67. Dual cycle efficiency lies between:
A) Otto & Diesel
B) Diesel & Carnot
C) Otto & Carnot
D) Rankine & Brayton
Answer: A

---

68. If heat added at constant volume portion increases, Dual cycle efficiency:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: A

IC ENGINE PERFORMANCE

---

69. Indicated Power (IP) is calculated using:
A) $IP = \frac{P_m LAN}{60}$
B) $BP = \frac{2\pi NT}{60}$
C) $IP = BP - FP$
D) None
Answer: A
Where P_m= mean effective pressure
Ref: Khurmi

---

70. Mean effective pressure is defined as:
A) Maximum pressure
B) Average cylinder pressure
C) Hypothetical constant pressure producing same work
D) Atmospheric pressure
Answer: C

---

71. If $IP = 120$ kWand $BP = 100$ kW, friction power is:

A) 10 kW
B) 15 kW
C) 20 kW
D) 25 kW
Answer: C

$$FP = IP - BP = 20$$

---

72. Mechanical efficiency is:

$$\eta_m = \frac{BP}{IP}$$

Correct answer:
A) True
B) False
C) Only Diesel
D) Only Petrol
Answer: A

---

73. Brake thermal efficiency is:
A) $\frac{BP}{\text{Heat supplied}}$
B) $\frac{IP}{\text{Heat supplied}}$
C) $\frac{FP}{\text{Heat supplied}}$
D) None
Answer: A

AIR COMPRESSOR – WORK CALCULATIONS

---

74. Work done in isothermal compression is:

$$W = mRT \ln\left(\frac{P_2}{P_1}\right)$$

Correct answer:
A) True
B) False
Answer: A

---

75. For adiabatic compression, work done is:

$$W = \frac{\gamma}{\gamma - 1} P_1 V_1 \left[\left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} - 1 \right]$$

Correct option:
A) True
B) False
Answer: A

---

76. Multistage compression reduces:
A) Power required
B) Pressure ratio
C) Temperature
D) Speed
Answer: A

---

77. Ideal intermediate pressure for minimum work is:

$$P_i = \sqrt{P_1 P_2}$$

Correct option:
A) True
B) False
Answer: A

---

78. Volumetric efficiency decreases with increase in:
A) Clearance volume
B) Speed
C) Pressure ratio
D) Both A and C
Answer: D

NUMERICAL – COMPRESSOR

---

79. Air is compressed isothermally from 1 bar to 5 bar. If $mRT = 1000$, work done is:
A) 1609 J
B) 2000 J
C) 5000 J
D) 800 J
Answer: A

$$W = mRT\ln\left(\frac{5}{1}\right)$$
$$= 1000 \times \ln(5)$$
$$= 1000 \times 1.609$$
$$= 1609 \text{ J}$$

GAS TURBINES – BRAYTON CYCLE

---

80. Brayton cycle consists of:

A) Two adiabatic & two constant pressure processes

B) Two constant volume processes

C) Two isothermal processes

D) None

Answer: A

---

81. Thermal efficiency of Brayton cycle is:

$$\eta = 1 - \frac{1}{r_p^{(\gamma-1)/\gamma}}$$

Where r_p= pressure ratio

Correct option:

A) True

B) False

Answer: A

---

82. Increasing pressure ratio in Brayton cycle increases:

A) Efficiency

B) Work

C) Fuel

D) Loss

Answer: A

---

83. In gas turbine, compressor consumes approximately:

A) 10% turbine power

B) 30% turbine power

C) 50–60% turbine power

D) 90%

Answer: C

Ref: P.K. Nag

JET PROPULSION

84. Thrust produced by jet engine is given by:

$$F = \dot{m}(V_e - V_0)$$

Correct option:
A) True
B) False
Answer: A

85. Jet engine works on:
A) Reaction principle
B) Expansion principle
C) Compression principle
D) Condensation principle
Answer: A

86. Specific impulse is:
A) Thrust per unit mass flow rate
B) Thrust per unit fuel consumption
C) Work
D) Power
Answer: B

87. Ramjet engine has:
A) Compressor
B) Turbine
C) No moving parts
D) Flywheel
Answer: C

ADVANCED NUMERICAL – BRAKE POWER

88. If torque = 150 Nm and speed = 2500 rpm, BP is approx:
A) 25 kW
B) 39 kW
C) 50 kW
D) 60 kW
Answer: B

$$BP = \frac{2\pi NT}{60}$$
$$= \frac{2\pi \times 2500 \times 150}{60}$$
$$\approx 39 \text{ kW}$$

---

89. If fuel supplied = 0.02 kg/s and calorific value = 42000 kJ/kg, heat supplied is:
A) 840 kW
B) 420 kW
C) 210 kW
D) 100 kW
Answer: A

$$\dot{Q} = \dot{m} \times CV$$
$$= 0.02 \times 42000 = 840 \text{ kW}$$

---

90. Brake thermal efficiency is:

$$\eta_{bth} = \frac{BP}{\dot{m}_f \times CV}$$

Correct option:
A) True
B) False
Answer: A

CONCEPTUAL TRAPS

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91. Diesel engines operate at higher compression ratio than petrol – True
    Ref: Ganesan
92. Otto cycle represents petrol engine – True
    Ref: Khurmi
93. Adiabatic curve steeper than isothermal – True
    Ref: P.K. Nag
94. Compressor work minimum for isothermal – True
    Ref: Nag
95. Gas turbine works on Brayton cycle – True
    Ref: Ganesan
96. Jet propulsion follows Newton's third law – True
    Ref: Ganesan

97. Indicated power > Brake power – True
Ref: Khurmi
98. Mechanical efficiency < 1 – True
Ref: Khurmi
99. Clearance reduces volumetric efficiency – True
Ref: Khurmi
100. Intercooling reduces compressor work – True
Ref: Nag
101. In Diesel cycle, heat added at constant pressure – True
Ref: Khurmi
102. Dual cycle combines Otto and Diesel – True
Ref: Khurmi
103. Otto efficiency depends only on compression ratio – True
Ref: Khurmi
104. Diesel efficiency depends on cut-off ratio – True
Ref: Khurmi
105. In Brayton cycle, heat addition at constant pressure – True
Ref: Nag
106. Ramjet has no compressor – True
Ref: Ganesan
107. Higher compression ratio increases thermal efficiency – True
Ref: Khurmi
108. Specific heat ratio affects cycle efficiency – True
Ref: Nag
109. P–V area represents work – True
Ref: Nag
110. Work done in isochoric process is zero – True
Ref: Nag
111. Indicated mean effective pressure used in IP calculation – True
Ref: Khurmi
112. Brake power measured using dynamometer – True
Ref: Khurmi
113. Polytropic index equals 1 for isothermal – True
Ref: Nag
114. Polytropic index equals γ for adiabatic – True
Ref: Nag
115. Heat rejection in Otto occurs at constant volume – True
Ref: Khurmi
116. Cut-off ratio affects Diesel efficiency – True
Ref: Khurmi

117. Brayton efficiency increases with pressure ratio – True
Ref: Nag
118. Jet thrust proportional to mass flow rate – True
Ref: Ganesan
119. Compressor volumetric efficiency decreases with pressure ratio – True
Ref: Khurmi
120. Two-stroke engine produces more power per cycle than four-stroke – True
Ref: Ganesan

Advanced Cycles, Engine Power Calculations, Compressors, Gas Turbines & Jet Propulsion

---

OTTO CYCLE – ADVANCED NUMERICALS

---

121. An Otto cycle has compression ratio $r = 12, \gamma = 1.4$. Efficiency is approximately:
A) 55%
B) 60%
C) 63%
D) 68%
Answer: C
Step-by-Step Solution:

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$
$$= 1 - \frac{1}{12^{0.4}}$$
$$12^{0.4} \approx 2.70$$
$$\eta = 1 - \frac{1}{2.70}$$
$$\approx 1 - 0.37 = 0.63 = 63\%$$

Ref: R.S. Khurmi – *Thermal Engineering*

---

122. For same compression ratio, which cycle gives highest efficiency?
A) Diesel
B) Dual
C) Otto
D) Brayton
Answer: C

---

123. Increasing specific heat ratio γincreases Otto efficiency because:

A) Less heat rejected
B) More compression work
C) Higher expansion work
D) Lower pressure
Answer: C
Concept Clarity Note:
Higher γincreases temperature rise during expansion → more work output.
Ref: P.K. Nag

DIESEL CYCLE – NUMERICAL ANALYSIS

---

124. A Diesel cycle has $r = 18$, $\rho = 2$, $\gamma = 1.4$. Increasing $r$will:
A) Decrease efficiency
B) Increase efficiency
C) No change
D) Zero
Answer: B

---

125. If cut-off ratio increases from 1.5 to 2.5, efficiency:
A) Increases
B) Decreases
C) Same
D) Infinite
Answer: B

---

126. Diesel cycle efficiency approaches Otto cycle efficiency when:
A) $\rho \to 1$
B) $r \to 0$
C) $\gamma \to 0$
D) Pressure constant
Answer: A
Concept Clarity Note:
If cut-off ratio $\rho = 1$, constant pressure heat addition disappears → Diesel becomes Otto.
Ref: Khurmi

DUAL CYCLE – APPLICATION

---

127. Dual cycle reduces to Diesel cycle when:
A) Constant volume heat addition = 0
B) Constant pressure heat addition = 0

C) Both equal
D) None
Answer: A

---

128. Dual cycle reduces to Otto cycle when:
A) Constant pressure heat addition = 0
B) Constant volume heat addition = 0
C) Both present
D) None
Answer: A

ENGINE PERFORMANCE – FULL NUMERICAL

---

129. A 4-stroke engine has:

- $P_m = 6$ bar
- $L = 0.3$ m
- $A = 0.01$ m^2
- $N = 3000$ rpm

Indicated Power is approximately:
A) 45 kW
B) 60 kW
C) 75 kW
D) 90 kW
Answer: A
Step-by-Step Solution:
For 4-stroke engine, power strokes per minute:

$$\frac{N}{2}$$

$$IP = \frac{P_m LAN}{60} \times \frac{1}{2}$$

$$= \frac{6 \times 10^5 \times 0.3 \times 0.01 \times 3000}{60 \times 2}$$

$$\approx 45 \text{ kW}$$

Ref: Khurmi

---

130. If mechanical efficiency = 80% and IP = 50 kW, BP is:
A) 35 kW
B) 40 kW

C) 45 kW
D) 50 kW
Answer: B

$$BP = \eta_m \times IP = 0.8 \times 50 = 40$$

---

131. Friction Power equals:
A) $IP - BP$
B) $BP - IP$
C) $IP + BP$
D) BP/IP
Answer: A

BRAKE THERMAL EFFICIENCY NUMERICAL

---

132. A petrol engine produces 30 kW. Fuel flow = 0.01 kg/s. CV = 42000 kJ/kg. Brake thermal efficiency is:
A) 60%
B) 50%
C) 45%
D) 71%
Answer: D

$$\dot{Q} = 0.01 \times 42000 = 420 \text{ kW}$$
$$\eta_{bth} = \frac{30}{420}$$
$$\approx 0.071 = 71\%$$

AIR COMPRESSOR – MULTI-STAGE

---

133. In two-stage compressor, ideal intermediate pressure is:

$$P_i = \sqrt{P_1 P_2}$$

Correct option:
A) True
B) False
Answer: A

---

134. Multistage compression reduces:

A) Leakage
B) Work input
C) Pressure
D) Speed
Answer: B

---

135. If intercooling is perfect, air is cooled to:
A) Final temperature
B) Inlet temperature
C) Zero
D) Atmospheric pressure
Answer: B

NUMERICAL – COMPRESSOR WORK

---

136. Air compressed isothermally from 1 bar to 10 bar. If $mRT = 2000$, work done is:
A) 4600 J
B) 4000 J
C) 2000 J
D) 5000 J
Answer: A

$$W = mRT \ln\left(\frac{10}{1}\right)$$
$$= 2000 \times 2.303$$
$$\approx 4600 \text{ J}$$

GAS TURBINES – POWER CALCULATION

---

137. In Brayton cycle, increasing pressure ratio beyond optimum:
A) Always increases efficiency
B) May decrease net work
C) No effect
D) Zero
Answer: B

---

138. Net work of gas turbine =
A) Turbine work
B) Compressor work

C) Turbine work − Compressor work
D) Heat supplied
Answer: C

---

139. If turbine work = 800 kW and compressor work = 500 kW, net output is:
A) 300 kW
B) 1300 kW
C) 400 kW
D) 500 kW
Answer: A

JET PROPULSION – NUMERICAL

---

140. A jet engine has mass flow rate 20 kg/s. Exit velocity = 600 m/s, inlet velocity = 200 m/s. Thrust is:
A) 4000 N
B) 6000 N
C) 8000 N
D) 10000 N
Answer: C

$$F = \dot{m}(V_e - V_0)$$
$$= 20(600 - 200)$$
$$= 20 \times 400$$
$$= 8000 \text{ N}$$

---

141. Increasing compression ratio increases Otto efficiency – True
Ref: Khurmi
142. Diesel engines use compression ignition – True
Ref: Ganesan
143. Cut-off ratio affects Diesel efficiency – True
Ref: Khurmi
144. Dual cycle efficiency lies between Otto & Diesel – True
Ref: Khurmi
145. IMEP used for IP calculation – True
Ref: Khurmi
146. Mechanical efficiency < 1 – True
Ref: Khurmi
147. Compressor work minimum for isothermal – True
Ref: Nag

148. Intercooling reduces compressor work – True
Ref: Nag
149. Volumetric efficiency affected by clearance – True
Ref: Khurmi
150. Brayton cycle heat addition at constant pressure – True
Ref: Nag
151. Gas turbine efficiency increases with pressure ratio – True
Ref: Nag
152. Ramjet has no moving parts – True
Ref: Ganesan
153. Jet propulsion based on Newton's third law – True
Ref: Ganesan
154. Otto cycle represents petrol engine – True
Ref: Khurmi
155. Diesel engines have higher compression ratio – True
Ref: Ganesan
156. Brake power measured by dynamometer – True
Ref: Khurmi
157. Friction power = IP − BP – True
Ref: Khurmi
158. Polytropic index for isothermal = 1 – True
Ref: Nag
159. Polytropic index for adiabatic = γ– True
Ref: Nag
160. P–V diagram area represents work – True
Ref: Nag
161. Heat addition constant volume in Otto – True
Ref: Khurmi
162. Heat addition constant pressure in Diesel – True
Ref: Khurmi
163. Specific heat ratio affects efficiency – True
Ref: Nag
164. Gas turbines lighter than steam turbines – True
Ref: Ganesan
165. Two-stroke engine produces power every revolution – True
Ref: Ganesan
166. Four-stroke engine more fuel efficient – True
Ref: Ganesan
167. Diesel cycle more practical for heavy vehicles – True
Ref: Ganesan

168. Air standard cycles assume ideal gas – True
Ref: Nag
169. Brayton cycle used in aircraft – True
Ref: Ganesan
170. Turbojet produces thrust by momentum change – True
Ref: Ganesan
171. Thermal efficiency increases with γ– True
Ref: Nag
172. Adiabatic curve steeper than isothermal – True
Ref: Nag
173. Work done in isochoric process zero – True
Ref: Nag
174. Higher pressure ratio improves Brayton efficiency – True
Ref: Nag
175. Mechanical efficiency depends on friction – True
Ref: Khurmi
176. Specific impulse measures propulsion efficiency – True
Ref: Ganesan
177. Gas turbine cycle is open cycle – True
Ref: Ganesan
178. Compressor consumes major turbine power – True
Ref: Nag
179. Dual cycle represents real engine better – True
Ref: Khurmi
180. Otto efficiency independent of cut-off ratio – True
Ref: Khurmi

ADVANCED OTTO & DIESEL NUMERICALS

---

181. An Otto cycle has $r = 16, \gamma = 1.4$. Efficiency is approximately:
A) 60%
B) 65%
C) 67%
D) 70%
Answer: C
Step-by-Step Solution:

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$

$$= 1 - \frac{1}{16^{0.4}}$$
$$16^{0.4} \approx 3.03$$
$$\eta = 1 - \frac{1}{3.03}$$
$$= 1 - 0.33 = 0.67 = 67\%$$

Ref: R.S. Khurmi – *Thermal Engineering*

---

182. Diesel cycle with very small cut-off ratio behaves like:
A) Otto cycle
B) Dual cycle
C) Brayton cycle
D) Rankine cycle
Answer: A

---

183. If compression ratio doubles, Otto efficiency increases because:
A) More heat supplied
B) Less heat rejected
C) More expansion work
D) Lower pressure
Answer: C

ADVANCED DIESEL NUMERICAL

---

184. A Diesel cycle has compression ratio 20. Increasing cut-off ratio from 1.5 to 2 will:
A) Increase efficiency
B) Decrease efficiency
C) No effect
D) Increase pressure
Answer: B

---

185. Diesel cycle efficiency approaches Carnot efficiency when:
A) Cut-off ratio = 1
B) Compression ratio = 1
C) Pressure zero
D) Volume zero
Answer: A

ENGINE PERFORMANCE – FULL ANALYTICAL

186. A 4-cylinder 4-stroke engine has:

- $P_m = 8$ bar
- $L = 0.25$ m
- $A = 0.008$ m^2
- $N = 3000$ rpm

Total IP is approximately:
A) 60 kW
B) 80 kW
C) 100 kW
D) 120 kW
Answer: B
Step-by-Step Solution:
Power strokes per cylinder:

$$\frac{N}{2}$$

Total IP:

$$\begin{aligned} IP &= \frac{P_m LAN}{60} \times \frac{1}{2} \times 4 \\ &= \frac{8 \times 10^5 \times 0.25 \times 0.008 \times 3000}{60 \times 2} \times 4 \\ &\approx 80 \text{ kW} \end{aligned}$$

Ref: Khurmi

187. If mechanical efficiency = 0.85 and IP = 100 kW, BP =
A) 75 kW
B) 80 kW
C) 85 kW
D) 90 kW
Answer: C

$$BP = 0.85 \times 100 = 85$$

188. If BP = 50 kW and fuel energy supplied = 200 kW, brake thermal efficiency is:
A) 20%
B) 25%
C) 30%
D) 35%

Answer: B

$$\eta_{bth} = \frac{50}{200} = 0.25$$

COMPRESSOR – ADVANCED

---

189. Work input of compressor is minimum when compression is:
A) Adiabatic
B) Isothermal
C) Polytropic
D) Isochoric
Answer: B

---

190. Two-stage compression with perfect intercooling reduces work by:
A) Equal pressure ratio per stage
B) Unequal pressure ratio
C) Increasing temperature
D) None
Answer: A

---

191. If pressure ratio = 16 and two-stage compression used, ideal intermediate pressure is:
A) 2 bar
B) 4 bar
C) 8 bar
D) 16 bar
Answer: B

$$P_i = \sqrt{P_1 P_2}$$
$$= \sqrt{1 \times 16} = 4$$

---

192. Volumetric efficiency decreases when:
A) Clearance volume increases
B) Temperature decreases
C) Pressure decreases
D) Speed decreases
Answer: A

BRAYTON CYCLE – NUMERICAL

---

193. A Brayton cycle has pressure ratio 6. $\gamma = 1.4$. Efficiency approx:
A) 30%
B) 40%
C) 50%
D) 60%
Answer: B

$$\eta = 1 - \frac{1}{r_p^{(\gamma-1)/\gamma}}$$
$$= 1 - \frac{1}{6^{0.286}}$$
$$6^{0.286} \approx 1.7$$
$$\eta = 1 - 0.59 \approx 0.41 = 40\%$$

Ref: P.K. Nag

---

194. In gas turbine, if turbine work = 900 kW and compressor work = 600 kW, net output =
A) 300 kW
B) 1500 kW
C) 500 kW
D) 600 kW
Answer: A

---

195. Increasing pressure ratio beyond optimum reduces:
A) Efficiency
B) Net work
C) Fuel
D) Speed
Answer: B

JET PROPULSION – ADVANCED NUMERICALS

---

196. A turbojet has $\dot{m} = 30$ kg/s, $V_e = 700$ m/s, $V_0 = 300$ m/s. Thrust is:
A) 6000 N
B) 9000 N
C) 12000 N
D) 15000 N
Answer: C

$$F = \dot{m}(V_e - V_0)$$
$$= 30(400) = 12000$$

197. Specific impulse is defined as:
A) Thrust / weight flow rate
B) Power / thrust
C) Heat / fuel
D) Velocity / mass
Answer: A

198. Higher exit velocity increases:
A) Thrust
B) Pressure
C) Temperature
D) Volume
Answer: A

199. Diesel engine has higher compression ratio than petrol – True
Ref: Ganesan
200. Otto cycle heat addition constant volume – True
Ref: Khurmi
201. Diesel cycle heat addition constant pressure – True
Ref: Khurmi
202. Dual cycle more realistic for actual engines – True
Ref: Khurmi
203. Work done in isochoric process zero – True
Ref: Nag
204. Adiabatic process has no heat transfer – True
Ref: Nag
205. Isothermal compression gives minimum work – True
Ref: Nag
206. Mechanical efficiency < 1 – True
Ref: Khurmi
207. Brake power measured by dynamometer – True
Ref: Khurmi
208. Friction power $= IP - BP$ – True
Ref: Khurmi
209. Increasing compression ratio increases efficiency – True
Ref: Khurmi
210. Diesel efficiency depends on cut-off ratio – True
Ref: Khurmi

211. Brayton cycle used in aircraft engines – True
Ref: Ganesan
212. Gas turbine lighter than steam turbine – True
Ref: Nag
213. Compressor consumes large portion of turbine work – True
Ref: Nag
214. Jet propulsion based on momentum change – True
Ref: Ganesan
215. Ramjet has no compressor – True
Ref: Ganesan
216. Specific heat ratio affects efficiency – True
Ref: Nag
217. P–V diagram area gives work – True
Ref: Nag
218. T–S diagram area gives heat transfer – True
Ref: Nag
219. Two-stroke engine produces power every revolution – True
Ref: Ganesan
220. Four-stroke engine more fuel efficient – True
Ref: Ganesan
221. Diesel engine does not use spark plug – True
Ref: Ganesan
222. Indicated power calculated using IMEP – True
Ref: Khurmi
223. Higher pressure ratio improves Brayton efficiency – True
Ref: Nag
224. Dual cycle efficiency between Otto & Diesel – True
Ref: Khurmi
225. Work done in adiabatic process depends on γ– True
Ref: Nag
226. Volumetric efficiency decreases with clearance – True
Ref: Khurmi
227. Compressor work reduced by intercooling – True
Ref: Nag
228. Gas turbine is open cycle – True
Ref: Ganesan
229. Jet thrust proportional to mass flow rate – True
Ref: Ganesan
230. Increasing γincreases cycle efficiency – True
Ref: Nag

231. Diesel engine suited for heavy vehicles – True
Ref: Ganesan
232. Otto efficiency independent of cut-off ratio – True
Ref: Khurmi
233. Heat rejection in Otto at constant volume – True
Ref: Khurmi
234. Brayton heat addition constant pressure – True
Ref: Nag
235. Friction reduces mechanical efficiency – True
Ref: Khurmi
236. Gas turbine efficiency depends on pressure ratio – True
Ref: Nag
237. Specific impulse measures propulsion efficiency – True
Ref: Ganesan
238. Adiabatic curve steeper than isothermal – True
Ref: Nag
239. Dual cycle better approximates real engines – True
Ref: Khurmi
240. Indicated power always greater than brake power – True
Ref: Khurmi

Unit VI: Hydraulics and Fluid Power Systems

🔷 Fluid Fundamentals (Statics, Kinematics, Dynamics)

---

1. Pressure at a depth $h$in a static fluid is given by:
A) $P = \rho g h$
B) $P = \rho h$
C) $P = g h$
D) $P = \rho g$
Answer: A
Fluid Logic Solution:
Hydrostatic pressure variation is:

$$P = \rho g h$$

Pressure increases linearly with depth.
Ref: R.K. Bansal – *Fluid Mechanics and Hydraulic Machines*

---

2. Absolute pressure is equal to:
A) Gauge pressure
B) Atmospheric pressure
C) Gauge pressure + Atmospheric pressure
D) Vacuum pressure
Answer: C

$$P_{abs} = P_{gauge} + P_{atm}$$

Ref: Khurmi

---

3. Buoyant force equals:
A) Weight of body
B) Weight of fluid displaced
C) Density of fluid
D) Pressure
Answer: B
Fluid Logic Solution:
Archimedes' principle:

$$F_b = \rho g V$$

Equal to weight of displaced fluid.
Ref: Bansal

---

4. A body floats when:
A) Density of body > fluid
B) Density of body < fluid
C) Equal densities
D) Zero density
Answer: B

---

5. Continuity equation for incompressible flow is:
A) $A_1V_1 = A_2V_2$
B) $A_1 + V_1 = A_2 + V_2$
C) $A_1 = A_2$
D) $V_1 = V_2$
Answer: A

$$A_1V_1 = A_2V_2$$

Ref: Bansal

---

6. If pipe diameter decreases, velocity:
A) Decreases
B) Increases
C) Constant
D) Zero
Answer: B
Because $A \downarrow \Rightarrow V \uparrow$

---

7. Reynolds number is given by:
A) $\frac{\rho VD}{\mu}$
B) $\frac{V}{D}$
C) ρgh
D) $\frac{\mu}{\rho}$
Answer: A

---

8. Flow is laminar when Reynolds number is:
A) < 2000
B) > 4000
C) = 3000
D) Infinite
Answer: A

9. Bernoulli's equation is:

$$\frac{P}{\rho g} + \frac{V^2}{2g} + z = \text{constant}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

10. Hydraulic grade line represents:
A) Total head
B) Pressure head + elevation head
C) Velocity head
D) Friction
Answer: B

$$HGL = \frac{P}{\rho g} + z$$

🔢 NUMERICALS – BERNOULLI APPLICATIONS

11. Water flows at 2 m/s in 0.2 m diameter pipe. If diameter reduces to 0.1 m, velocity becomes:
A) 4 m/s
B) 6 m/s
C) 8 m/s
D) 16 m/s
Answer: C
Fluid Logic Solution:

$$A_1V_1 = A_2V_2$$
$$\left(\frac{0.2}{0.1}\right)^2 = 4$$
$$V_2 = 2 \times 4 = 8$$

Ref: Bansal

12. Water flowing at 5 m/s has velocity head equal to:

A) 1.27 m
B) 2.55 m
C) 3.5 m
D) 4 m
Answer: A

$$\frac{V^2}{2g} = \frac{25}{19.62} \approx 1.27 \text{ m}$$

---

13. If pressure head decreases, velocity head:
A) Decreases
B) Increases
C) Constant
D) Zero
Answer: B
From Bernoulli principle.

---

14. Venturimeter works on:
A) Continuity
B) Bernoulli
C) Archimedes
D) Pascal
Answer: B

---

15. Discharge through venturi meter is proportional to:
A) $\sqrt{\Delta h}$
B) Δh
C) $1/\Delta h$
D) Constant
Answer: A

🔷 FLOW THROUGH PIPES

---

16. Darcy-Weisbach equation is:

$$h_f = \frac{4fLV^2}{2gD}$$

Correct option:
A) True
B) False

Answer: A
Ref: Bansal

---

17. Head loss due to friction increases with:
A) Velocity
B) Pipe length
C) Roughness
D) All
Answer: D

---

18. Minor losses include:
A) Friction loss
B) Entrance/Exit loss
C) Length loss
D) Velocity loss
Answer: B

---

19. If velocity doubles, friction loss becomes:
A) Double
B) Four times
C) Half
D) Same
Answer: B
Because $h_f \propto V^2$

---

20. Froude number is:
A) $\frac{V}{\sqrt{gL}}$
B) $\frac{\rho VD}{\mu}$
C) $\frac{P}{\rho g}$
D) V^2/g
Answer: A

🔷 **IMPACT OF JETS**

---

21. Force exerted by jet on stationary plate is:

$$F = \rho A V^2$$

Correct option:

A) True
B) False
Answer: A

---

22. If jet strikes moving plate, force depends on:
A) Relative velocity
B) Absolute velocity
C) Pressure
D) Height
Answer: A

---

23. Efficiency of jet on moving vane is maximum when vane speed equals:
A) V
B) $\frac{V}{2}$
C) $2V$
D) Zero
Answer: B

---

24. Work done by jet equals:
A) Force × velocity
B) Force × relative velocity
C) Pressure × area
D) Zero
Answer: A

🔷 BOUNDARY LAYER

---

25. Boundary layer thickness increases with:
A) Distance from leading edge
B) Velocity
C) Pressure
D) Density
Answer: A

---

26. Flow separation occurs due to:
A) Favorable pressure gradient
B) Adverse pressure gradient
C) Constant pressure
D) Zero velocity
Answer: B

🔷 TURBINES – INTRODUCTION

27. Pelton turbine is:
A) Reaction turbine
B) Impulse turbine
C) Axial turbine
D) Radial pump
Answer: B

28. Francis turbine is:
A) Impulse
B) Reaction
C) Axial only
D) Reciprocating
Answer: B

29. Kaplan turbine used for:
A) High head
B) Medium head
C) Low head
D) Zero head
Answer: C

30. Specific speed of turbine is:

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

Correct option:
A) True
B) False
Answer: A

🔢 NUMERICAL – TURBINE

31. If turbine speed doubles, specific speed:
A) Doubles
B) Halves
C) Same
D) Zero

Answer: A

---

32. Power developed by turbine is:

$$P = \rho g Q H$$

Correct option:
A) True
B) False
Answer: A

◆ **PUMPS**

---

33. Centrifugal pump works on:
A) Positive displacement
B) Centrifugal force
C) Impulse
D) Buoyancy
Answer: B

---

34. Reciprocating pump is:
A) Dynamic
B) Positive displacement
C) Axial
D) Turbine
Answer: B

---

35. Priming is required in:
A) Reciprocating pump
B) Centrifugal pump
C) Turbine
D) Compressor
Answer: B

---

36. Cavitation occurs due to:
A) High pressure
B) Low pressure below vapor pressure
C) High velocity
D) Temperature drop
Answer: B

---

37. Slip in reciprocating pump is:
A) Negative
B) Positive
C) Zero
D) Always negative
Answer: B

---

38. If actual discharge > theoretical discharge, slip is:
A) Positive
B) Negative
C) Zero
D) Infinite
Answer: B

🔷 FLUID POWER SYSTEMS

---

39. A 4/2 direction control valve means:
A) 4 ports, 2 positions
B) 2 ports, 4 positions
C) 4 actuators
D) 2 actuators
Answer: A

---

40. Hydraulic actuator converts:
A) Mechanical to electrical
B) Hydraulic to mechanical
C) Electrical to hydraulic
D) Thermal to hydraulic
Answer: B

🔷 Bernoulli Applications, Pipe Flow & Impact of Jets (Numerical Focus)

---

41. Water flows through a horizontal pipe. If pressure decreases, velocity:
A) Decreases
B) Increases
C) Constant
D) Zero
Answer: B
Fluid Logic Solution:
From Bernoulli:

$$\frac{P}{\rho g} + \frac{V^2}{2g} = \text{constant}$$

Decrease in pressure head → increase in velocity head.
Ref: R.K. Bansal – *Fluid Mechanics and Hydraulic Machines*

---

42. A pipe carries water at 3 m/s. Velocity head equals:
A) 0.46 m
B) 0.92 m
C) 1.5 m
D) 2 m
Answer: A

$$\frac{V^2}{2g} = \frac{9}{19.62} \approx 0.46 \text{ m}$$

Ref: Bansal

---

43. If area reduces to half, velocity becomes:
A) Half
B) Double
C) Four times
D) Same
Answer: B

$$A_1V_1 = A_2V_2$$

Ref: Bansal

---

44. Head loss due to friction is:

$$h_f = \frac{4fLV^2}{2gD}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

---

45. If pipe length doubles, friction loss:
A) Halves
B) Doubles

C) Four times
D) Same
Answer: B
Since $h_f \propto L$
Ref: Khurmi

---

46. If velocity doubles, friction loss becomes:
A) Double
B) Four times
C) Eight times
D) Same
Answer: B

$$h_f \propto V^2$$

Ref: Bansal

---

47. Reynolds number 3000 indicates:
A) Laminar
B) Turbulent
C) Transition
D) Steady
Answer: C
Ref: Bansal

---

48. Hydraulic mean depth is defined as:
A) $\frac{\text{Area}}{\text{Perimeter}}$
B) $\frac{\text{Area}}{\text{Wetted perimeter}}$
C) $\frac{V}{A}$
D) $\frac{P}{\rho g}$
Answer: B

$$R = \frac{A}{P}$$

Ref: S.K. Som & Biswas

---

49. Force exerted by jet on stationary flat plate is:

$$F = \rho A V^2$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

---

50. Jet diameter = 0.05 m, velocity = 20 m/s. Force on plate is approx:
A) 500 N
B) 785 N
C) 1570 N
D) 3140 N
Answer: C
Fluid Logic Solution:

$$A = \frac{\pi d^2}{4}$$
$$= 0.00196$$
$$F = \rho A V^2$$
$$= 1000 \times 0.00196 \times 400$$
$$\approx 1570 \text{ N}$$

Ref: Bansal

---

51. Maximum efficiency of jet on moving vane occurs when vane speed =
A) V
B) $\frac{V}{2}$
C) $2V$
D) 0
Answer: B
Ref: Bansal

---

52. Work done by jet per second equals:
A) Force × jet velocity
B) Force × vane velocity
C) Pressure × area
D) Zero
Answer: B
Ref: Bansal

---

53. Boundary layer thickness increases with:

A) Distance from leading edge
B) Velocity decrease
C) Pressure drop
D) Density
Answer: A
Ref: Frank M. White – *Fluid Mechanics*

---

54. Separation occurs when pressure gradient is:
A) Favorable
B) Adverse
C) Zero
D) Constant
Answer: B
Ref: Frank M. White

---

55. Mach number is:

$$M = \frac{V}{a}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

🔷 TURBINES – PERFORMANCE

---

56. Pelton turbine is suitable for:
A) Low head
B) Medium head
C) High head
D) Zero head
Answer: C
Ref: Bansal

---

57. Francis turbine is:
A) Axial flow
B) Radial flow
C) Mixed flow
D) Tangential

Answer: C
Ref: Bansal

---

58. Kaplan turbine blades are:
A) Fixed
B) Adjustable
C) Radial
D) Stationary
Answer: B
Ref: Bansal

---

59. Specific speed of turbine is:

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

---

60. High specific speed indicates:
A) Pelton
B) Francis
C) Kaplan
D) Reciprocating
Answer: C
Ref: Bansal

🔷 **TURBINE NUMERICAL**

---

61. Turbine develops 500 kW under head 25 m. If speed doubles, specific speed:
A) Doubles
B) Halves
C) Same
D) Quadruples
Answer: A
Since $N_s \propto N$
Ref: Bansal

---

62. Hydraulic efficiency of turbine is:

$$\eta_h = \frac{\text{Power delivered to runner}}{\rho g Q H}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

◆ PUMPS – ADVANCED

---

63. Centrifugal pump head is given by Euler equation:

$$H = \frac{V_w u}{g}$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi

---

64. Specific speed of pump is:

$$N_s = \frac{N\sqrt{Q}}{H^{3/4}}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bansal

---

65. High specific speed pump is:
A) Radial flow
B) Axial flow
C) Reciprocating
D) Gear
Answer: B
Ref: Khurmi

---

66. Priming is required because centrifugal pump cannot:
A) Handle air
B) Handle water
C) Rotate
D) Create pressure
Answer: A
Ref: Khurmi

---

67. Cavitation occurs when:
A) Pressure > vapor pressure
B) Pressure < vapor pressure
C) Velocity zero
D) Density zero
Answer: B
Ref: Bansal

---

68. Net Positive Suction Head (NPSH) prevents:
A) Friction
B) Cavitation
C) Slip
D) Leakage
Answer: B
Ref: Khurmi

🔷 RECIPROCATING PUMP

---

69. Theoretical discharge of reciprocating pump is:

$$Q = ALN$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi

---

70. Slip is defined as:
A) Theoretical − Actual
B) Actual − Theoretical
C) Zero
D) Pressure

Answer: A

$$Slip = Q_{th} - Q_{act}$$

Ref: Khurmi

◆ FLUID POWER SYSTEMS

---

71. 3/2 direction control valve means:
A) 3 ports, 2 positions
B) 2 ports, 3 positions
C) 3 cylinders
D) 2 pumps
Answer: A
Ref: S.R. Majumdar – *Oil Hydraulics and Pneumatics*

---

72. 4/3 valve has:
A) 4 ports, 3 positions
B) 3 ports, 4 positions
C) 4 actuators
D) 3 pumps
Answer: A
Ref: Majumdar

---

73. Flow control valve controls:
A) Pressure
B) Flow rate
C) Direction
D) Temperature
Answer: B
Ref: Majumdar

---

74. Pressure relief valve protects system from:
A) Leakage
B) Overpressure
C) Cavitation
D) Slip
Answer: B
Ref: Majumdar

---

75. Hydraulic cylinder converts:

A) Hydraulic to linear motion
B) Electrical to hydraulic
C) Thermal to mechanical
D) Rotary to electrical
Answer: A
Ref: Majumdar

---

76. Pneumatic systems use:
A) Oil
B) Water
C) Air
D) Steam
Answer: C
Ref: Majumdar

---

77. Actuator converts:
A) Mechanical to hydraulic
B) Hydraulic to mechanical
C) Electrical to mechanical
D) Thermal to electrical
Answer: B
Ref: Majumdar

---

78. Check valve allows flow in:
A) Both directions
B) One direction
C) No direction
D) Variable direction
Answer: B
Ref: Majumdar

---

79. Solenoid valve is operated by:
A) Pressure
B) Spring
C) Electrical signal
D) Manual lever
Answer: C
Ref: Majumdar

---

80. Hydraulic accumulator stores:

A) Flow
B) Pressure energy
C) Temperature
D) Velocity
Answer: B
Ref: Majumdar

🔷 **Heavy Numericals: Bernoulli, Pipe Flow, Impact of Jets, Turbines & Pumps**

---

81. Water flows through a pipe of diameter 0.3 m at 2 m/s. Discharge is:
A) 0.14 m^3/s
B) 0.28 m^3/s
C) 0.42 m^3/s
D) 0.56 m^3/s
Answer: A
Fluid Logic Solution:

$$
\begin{aligned}
Q &= AV = \frac{\pi D^2}{4} V \\
&= \frac{\pi (0.3)^2}{4} \times 2 \\
&= 0.141 \ \mathrm{m}^3/\mathrm{s}
\end{aligned}
$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

82. If discharge remains constant and diameter is halved, velocity becomes:
A) Double
B) Four times
C) Same
D) Half
Answer: B

$$A \propto D^2$$

Halving diameter reduces area to $\frac{1}{4}$, so velocity becomes 4 times.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

83. Head loss in pipe 100 m long, diameter 0.2 m, velocity 3 m/s, $f = 0.02$is approximately:
A) 0.9 m
B) 1.8 m
C) 2.7 m
D) 3.6 m

Answer: B

$$h_f = \frac{4fLV^2}{2gD}$$
$$= \frac{4 \times 0.02 \times 100 \times 9}{2 \times 9.81 \times 0.2}$$
$$\approx 1.8 \text{ m}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

84. If velocity increases to 6 m/s in above pipe, head loss becomes:
A) 3.6 m
B) 5.4 m
C) 7.2 m
D) 9 m
Answer: C
Since $h_f \propto V^2$:

$$(6/3)^2 = 4$$
$$1.8 \times 4 = 7.2 \text{ m}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

85. Water jet of 25 m/s strikes stationary plate. Force per m² area is:
A) 312500 N
B) 625000 N
C) 937500 N
D) 1250000 N
Answer: B

$$F = \rho V^2 = 1000 \times 25^2$$
$$= 625000 \text{ N/m}^2$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

86. Maximum efficiency of jet striking moving vane is:
A) 50%
B) 75%
C) 100%
D) 25%
Answer: C
Occurs when vane speed $= \frac{V}{2}$.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

87. Pelton turbine works on principle of:
A) Reaction
B) Impulse
C) Pressure difference
D) Cavitation
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

88. Francis turbine is best suited for:
A) High head
B) Medium head
C) Low head
D) Very low head
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

89. Kaplan turbine is axial flow and used for:
A) High head
B) Medium head
C) Low head
D) Zero head
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

90. Turbine output power is:

$$P = \eta \rho g Q H$$

Correct option:
A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

91. If head doubles, turbine power becomes:
A) Double
B) Four times
C) Half
D) Same
Answer: A

Since $P \propto H$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

92. Specific speed of turbine increases with:

A) Head

B) Speed

C) Power decrease

D) Density

Answer: B

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

93. Centrifugal pump head depends on:

A) Blade velocity

B) Gravity only

C) Density only

D) Pressure only

Answer: A

$$H = \frac{V_w u}{g}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

94. If impeller speed doubles, head becomes:

A) Double

B) Four times

C) Same

D) Half

Answer: B

Since $H \propto N^2$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

95. Pump power required is:

$$P = \frac{\rho g Q H}{\eta}$$

Correct option:

A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

96. Cavitation causes:
A) Smooth flow
B) Noise & vibration
C) Increased efficiency
D) Zero effect
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

97. NPSH available must be:
A) Less than required
B) Equal to zero
C) Greater than required
D) Negative
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

98. Reciprocating pump discharge is:
A) Continuous
B) Pulsating
C) Zero
D) Rotational
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

99. Slip becomes negative when:
A) Actual > Theoretical discharge
B) Actual < Theoretical
C) Equal
D) Zero
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

100. Hydraulic efficiency of pump is:

$$\eta_h = \frac{gH}{V_w u}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

101. A 4/3 valve has how many flow paths?
A) 3
B) 4
C) 12
D) 7
Answer: C
4 ports × 3 positions.
Ref: *Oil Hydraulics and Pneumatics: Principles and Maintenance*, S.R. Majumdar

---

102. Pressure control valve maintains:
A) Flow rate
B) System pressure
C) Direction
D) Speed
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

103. Flow control valve is used to control:
A) Cylinder speed
B) Pressure
C) Temperature
D) Cavitation
Answer: A
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

104. Hydraulic motor converts:
A) Mechanical to hydraulic
B) Hydraulic to rotary motion
C) Electrical to hydraulic
D) Air to water
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

105. Pneumatic systems operate at:
A) Very high pressure
B) Low to moderate pressure
C) Vacuum
D) Steam pressure
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

106. Accumulator stores energy in form of:
A) Flow
B) Pressure
C) Temperature
D) Velocity
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

107. Direction control valve controls:
A) Speed
B) Pressure
C) Flow direction
D) Density
Answer: C
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

108. Relief valve opens when:
A) Pressure exceeds limit
B) Pressure drops
C) Flow decreases
D) Temperature rises
Answer: A
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

109. Double acting cylinder moves in:
A) One direction
B) Both directions
C) No direction
D) Vertical only
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

110. Hydraulic systems are preferred over pneumatic because:
A) Lower cost
B) Higher force capacity
C) Lower maintenance
D) Air compressibility
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

🔷 Advanced Turbine & Pump Numericals, Specific Speed & Dimensionless Numbers

---

111. Specific speed of a turbine is 30. This turbine is likely:
A) Pelton
B) Francis
C) Kaplan
D) Axial pump
Answer: A
Fluid Logic Solution:
Low specific speed → High head → Pelton turbine.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

112. If specific speed increases, turbine type changes from:
A) Pelton → Francis → Kaplan
B) Kaplan → Francis → Pelton
C) Francis → Pelton → Kaplan
D) Kaplan → Pelton → Francis
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

113. A turbine operates under head 16 m at 300 rpm producing 400 kW. Specific speed is approximately:
A) 60
B) 90
C) 120
D) 150
Answer: B
Fluid Logic Solution:

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

$$= \frac{300\sqrt{400}}{16^{5/4}}$$

$$= \frac{300 \times 20}{32}$$
$$\approx 90$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

114. Reaction turbines operate on:
A) Impulse only
B) Pressure + Kinetic energy
C) Pressure only
D) Gravity
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

115. Degree of reaction for Pelton turbine is:
A) 0
B) 0.5
C) 1
D) >1
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

116. Draft tube is used in:
A) Pelton turbine
B) Francis turbine
C) Reciprocating pump
D) Venturimeter
Answer: B
Fluid Logic Solution:
Draft tube recovers kinetic energy in reaction turbines.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

117. Cavitation in turbines occurs due to:
A) High pressure
B) Low pressure below vapor pressure
C) High velocity only
D) High density
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

118. Specific speed of pump is:

$$N_s = \frac{N\sqrt{Q}}{H^{3/4}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

119. If pump speed doubles, discharge becomes:
A) Same
B) Double
C) Four times
D) Half
Answer: B
Since $Q \propto N$
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

120. If pump speed doubles, head becomes:
A) Double
B) Four times
C) Same
D) Half
Answer: B
Since $H \propto N^2$
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

121. If pump speed doubles, power becomes:
A) Double
B) Four times
C) Eight times
D) Same
Answer: C
Since $P \propto N^3$
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

122. A centrifugal pump delivers 0.1 m³/s at 20 m head. Power required (η=80%) is approx:
A) 15 kW
B) 20 kW

C) 25 kW
D) 30 kW
Answer: C
Fluid Logic Solution:

$$P = \frac{\rho g Q H}{\eta}$$
$$= \frac{1000 \times 9.81 \times 0.1 \times 20}{0.8}$$
$$\approx 25\ \mathrm{kW}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

123. In reciprocating pump, air vessel is used to:
A) Increase pressure
B) Reduce pulsation
C) Reduce discharge
D) Increase slip
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

124. Hydraulic ram works on principle of:
A) Bernoulli
B) Water hammer
C) Pascal
D) Continuity
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

125. Boundary layer separation increases:
A) Lift
B) Drag
C) Velocity
D) Pressure
Answer: B
Ref: *Fluid Mechanics*, Frank M. White

🔷 DIMENSIONLESS NUMBERS

---

126. Reynolds number represents ratio of:

A) Inertia / Viscous forces
B) Gravity / Inertia
C) Pressure / Viscous
D) Density / Viscosity
Answer: A

$$Re = \frac{\rho V D}{\mu}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

127. Froude number represents ratio of:
A) Inertia / Gravity
B) Viscous / Inertia
C) Pressure / Gravity
D) Velocity / Density
Answer: A

$$Fr = \frac{V}{\sqrt{gL}}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

128. Mach number represents ratio of:
A) Flow velocity / Speed of sound
B) Inertia / Gravity
C) Pressure / Density
D) Density / Viscosity
Answer: A

$$M = \frac{V}{a}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

129. Flow becomes turbulent when Reynolds number exceeds:
A) 2000
B) 3000
C) 4000
D) 1000
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

130. Hydraulic efficiency of Pelton turbine is maximum when bucket speed is:
A) V
B) $\frac{V}{2}$
C) $2V$
D) Zero
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

131. Velocity of whirl at outlet of Pelton wheel ideally is:
A) Zero
B) Maximum
C) Double inlet
D) Half inlet
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

132. Manometric efficiency of pump is:

$$\eta_m = \frac{gH}{V_w u}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

133. Slip in reciprocating pump can be reduced by:
A) Air vessel
B) Increasing speed
C) Decreasing pressure
D) Increasing diameter
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

134. If suction head increases, cavitation risk:
A) Decreases
B) Increases
C) Same
D) Zero
Answer: B

Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

135. Draft tube efficiency is:

$$\eta_d = \frac{\text{Recovered head}}{\text{Available head}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

🔷 **FLUID POWER SYSTEMS (Advanced Component Focus)**

---

136. 4/2 valve has how many flow paths?
A) 4
B) 2
C) 8
D) 6
Answer: C
4 ports × 2 positions.
Ref: *Oil Hydraulics and Pneumatics: Principles and Maintenance*, S.R. Majumdar

---

137. Flow control valve with check valve allows:
A) Bi-directional control
B) Free reverse flow
C) Pressure increase
D) Cavitation
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

138. Sequence valve controls:
A) Flow
B) Direction
C) Pressure sequence
D) Temperature
Answer: C
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

139. Hydraulic motor speed depends on:

A) Pressure
B) Flow rate
C) Density
D) Temperature
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

140. Double acting cylinder requires:
A) One port
B) Two ports
C) Three ports
D) No port
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

🔷 **Advanced Comparisons, Heavy Numericals & Fluid Power Mastery**

---

141. For maximum power transmission through pipe, head loss due to friction equals:
A) Total head
B) $\frac{H}{2}$
C) $\frac{H}{3}$
D) Zero
Answer: C
Fluid Logic Solution:
Maximum power condition:

$$h_f = \frac{H}{3}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

142. Efficiency under maximum power condition is:
A) 33%
B) 50%
C) 66.7%
D) 75%
Answer: C

$$\eta = \frac{H - h_f}{H} = \frac{2H/3}{H} = \frac{2}{3}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

143. A pipe carries water under 30 m head. Maximum power transmission head loss is:
A) 5 m
B) 10 m
C) 15 m
D) 20 m
Answer: B

$$h_f = \frac{30}{3} = 10 \text{ m}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

144. If jet velocity is 40 m/s, maximum efficiency occurs at vane speed:
A) 10 m/s
B) 20 m/s
C) 30 m/s
D) 40 m/s
Answer: B

$$u = \frac{V}{2}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

145. Hydraulic efficiency of Pelton wheel ideally is:
A) 50%
B) 70%
C) 100%
D) 0%
Answer: C
Ideal condition: whirl velocity at outlet = 0.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

146. If discharge doubles in centrifugal pump, head approximately:
A) Doubles
B) Same
C) Halves
D) Quadruples
Answer: B
Head independent of discharge for fixed speed.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

147. In reciprocating pump, negative slip occurs when:
A) Suction pressure low
B) Delivery valve leaks
C) Actual discharge > Theoretical discharge
D) Air vessel present
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

148. Specific speed of pump indicates:
A) Type of pump
B) Pressure
C) Density
D) Slip
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

149. High specific speed pump is:
A) Radial
B) Mixed
C) Axial
D) Reciprocating
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

150. Cavitation damage occurs due to:
A) High temperature
B) Bubble collapse
C) High density
D) Low velocity
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

🔷 ADVANCED PIPE NUMERICAL

---

151. A 200 m pipe, diameter 0.3 m, velocity 2 m/s, $f = 0.02$. Head loss is approximately:
A) 1.8 m
B) 2.7 m
C) 3.6 m
D) 4.5 m
Answer: C

$$h_f = \frac{4fLV^2}{2gD}$$
$$= \frac{4(0.02)(200)(4)}{2(9.81)(0.3)}$$
$$\approx 3.6 \text{ m}$$

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

152. If diameter doubles, friction loss becomes approximately:
A) Half
B) One-fourth
C) One-eighth
D) Same
Answer: C
Since $h_f \propto \frac{1}{D^5}$for constant discharge.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

◆ IMPACT OF JET – CURVED VANE

---

153. For curved vane deflecting jet by 180°, force becomes:
A) ρAV^2
B) $2\rho AV^2$
C) $\frac{1}{2}\rho AV^2$
D) Zero
Answer: B
Momentum change doubles.
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

154. Work done per second by jet equals:

$$W = \rho AV(V - u)u$$

Correct option:
A) True
B) False
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

◆ TURBINE COMPARISON

---

155. Pelton turbine operates under:
A) Low head
B) Medium head
C) High head
D) Variable head
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

156. Francis turbine is suitable for:
A) High head only
B) Medium head
C) Low head only
D) Zero head
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

157. Kaplan turbine is reaction turbine with:
A) Fixed blades
B) Adjustable blades
C) Buckets
D) No runner
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

158. Draft tube increases turbine efficiency by:
A) Increasing head
B) Recovering kinetic energy
C) Increasing discharge
D) Increasing pressure loss
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

🔷 FLUID POWER SYSTEMS – CIRCUIT FOCUS

---

159. A 3/2 valve is commonly used for:
A) Double acting cylinder
B) Single acting cylinder
C) Pump
D) Turbine
Answer: B

Ref: *Oil Hydraulics and Pneumatics: Principles and Maintenance*, S.R. Majumdar

---

160. 4/3 valve in neutral position may:
A) Block flow
B) Allow free flow
C) Connect pump to tank
D) All
Answer: D
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

161. Pressure reducing valve maintains:
A) Inlet pressure
B) Outlet pressure constant
C) Flow
D) Speed
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

162. Flow control valve affects:
A) Force
B) Speed
C) Pressure
D) Density
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

163. Check valve prevents:
A) Forward flow
B) Reverse flow
C) Pressure
D) Temperature
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

164. Hydraulic accumulator stores energy as:
A) Potential energy
B) Pressure energy
C) Kinetic energy
D) Heat energy
Answer: B

Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

165. Hydraulic systems preferred when:
A) Low force required
B) High precision force required
C) Only air available
D) Low cost priority
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

166. Pneumatic systems are cleaner because:
A) Use oil
B) Use water
C) Use compressed air
D) Use steam
Answer: C
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

167. Relief valve protects system from:
A) Low pressure
B) Overpressure
C) Slip
D) Cavitation
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

168. Hydraulic motor converts:
A) Mechanical to hydraulic
B) Hydraulic to rotary motion
C) Pneumatic to electrical
D) Thermal to hydraulic
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

169. Bernoulli equation valid for:
A) Viscous flow
B) Ideal flow
C) Turbulent only
D) Compressible only
Answer: B

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

170. Continuity equation based on:
A) Energy conservation
B) Momentum
C) Mass conservation
D) Pressure law
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

171. In laminar flow, head loss proportional to:
A) V
B) V^2
C) V^3
D) Constant
Answer: A
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

172. In turbulent flow, head loss proportional to:
A) V
B) V^2
C) V^3
D) Constant
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

173. Hydraulic gradient line slope indicates:
A) Velocity
B) Pressure
C) Head loss
D) Discharge
Answer: C
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

174. Specific speed independent of:
A) Speed
B) Power
C) Head
D) Fluid density
Answer: D

Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

175. Reaction turbines operate with:
A) Atmospheric pressure
B) Completely filled passages
C) Free jet
D) Air
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.K. Bansal

---

176. Reciprocating pump is best for:
A) Large discharge low head
B) Small discharge high head
C) Low pressure
D) Cavitation
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

177. Centrifugal pump best suited for:
A) Small discharge
B) Large discharge moderate head
C) Very high head
D) Zero head
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

---

178. Hydraulic systems operate typically at pressure:
A) 1–5 bar
B) 50–300 bar
C) 1000 bar
D) 0 bar
Answer: B
Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

179. Pneumatic systems are faster but less precise because:
A) Oil compressibility
B) Air compressibility
C) High pressure
D) High density
Answer: B

Ref: *Oil Hydraulics and Pneumatics*, S.R. Majumdar

---

180. Cavitation can be prevented by increasing:
A) Suction lift
B) NPSH available
C) Velocity
D) Head loss
Answer: B
Ref: *Fluid Mechanics and Hydraulic Machines*, R.S. Khurmi

Unit VII: Steam Boilers, Nozzles, Turbines and Condensers

Steam Properties & Basic Boiler Concepts

---

1. Sensible heat of steam is:
A) Heat required to convert water to steam
B) Heat required to raise water temperature to saturation temperature
C) Heat required to superheat steam
D) Total enthalpy
Answer: B
Power Plant Logic:
Sensible heat h_f is heat required to raise water from $0°C$ to saturation temperature.
Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

2. Latent heat of vaporization is:
A) Heat to raise temperature
B) Heat to change phase at constant temperature
C) Heat for superheating
D) Internal energy
Answer: B

$$h_{fg} = h_g - h_f$$

Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

3. Dryness fraction x is defined as:

$$x = \frac{\text{Mass of dry steam}}{\text{Total mass of wet steam}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Steam Tables*, R.S. Khurmi

---

4. Enthalpy of wet steam is:

$$h = h_f + xh_{fg}$$

Correct option:

A) True
B) False
Answer: A
Ref: *Steam Tables*, R.S. Khurmi

---

5. If dryness fraction increases, enthalpy of steam:
A) Decreases
B) Increases
C) Constant
D) Zero
Answer: B
Ref: *Steam Tables*, R.S. Khurmi

---

6. At critical point of water:
A) $h_{fg} = 0$
B) $h_f = 0$
C) $h_g = 0$
D) Pressure zero
Answer: A
Power Plant Logic:
At critical point, saturated liquid and vapor phases merge → no latent heat.
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

---

7. Steam tables are used to determine:
A) Velocity
B) Enthalpy & Entropy
C) Pressure only
D) Temperature only
Answer: B
Ref: *Steam Tables*, R.K. Rajput

---

8. On Mollier diagram, vertical axis represents:
A) Pressure
B) Enthalpy
C) Entropy
D) Temperature
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

9. Isentropic expansion on Mollier chart is:

A) Vertical line
B) Horizontal line
C) Inclined line
D) Curve
Answer: A
Power Plant Logic:
Entropy constant → vertical line on $h - s$diagram.
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

---

10. Superheated steam lies:
A) Left of saturation line
B) Right of dry saturated line
C) On wet region
D) On saturated line
Answer: B
Ref: *Steam Tables*, R.S. Khurmi

🔢 **NUMERICALS – DRYNESS FRACTION**

---

11. Wet steam has $h = 2400$kJ/kg, $h_f = 640$, $h_{fg} = 2100$. Dryness fraction is:
A) 0.7
B) 0.8
C) 0.85
D) 0.9
Answer: B

$$
\begin{aligned}
x &= \frac{h - h_f}{h_{fg}} \\
&= \frac{2400 - 640}{2100} \\
&= 0.8
\end{aligned}
$$

Ref: *Steam Tables*, R.S. Khurmi

---

12. If dryness fraction = 1, steam is:
A) Wet
B) Superheated
C) Dry saturated
D) Compressed liquid
Answer: C
Ref: *Steam Tables*, R.S. Khurmi

BOILERS – CLASSIFICATION

13. Fire-tube boiler carries:
A) Water inside tubes
B) Flue gases inside tubes
C) Steam only
D) Air
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

14. Water-tube boiler carries:
A) Flue gases in tubes
B) Water in tubes
C) Steam outside
D) Air
Answer: B
Ref: *Steam Power Engineering*, Vinayak Kulkarni

15. Water-tube boilers operate at:
A) Low pressure
B) High pressure
C) Vacuum
D) Low temperature
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

16. Babcock & Wilcox boiler is:
A) Fire-tube
B) Water-tube
C) Vertical
D) Portable
Answer: B
Ref: *Steam Power Engineering*, Vinayak Kulkarni

17. Lancashire boiler is:
A) Water-tube
B) Fire-tube
C) High pressure
D) Once-through

Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

18. Boiler mountings are:
A) Efficiency devices
B) Safety devices
C) Accessories
D) Turbine parts
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

19. Superheater is classified as:
A) Mounting
B) Accessory
C) Valve
D) Turbine
Answer: B
Power Plant Logic:
Accessories improve efficiency.
Ref: *Thermal Engineering*, R.S. Khurmi

---

20. Safety valve is:
A) Accessory
B) Mounting
C) Turbine
D) Condenser
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

🔢 BOILER PERFORMANCE NUMERICALS

---

21. Boiler evaporates 5000 kg/hr steam. Equivalent evaporation is:

$$EE = \frac{m(h - h_f)}{2257}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi

22. Boiler efficiency is:

$$\eta = \frac{\text{Heat utilized}}{\text{Heat supplied}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi

23. If fuel calorific value increases, boiler efficiency:
A) Always increases
B) Depends on losses
C) Always decreases
D) Zero
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

24. Equivalent evaporation is expressed in:
A) kg/hr
B) kg/kWh
C) kg of steam per kg of fuel
D) Joules
Answer: C
Ref: *Thermal Engineering*, R.S. Khurmi

25. Higher equivalent evaporation indicates:
A) Poor performance
B) Better performance
C) Low efficiency
D) Zero efficiency
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

STEAM NOZZLES – BASICS

26. Steam nozzle converts:
A) Pressure energy to velocity
B) Velocity to pressure

C) Heat to work
D) Work to heat
Answer: A
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

---

27. Convergent nozzle is used when exit pressure is:
A) Above critical pressure
B) Equal to critical pressure
C) Below critical pressure
D) Zero
Answer: A
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

---

28. For maximum discharge, critical pressure ratio is:

$$\frac{P_2}{P_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

---

29. If $n = 1.3$, critical pressure ratio approx:
A) 0.546
B) 0.75
C) 0.9
D) 0.3
Answer: A
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

---

30. Choking in nozzle occurs when:
A) Velocity zero
B) Pressure equal
C) Critical pressure reached
D) Temperature zero
Answer: C
Ref: *Applied Thermodynamics*, T.D. Eastop & A. McConkey

◆ STEAM TURBINES – BASICS

---

31. Impulse turbine operates on:
A) Pressure drop in moving blades
B) Pressure constant across blades
C) Reaction only
D) Condensation
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

32. Reaction turbine has:
A) No pressure drop in rotor
B) Pressure drop in rotor
C) Only impulse
D) No velocity change
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

33. Compounding is required to:
A) Increase pressure
B) Reduce rotor speed
C) Increase dryness fraction
D) Increase head
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

34. Velocity compounding is also called:
A) Rateau
B) Curtis
C) Parsons
D) De Laval
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

---

35. Pressure compounding is also called:
A) Curtis
B) Rateau
C) Parsons
D) Laval
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi

◆ CONDENSERS

36. Jet condenser mixes:
A) Steam & water
B) Steam & air
C) Water & air
D) Steam & oil
Answer: A
Ref: *Steam Power Engineering*, Vinayak Kulkarni

37. Surface condenser keeps steam and cooling water:
A) Mixed
B) Separate
C) Heated
D) Boiled
Answer: B
Ref: *Steam Power Engineering*, Vinayak Kulkarni

38. Vacuum in condenser improves:
A) Boiler efficiency
B) Turbine efficiency
C) Condenser efficiency
D) No effect
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

39. Condenser efficiency is:

$$\eta = \frac{T_{in} - T_{out}}{T_{in} - T_{cool}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Steam Power Engineering*, Vinayak Kulkarni

40. Surface condenser preferred because:
A) Cheap
B) No mixing of water

C) Small size
D) No vacuum
Answer: B
Ref: *Steam Power Engineering*, Vinayak Kulkarni

---

41. A boiler generates 4000 kg/hr steam. Enthalpy of steam = 2800 kJ/kg, feed water enthalpy = 500 kJ/kg. Equivalent evaporation (from and at 100°C) is approximately:
A) 3500 kg/hr
B) 4080 kg/hr
C) 4500 kg/hr
D) 5000 kg/hr
Answer: B
Power Plant Logic:

$$EE = \frac{m(h - h_f)}{2257}$$
$$= \frac{4000(2800 - 500)}{2257}$$
$$\approx 4080 \text{ kg/hr}$$

Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

42. Boiler efficiency is:

$$\eta_b = \frac{m(h - h_f)}{m_f \times CV}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

43. Water-tube boiler advantage over fire-tube is:
A) Low pressure only
B) Slow steam generation
C) Higher pressure capability
D) Larger water storage
Answer: C
Ref: *Steam Power Engineering*, Vinayak Kulkarni

---

44. Mountings are essential for:
A) Efficiency
B) Safety
C) Economy
D) Speed
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

45. Economizer is classified as:
A) Mounting
B) Accessory
C) Valve
D) Turbine
Answer: B
Power Plant Logic:
Accessories improve efficiency; mountings ensure safety.
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

STEAM NOZZLES – NUMERICAL FOCUS

---

46. Maximum mass discharge through nozzle occurs at:
A) Maximum velocity
B) Critical pressure ratio
C) Minimum temperature
D) Zero friction
Answer: B

$$\frac{P_2}{P_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$$

Ref: *Applied Thermodynamics for Engineering Technologists*, T.D. Eastop & A. McConkey

---

47. For steam, $n = 1.3$. Critical pressure ratio is approximately:
A) 0.546
B) 0.75
C) 0.90
D) 0.32
Answer: A
Ref: *Applied Thermodynamics*, Eastop & McConkey

---

48. If exit pressure falls below critical pressure, mass flow rate:

A) Increases
B) Decreases
C) Remains constant
D) Zero
Answer: C
Power Plant Logic:
Choked flow → discharge maximum and constant.
Ref: *Applied Thermodynamics*, Eastop & McConkey

---

49. Nozzle efficiency is defined as:

$$\eta_n = \frac{V_{actual}^2}{V_{ideal}^2}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Applied Thermodynamics*, Eastop & McConkey

---

50. Friction in nozzle causes:
A) Increase in velocity
B) Decrease in exit velocity
C) Increase in pressure
D) Zero effect
Answer: B
Ref: *Applied Thermodynamics*, Eastop & McConkey

STEAM TURBINES – COMPOUNDING

---

51. In velocity compounding (Curtis stage), pressure drop occurs in:
A) Each moving blade
B) Each fixed blade
C) Only first nozzle
D) Entire rotor
Answer: C
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

52. In pressure compounding (Rateau), pressure drops:
A) Entirely in one stage
B) In successive stages

C) In moving blades only
D) In condenser
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

53. Compounding is necessary because:
A) Steam pressure high
B) Rotor speed would be too high
C) Efficiency low
D) Steam wet
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

54. Degree of reaction for Parsons turbine is approximately:
A) 0
B) 0.5
C) 1
D) 2
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

55. In impulse turbine, pressure remains constant across:
A) Nozzle
B) Rotor
C) Stator
D) Boiler
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

MOLLIER DIAGRAM APPLICATION

---

56. Isentropic expansion on Mollier diagram is:
A) Horizontal
B) Vertical
C) Diagonal
D) Curved
Answer: B
Ref: *Applied Thermodynamics*, Eastop & McConkey

---

57. Enthalpy drop in turbine equals:

$$\Delta h = h_1 - h_2$$

Correct option:
A) True
B) False
Answer: A
Ref: *Steam Tables*, R.S. Khurmi

---

58. Turbine work per kg steam equals:

$$W = h_1 - h_2$$

Correct option:
A) True
B) False
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

CONDENSERS

---

59. Vacuum efficiency of condenser is:

$$\eta_v = \frac{\text{Actual vacuum}}{\text{Ideal vacuum}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Steam Power Engineering*, Vinayak Kulkarni

---

60. Surface condenser advantage over jet condenser is:
A) Lower cost
B) Mixing allowed
C) Pure condensate obtained
D) Small size
Answer: C
Ref: *Steam Power Engineering*, Vinayak Kulkarni

📘 **UNIT VII – PART 3 (Questions 101–160)**

ADVANCED NUMERICALS

101. Steam expands in nozzle from 10 bar to 5 bar. Initial enthalpy = 2800 kJ/kg, final enthalpy = 2600 kJ/kg. Exit velocity is approximately:
A) 400 m/s
B) 600 m/s
C) 632 m/s
D) 800 m/s
Answer: C

$$V = \sqrt{2(h_1 - h_2) \times 1000}$$
$$= \sqrt{2(200) \times 1000}$$
$$= 632 \text{ m/s}$$

Ref: *Applied Thermodynamics*, Eastop & McConkey

---

102. If nozzle efficiency is 90%, actual velocity becomes:
A) 600 m/s
B) 620 m/s
C) 630 m/s
D) 650 m/s
Answer: A

$$V_{actual} = \sqrt{\eta_n} \times V_{ideal}$$
$$= \sqrt{0.9} \times 632 \approx 600$$

Ref: *Applied Thermodynamics*, Eastop & McConkey

---

103. Turbine efficiency is:

$$\eta_t = \frac{\text{Actual enthalpy drop}}{\text{Isentropic enthalpy drop}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

104. If condenser pressure decreases, turbine work:
A) Decreases
B) Increases

C) Same
D) Zero
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

---

105. Rankine cycle efficiency improves by:
A) Increasing condenser pressure
B) Decreasing boiler pressure
C) Increasing boiler pressure
D) Removing condenser
Answer: C
Ref: *Power Plant Engineering*, P.K. Nag

---

106. Steam turbine governing methods include:
A) Throttle governing
B) Nozzle control
C) Bypass governing
D) All
Answer: D
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

107. Reaction turbine has higher efficiency because:
A) Pressure drop distributed
B) No compounding
C) No velocity change
D) No expansion
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

108. Impulse turbine blade efficiency maximum when:
A) Blade speed = steam speed
B) Blade speed = half steam speed
C) Zero
D) Double
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

109. Fire-tube boiler contains large water volume – True
110. Water-tube boiler responds faster to load changes – True
111. Superheater increases steam temperature – True

112. Mountings mandatory for safe operation – True
113. Accessories improve efficiency – True
114. Choking occurs at sonic velocity – True
115. Critical pressure ratio independent of back pressure below critical – True
116. Impulse turbine has zero degree of reaction – True
117. Parsons turbine is reaction turbine – True
118. Compounding reduces rotor speed – True
119. Mollier diagram useful for turbine analysis – True
120. Enthalpy drop equals turbine work – True
121. Condenser maintains vacuum – True
122. Surface condenser prevents mixing – True
123. Vacuum improves turbine efficiency – True
124. Boiler efficiency < 100% – True
125. Equivalent evaporation measures performance – True
126. Economizer reduces fuel consumption – True
127. Air preheater improves efficiency – True
128. Impulse turbine suitable for high head – True
129. Reaction turbine requires draft tube – True
130. Nozzle converts heat energy to kinetic energy – True
131. Friction reduces nozzle efficiency – True
132. Dryness fraction < 1 for wet steam – True
133. At critical point latent heat zero – True
134. Superheated steam has no moisture – True
135. Condenser increases cycle efficiency – True
136. Jet condenser mixes steam & cooling water – True
137. Surface condenser keeps fluids separate – True
138. Vacuum efficiency depends on air leakage – True
139. Throttle governing changes pressure – True
140. Nozzle control governs impulse turbine – True

UNIT VII – FINAL CONSOLIDATION

---

141. The function of a steam separator in a boiler is to:

A) Increase pressure
B) Remove moisture from steam
C) Increase temperature
D) Reduce velocity

Answer: B

Power Plant Logic:
Steam separator removes entrained water droplets → increases dryness fraction and prevents turbine blade erosion.
Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

142. If dryness fraction of steam entering turbine decreases, turbine efficiency:
A) Increases
B) Decreases
C) Remains same
D) Becomes zero
Answer: B
Power Plant Logic:
Wet steam causes blade erosion and reduces effective enthalpy drop.
Ref: *Applied Thermodynamics for Engineering Technologists*, T.D. Eastop & A. McConkey

---

143. The purpose of reheating steam in Rankine cycle is to:
A) Increase boiler pressure
B) Reduce moisture content at turbine exit
C) Increase condenser pressure
D) Reduce turbine speed
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

---

144. In pressure-velocity compounding, pressure drop occurs:
A) In one stage only
B) In multiple stages and velocity stages
C) Only in moving blades
D) Only in condenser
Answer: B
Power Plant Logic:
Pressure divided into stages; each stage may have velocity compounding.
Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

145. The enthalpy drop in an ideal impulse turbine occurs in:
A) Moving blades
B) Fixed blades (nozzle)
C) Rotor only
D) Condenser
Answer: B
Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

146. Degree of reaction is defined as:

$$R = \frac{\text{Enthalpy drop in rotor}}{\text{Total enthalpy drop}}$$

Correct option:
A) True
B) False
Answer: A
Ref: *Applied Thermodynamics*, Eastop & McConkey

---

147. For an impulse turbine, degree of reaction is:
A) 0
B) 0.5
C) 1
D) 2
Answer: A
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

148. For a pure reaction turbine, degree of reaction is:
A) 0
B) 0.5
C) 1
D) 2
Answer: C
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

149. The main reason for using a surface condenser instead of a jet condenser in power plants is:
A) Lower cost
B) Smaller size
C) Reuse of pure condensate
D) Higher temperature
Answer: C
Ref: *Steam Power Engineering*, Vinayak Kulkarni

---

150. If air leaks into condenser increase, vacuum efficiency:
A) Increases
B) Decreases

C) Same
D) Zero
Answer: B
Power Plant Logic:
Air reduces vacuum → increases back pressure → lowers turbine efficiency.
Ref: *Steam Power Engineering*, Vinayak Kulkarni

---

151. Vacuum in condenser is highest when:
A) Back pressure high
B) Back pressure low
C) Steam pressure high
D) Temperature high
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

---

152. The function of air pump in condenser is to:
A) Pump steam
B) Remove air and non-condensable gases
C) Increase pressure
D) Increase temperature
Answer: B
Ref: *Steam Power Engineering*, Vinayak Kulkarni

---

153. The main objective of a steam nozzle in turbine stage is to:
A) Increase pressure
B) Convert enthalpy into kinetic energy
C) Reduce temperature
D) Condense steam
Answer: B

$$V = \sqrt{2(h_1 - h_2) \times 1000}$$

Ref: *Applied Thermodynamics*, Eastop & McConkey

---

154. If condenser pressure decreases, Rankine cycle efficiency:
A) Decreases
B) Increases
C) Remains same
D) Zero
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

---

155. In an impulse turbine, velocity diagram shows:
A) Pressure drop in rotor
B) Only kinetic energy change
C) Condensation
D) Heat addition
Answer: B
Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

156. In reaction turbine, steam expands in:
A) Nozzle only
B) Moving blades only
C) Both fixed and moving blades
D) Condenser
Answer: C
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

157. Boiler efficiency improves by installing:
A) Safety valve
B) Superheater
C) Blow-off cock
D) Water level indicator
Answer: B
Power Plant Logic:
Superheater increases steam enthalpy → improves turbine efficiency.
Ref: *A Textbook of Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

158. Equivalent evaporation from and at 100°C is a measure of:
A) Pressure
B) Boiler performance
C) Turbine efficiency
D) Condenser vacuum
Answer: B
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

159. In De Laval turbine, compounding is:
A) Pressure compounding
B) Velocity compounding
C) No compounding
D) Reaction compounding

Answer: C
Power Plant Logic:
De Laval turbine is single-stage impulse turbine without compounding.
Ref: *Thermal Engineering*, R.S. Khurmi & J.K. Gupta

---

160. The primary function of condenser in Rankine cycle is to:
A) Increase pressure
B) Convert steam to water and maintain low back pressure
C) Increase temperature
D) Increase enthalpy
Answer: B
Ref: *Power Plant Engineering*, P.K. Nag

VIII: Refrigeration and Air Conditioning

❄️ REFRIGERATION BASICS & AIR REFRIGERATION (Bell-Coleman)

---

1. Refrigeration effect is defined as:
A) Heat rejected in condenser
B) Heat absorbed in evaporator
C) Work done by compressor
D) Total heat supplied
Answer: B
Cooling Logic:
Refrigerating effect $Q_L$is heat absorbed from the refrigerated space in evaporator.

$$Q_L = h_1 - h_4$$

Ref: *A Textbook of Refrigeration and Air Conditioning*, R.S. Khurmi & J.K. Gupta

---

2. COP of refrigerator is:

$$COP = \frac{Q_L}{W_{net}}$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi & Gupta

---

3. In Bell-Coleman cycle, refrigeration is produced by:
A) Vapor compression
B) Gas expansion
C) Absorption
D) Condensation
Answer: B
Ref: *Refrigeration and Air Conditioning*, Manohar Prasad

---

4. Bell-Coleman cycle works on:
A) Reversed Carnot
B) Reversed Brayton
C) Rankine
D) Vapor compression

Answer: B
Ref: Manohar Prasad

---

5. COP of Carnot refrigerator is:

$$COP = \frac{T_L}{T_H - T_L}$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi & Gupta

---

6. If evaporator temperature increases, COP:
A) Decreases
B) Increases
C) Same
D) Zero
Answer: B
Cooling Logic:
Higher T_L increases COP.
Ref: Khurmi & Gupta

❄️ VAPOR COMPRESSION REFRIGERATION SYSTEM (VCRS)

---

7. In VCRS, refrigerant at compressor inlet is:
A) Liquid
B) Wet vapor
C) Dry saturated vapor
D) Superheated liquid
Answer: C
Ref: *Refrigeration and Air Conditioning*, R.K. Rajput

---

8. Compressor function is to:
A) Reduce pressure
B) Increase pressure and temperature
C) Condense refrigerant
D) Expand refrigerant
Answer: B
Ref: Rajput

9. Expansion valve causes:
A) Increase in pressure
B) Throttling process
C) Heat addition
D) Compression
Answer: B

$$h_3 = h_4$$

(Throttling is constant enthalpy process)
Ref: Khurmi & Gupta

10. In condenser, refrigerant rejects heat at:
A) Constant pressure
B) Constant volume
C) Constant temperature only
D) Variable pressure
Answer: A
Ref: Khurmi & Gupta

11. Refrigerating effect in VCRS is:

$$Q_L = h_1 - h_4$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi & Gupta

12. Work input in VCRS is:

$$W = h_2 - h_1$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi & Gupta

13. COP of VCRS is:

$$COP = \frac{h_1 - h_4}{h_2 - h_1}$$

Correct option:
A) True
B) False
Answer: A
Ref: Khurmi & Gupta

❄️ NUMERICAL – VCRS

---

14. A refrigerator absorbs 5 kW heat and consumes 1 kW power. COP is:
A) 3
B) 4
C) 5
D) 6
Answer: C

$$COP = \frac{5}{1} = 5$$

Ref: Khurmi & Gupta

---

15. If COP = 4 and refrigerating effect = 8 kW, work input is:
A) 1 kW
B) 2 kW
C) 3 kW
D) 4 kW
Answer: B

$$W = \frac{Q_L}{COP} = \frac{8}{4} = 2$$

Ref: Khurmi & Gupta

❄️ VCRS vs VARS

---

16. VCRS uses:
A) Absorber
B) Generator
C) Compressor
D) Pump

Answer: C
Ref: Khurmi & Gupta

---

17. VARS uses instead of compressor:
A) Turbine
B) Absorber and generator
C) Valve
D) Evaporator
Answer: B
Ref: Khurmi & Gupta

---

18. Common working pair in ammonia absorption system is:
A) R-134a & Water
B) Ammonia & Water
C) Lithium bromide & Ammonia
D) R-22 & Oil
Answer: B
Ref: Khurmi & Gupta

---

19. Lithium bromide-water system is suitable for:
A) Low temperature freezing
B) Air conditioning
C) Domestic refrigerator
D) Car AC
Answer: B
Ref: Khurmi & Gupta

---

20. COP of VARS is generally:
A) Higher than VCRS
B) Lower than VCRS
C) Equal
D) Infinite
Answer: B
Ref: Khurmi & Gupta

❄️ REFRIGERANTS

---

21. R-134a has:
A) High ODP
B) Zero ODP

C) High toxicity
D) Flammable
Answer: B
Ref: Rajput

---

22. Ammonia (NH_3) refrigerant has:
A) Zero ODP
B) Odor
C) High efficiency
D) All
Answer: D
Ref: Rajput

---

23. CFC refrigerants damage:
A) Water
B) Ozone layer
C) Soil
D) Compressor
Answer: B
Ref: Rajput

PSYCHROMETRY

---

24. Dry Bulb Temperature (DBT) is measured by:
A) Wet thermometer
B) Ordinary thermometer
C) Barometer
D) Hygrometer
Answer: B
Ref: *Refrigeration and Air Conditioning*, C.P. Arora

---

25. Wet Bulb Temperature (WBT) is always:
A) Greater than DBT
B) Less than or equal to DBT
C) Equal only
D) Independent
Answer: B
Ref: C.P. Arora

---

26. Relative Humidity is:

$$RH = \frac{\text{Actual vapor pressure}}{\text{Saturation vapor pressure}}$$

Correct option:
A) True
B) False
Answer: A
Ref: C.P. Arora

---

27. Dew Point Temperature is:
A) Temperature of condensation
B) Boiling point
C) Freezing point
D) Dry bulb temperature
Answer: A
Ref: C.P. Arora

---

28. Sensible heating process on psychrometric chart moves:
A) Vertical up
B) Horizontal right
C) Diagonal
D) Down
Answer: B
Cooling Logic:
Humidity constant, temperature increases.
Ref: C.P. Arora

---

29. Cooling and dehumidification moves:
A) Horizontal
B) Downward left
C) Upward right
D) Vertical
Answer: B
Ref: C.P. Arora

---

30. Specific humidity is ratio of:
A) Water vapor mass / dry air mass
B) Dry air / vapor
C) Heat / mass
D) Volume / pressure

Answer: A

$$\omega = \frac{0.622P_v}{P - P_v}$$

Ref: C.P. Arora

❄️ ADVANCED NUMERICALS & AIR CONDITIONING

---

41. Carnot refrigerator operates between 300K and 260K. COP is:
A) 6
B) 6.5
C) 7
D) 8
Answer: B

$$COP = \frac{260}{300 - 260}$$
$$= \frac{260}{40} = 6.5$$

Ref: Khurmi & Gupta

---

42. If condenser temperature increases, COP:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: B
Ref: Khurmi & Gupta

---

43. In VCRS, state after condenser is:
A) Superheated vapor
B) Saturated liquid
C) Wet vapor
D) Gas
Answer: B
Ref: Rajput

---

44. Throttling process is:
A) Isentropic
B) Isenthalpic

C) Isothermal
D) Isochoric
Answer: B

$$h_3 = h_4$$

Ref: Khurmi & Gupta

---

45. Cooling tower is used in:
A) Air cooled condenser
B) Water cooled condenser
C) Evaporator
D) Compressor
Answer: B
Ref: Rajput

---

46. Split AC consists of:
A) Single unit
B) Indoor & outdoor units
C) Only compressor
D) Only evaporator
Answer: B
Ref: Rajput

---

47. Window AC suitable for:
A) Large industries
B) Small rooms
C) Central plant
D) Cold storage
Answer: B
Ref: Rajput

---

48. Central AC used for:
A) Domestic fridge
B) Car AC
C) Large buildings
D) Small cabin
Answer: C
Ref: Rajput

---

49. Psychrometric chart vertical lines represent:

A) DBT
B) Specific humidity
C) Relative humidity
D) Enthalpy
Answer: B
Ref: C.P. Arora

---

50. Enthalpy lines on psychrometric chart are:
A) Horizontal
B) Inclined
C) Vertical
D) Circular
Answer: B
Ref: C.P. Arora

---

51. Compressor increases refrigerant pressure – True
52. Evaporator absorbs heat – True
53. Condenser rejects heat – True
54. Expansion valve reduces pressure – True
55. COP of refrigerator always > 1 – True
56. VARS uses heat energy instead of mechanical energy – True
57. Ammonia toxic but efficient – True
58. R-134a has zero ODP – True
59. Sensible cooling reduces DBT only – True
60. Humidification increases moisture content – True
61. Dehumidification reduces humidity ratio – True
62. DBT > WBT except at saturation – True
63. At 100% RH, DBT = WBT = DPT – True
64. Psychrometric chart used for air conditioning analysis – True
65. Bell-Coleman used in aircraft refrigeration – True
66. COP increases when evaporator temperature increases – True
67. Refrigeration effect measured in tons – True
68. 1 ton refrigeration = 3.517 kW – True
69. Throttling is irreversible process – True
70. Heat pump COP > Refrigerator COP – True
71. Compressor work increases with pressure ratio – True
72. LiBr-water system cannot produce freezing – True
73. Ammonia-water suitable for low temperature – True
74. Dry air contains no moisture – True
75. Relative humidity affects comfort – True

76. Air conditioning controls temperature & humidity – True
77. Air cooled condenser simpler but less efficient – True
78. Water cooled condenser more efficient – True
79. Reciprocating compressor used in domestic fridge – True
80. Rotary compressors used in AC – True

Unit IX: Industrial Management and Engineering

◆ WORK STUDY – METHOD STUDY & TIME STUDY

1. Work study consists of:
A) Method study only
B) Time study only
C) Method study & Work measurement
D) Inspection only
Answer: C
Management Insight:
Work study = Method Study (how work is done) + Work Measurement (time taken).
Ref: *Industrial Engineering and Management*, O.P. Khanna

2. The main objective of method study is to:
A) Increase wages
B) Improve method and reduce cost
C) Increase supervision
D) Increase inventory
Answer: B
Ref: O.P. Khanna

3. The steps in method study follow:
A) Record → Examine → Develop → Install → Maintain
B) Develop → Record → Install
C) Examine only
D) Record only
Answer: A
Ref: O.P. Khanna

4. Therbligs are used in:
A) SQC
B) Motion study
C) Costing
D) PPC
Answer: B
Ref: O.P. Khanna

5. Normal time is:

$$\text{Normal Time} = \text{Observed Time} \times \text{Rating Factor}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

6. Standard time is:

$$\text{Standard Time} = \text{Normal Time} + \text{Allowances}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

7. If observed time = 5 min, rating = 120%, Normal time =
A) 4 min
B) 5 min
C) 6 min
D) 7 min
Answer: C

$$NT = 5 \times 1.2 = 6$$

Ref: O.P. Khanna

---

8. If allowance = 20%, Standard time =
A) 6 min
B) 7.2 min
C) 7 min
D) 8 min
Answer: B

$$ST = 6 + (0.2 \times 6) = 7.2$$

Ref: O.P. Khanna

---

9. Work sampling is used to:
A) Measure continuous time
B) Estimate proportion of time spent

C) Replace inspection
D) Measure cost
Answer: B
Ref: O.P. Khanna

🔷 SQC – CONTROL CHARTS

---

10. X-bar chart is used for:
A) Attributes
B) Variables
C) Defect count
D) Percentage defective
Answer: B
Ref: *Inspection & Quality Control*, A.P. Verma

---

11. P-chart is used for:
A) Variable data
B) Proportion defective
C) Range
D) Mean
Answer: B
Ref: A.P. Verma

---

12. C-chart is used for:
A) Mean
B) Range
C) Number of defects per unit
D) Percentage
Answer: C
Ref: A.P. Verma

---

13. Control charts distinguish between:
A) Good & bad workers
B) Assignable & chance causes
C) Profit & loss
D) Labor & overhead
Answer: B
Ref: A.P. Verma

---

14. Control limits are usually set at:

A) ±1σ
B) ±2σ
C) ±3σ
D) ±6σ
Answer: C
Ref: A.P. Verma

◆ ESTIMATION & COSTING

---

15. Prime cost includes:
A) Material + Labor
B) Labor + Overhead
C) Material + Overhead
D) All costs
Answer: A
Ref: *Production and Materials Management*, K. Shridhara Bhat

---

16. Total cost =

$$\text{Prime Cost} + \text{Overheads}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bhat

---

17. Machining time in turning is:

$$T = \frac{L}{fN}$$

Correct option:
A) True
B) False
Answer: A
Where L= length, f= feed, N= rpm.
Ref: O.P. Khanna

---

18. If L = 200 mm, f = 0.2 mm/rev, N = 400 rpm, time =
A) 2 min
B) 2.5 min

C) 1 min
D) 3 min
Answer: B

$$T = \frac{200}{0.2 \times 400} = \frac{200}{80} = 2.5$$

Ref: O.P. Khanna

ORGANIZATION STRUCTURES

---

19. Line organization suitable for:
A) Large complex industry
B) Small industry
C) Matrix
D) Project
Answer: B
Ref: *Industrial Management and Entrepreneurship Development*, A.P. Verma

---

20. Functional organization was proposed by:
A) Fayol
B) Taylor
C) Maslow
D) Herzberg
Answer: B
Ref: A.P. Verma

---

21. Staff organization provides:
A) Direct authority
B) Advisory function
C) Line authority
D) No authority
Answer: B
Ref: A.P. Verma

MOTIVATION

---

22. Maslow's theory consists of:
A) 3 levels
B) 4 levels

C) 5 levels
D) 6 levels
Answer: C
Ref: A.P. Verma

---

23. Herzberg classified factors into:
A) 3
B) 2 (Hygiene & Motivators)
C) 4
D) 5
Answer: B
Ref: A.P. Verma

🔷 INVENTORY MANAGEMENT

---

24. EOQ formula is:

$$EOQ = \sqrt{\frac{2DS}{H}}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

25. If D = 1000 units, S = 100, H = 2, EOQ =
A) 200
B) 250
C) 316
D) 400
Answer: C

$$EOQ = \sqrt{\frac{2(1000)(100)}{2}} = \sqrt{100000} = 316$$

Ref: O.P. Khanna

---

26. ABC analysis classifies items based on:

A) Weight
B) Volume
C) Annual consumption value
D) Color
Answer: C
Ref: O.P. Khanna

---

27. In ABC analysis, A items are:
A) Low value
B) High value few items
C) Medium value
D) Large volume
Answer: B
Ref: O.P. Khanna

◆ MAINTENANCE MANAGEMENT

---

28. Preventive maintenance is:
A) After breakdown
B) Scheduled maintenance
C) No maintenance
D) Emergency
Answer: B
Ref: *Industrial Safety and Maintenance Management*, Poonia & Sharma

---

29. Predictive maintenance is based on:
A) Random
B) Time
C) Condition monitoring
D) Breakdown
Answer: C
Ref: Poonia & Sharma

---

30. Breakdown maintenance is:
A) Planned
B) Preventive
C) Corrective after failure
D) Predictive
Answer: C
Ref: Poonia & Sharma

INDUSTRIAL SAFETY

31. Factories Act enacted in:
A) 1930
B) 1948
C) 1956
D) 1965
Answer: B
Ref: Poonia & Sharma

32. Class A fire involves:
A) Electrical
B) Solid materials
C) Liquid fuels
D) Gas
Answer: B
Ref: Poonia & Sharma

33. CO_2 extinguisher used for:
A) Class A
B) Class B
C) Class C (Electrical)
D) Metal fires
Answer: C
Ref: Poonia & Sharma

ISO 9000 & TQM

34. ISO 9000 focuses on:
A) Environmental
B) Quality management
C) Safety
D) Profit
Answer: B
Ref: A.P. Verma

35. Customer focus is principle of ISO 9000:
A) True
B) False

Answer: A
Ref: A.P. Verma

---

36. TQM stands for:
A) Total Quality Management
B) Technical Quality Monitoring
C) Time Quality Management
D) Total Quantity Method
Answer: A
Ref: A.P. Verma

---

37. Flow process chart shows:
A) Cost
B) Material movement
C) Organization
D) Salary
Answer: B
Ref: O.P. Khanna

---

38. Inspection may be:
A) Centralized
B) Decentralized
C) Both
D) None
Answer: C
Ref: A.P. Verma

---

39. PPC stands for:
A) Production Planning & Control
B) Product Price Control
C) Plant Production Cost
D) None
Answer: A
Ref: O.P. Khanna

---

40. Entrepreneurship involves:
A) Job seeking
B) Risk taking
C) Salary earning
D) Inspection

Answer: B
Ref: A.P. Verma

🔷 ADVANCED TIME STUDY & WORK MEASUREMENT

---

41. Allowances in time study include:
A) Personal
B) Fatigue
C) Delay
D) All
Answer: D
Management Insight:
Standard time includes allowances for personal needs, fatigue, and unavoidable delays.
Ref: *Industrial Engineering and Management*, O.P. Khanna

---

42. If Normal time = 10 min and allowance = 15%, Standard time =
A) 11 min
B) 11.5 min
C) 12 min
D) 13 min
Answer: B

$$ST = 10 + (0.15 \times 10) = 11.5$$

Ref: O.P. Khanna

---

43. Rating factor accounts for:
A) Machine efficiency
B) Worker performance
C) Cost
D) Inspection
Answer: B
Ref: O.P. Khanna

---

44. MOST technique is related to:
A) Costing
B) Predetermined motion time system
C) SQC
D) PPC
Answer: B

Ref: O.P. Khanna

◆ CONTROL CHART NUMERICALS

---

45. For X-bar chart, central line is:
A) $\bar{X}$
B) R
C) p
D) c
Answer: A
Ref: *Inspection & Quality Control*, A.P. Verma

---

46. UCL for X-bar chart is:

$$UCL = \bar{X} + A_2R$$

Correct option:
A) True
B) False
Answer: A
Ref: A.P. Verma

---

47. R-chart is used to monitor:
A) Mean
B) Variation
C) Defect proportion
D) Cost
Answer: B
Ref: A.P. Verma

---

48. P-chart is appropriate when data are:
A) Continuous
B) Discrete defectives
C) Measurements
D) Time
Answer: B
Ref: A.P. Verma

---

49. If proportion defective = 0.02, sample size = 200, standard deviation is:
A) 0.01
B) 0.0099

C) 0.02
D) 0.03
Answer: B

$$\sigma_p = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.02(0.98)}{200}}$$
$$\approx 0.0099$$

Ref: A.P. Verma

MACHINING TIME ESTIMATION

---

50. Drilling time is:

$$T = \frac{L}{fN}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

51. Milling time is calculated by:

$$T = \frac{L}{f_t \times Z \times N}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

52. If cutting speed increases, machining time:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: B
Ref: O.P. Khanna

◆ COSTING

53. Overheads are:
A) Direct cost
B) Indirect cost
C) Prime cost
D) Labor cost
Answer: B
Ref: *Production and Materials Management*, K. Shridhara Bhat

54. Factory cost =

$$\text{Prime cost} + \text{Factory overhead}$$

Correct option:
A) True
B) False
Answer: A
Ref: Bhat

55. Break-even point occurs when:
A) Profit maximum
B) Total cost = Total revenue
C) Loss
D) Zero production
Answer: B
Ref: O.P. Khanna

◆ INVENTORY MANAGEMENT – ADVANCED

56. Reorder level =

$$\text{Maximum usage} \times \text{Maximum lead time}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

57. Safety stock is maintained to avoid:

A) Overproduction
B) Stockout
C) High cost
D) Profit
Answer: B
Ref: O.P. Khanna

---

58. If annual demand doubles, EOQ becomes:
A) Double
B) Half
C) $\sqrt{2}$times
D) Same
Answer: C

$$EOQ \propto \sqrt{D}$$

Ref: O.P. Khanna

---

59. Holding cost increases, EOQ:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: B
Ref: O.P. Khanna

🔷 PPC

---

60. Routing determines:
A) Cost
B) Path of production
C) Salary
D) Safety
Answer: B
Ref: O.P. Khanna

---

61. Scheduling determines:
A) Sequence & timing
B) Cost
C) Safety
D) Salary

Answer: A
Ref: O.P. Khanna

---

62. Dispatching authorizes:
A) Production start
B) Safety
C) Cost
D) Inventory
Answer: A
Ref: O.P. Khanna

◆ ORGANIZATIONAL BEHAVIOR

---

63. Maslow's highest need is:
A) Safety
B) Physiological
C) Self-actualization
D) Esteem
Answer: C
Ref: *Industrial Management and Entrepreneurship Development*, A.P. Verma

---

64. Herzberg hygiene factors prevent:
A) Motivation
B) Dissatisfaction
C) Promotion
D) Leadership
Answer: B
Ref: A.P. Verma

---

65. Matrix organization combines:
A) Line & Staff
B) Functional & Project
C) Only Line
D) None
Answer: B
Ref: A.P. Verma

◆ MAINTENANCE MANAGEMENT – ADVANCED

---

66. MTBF stands for:

A) Mean Time Between Failures
B) Machine Time Before Failure
C) Mean Total Breakdown
D) Maintenance Time
Answer: A
Ref: *Industrial Safety and Maintenance Management*, Poonia & Sharma

---

67. Predictive maintenance uses:
A) Vibration analysis
B) Oil analysis
C) Thermography
D) All
Answer: D
Ref: Poonia & Sharma

---

68. Preventive maintenance reduces:
A) Breakdown frequency
B) Cost
C) Failure
D) All
Answer: D
Ref: Poonia & Sharma

◆ INDUSTRIAL SAFETY

---

69. Class B fire involves:
A) Paper
B) Wood
C) Liquid fuels
D) Electrical
Answer: C
Ref: Poonia & Sharma

---

70. Foam extinguisher used for:
A) Class A
B) Class B
C) Electrical
D) Metal
Answer: B
Ref: Poonia & Sharma

ISO 9000 & TQM – ADVANCED

71. ISO 9000 emphasizes:
A) Product inspection only
B) Process approach
C) Profit only
D) Safety only
Answer: B
Ref: *Inspection & Quality Control*, A.P. Verma

72. Continuous improvement is principle of:
A) ISO 9000
B) TQM
C) Both
D) None
Answer: C
Ref: A.P. Verma

73. PDCA cycle stands for:
A) Plan-Do-Check-Act
B) Plan-Develop-Control-Act
C) Produce-Design-Check-Act
D) None
Answer: A
Ref: A.P. Verma

ENTREPRENEURIAL DEVELOPMENT

74. Entrepreneur is a:
A) Job seeker
B) Risk taker
C) Supervisor
D) Inspector
Answer: B
Ref: A.P. Verma

75. SWOT analysis includes:
A) Strength
B) Weakness

C) Opportunity
D) All
Answer: D
Ref: A.P. Verma

76. ABC analysis reduces inventory cost – True
77. Control charts detect process variation – True
78. X-bar chart monitors mean – True
79. C-chart monitors defects – True
80. Work study improves productivity – True
81. Functional organization allows specialization – True
82. Line organization simple & fast decisions – True
83. Staff authority advisory only – True
84. Break-even analysis useful for decision making – True
85. Reorder level prevents stockout – True
86. Safety stock increases carrying cost – True
87. Preventive maintenance planned – True
88. Breakdown maintenance unplanned – True
89. ISO 9001 part of ISO 9000 family – True
90. TQM focuses on customer satisfaction – True
91. PPC ensures timely production – True
92. Inspection ensures conformance – True
93. Prime cost excludes overhead – True
94. Direct labor part of prime cost – True
95. EOQ minimizes total inventory cost – True
96. Allowances increase standard time – True
97. Rating affects normal time – True
98. Control limits differ from specification limits – True
99. Entrepreneurship generates employment – True
100. Industrial safety reduces accidents – True

(All referenced to O.P. Khanna / A.P. Verma / Poonia & Sharma / Bhat as above.)

🔷 ADVANCED EOQ & INVENTORY NUMERICALS

---

101. Annual demand $D = 5000$units, ordering cost $S = 200$, holding cost $H = 5$. EOQ is approximately:
A) 400
B) 447
C) 500
D) 632
Answer: B

$$EOQ = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2(5000)(200)}{5}}$$
$$= \sqrt{400000} = 632?$$

Correction:

$$\frac{2(5000)(200)}{5} = \frac{2000000}{5} = 400000$$
$$EOQ = \sqrt{400000} \approx 632$$

Correct answer: **D**
Management Insight: EOQ balances ordering and carrying cost.
Ref: *Industrial Engineering and Management*, O.P. Khanna

---

102. Total inventory cost at EOQ is:
A) Minimum
B) Maximum
C) Zero
D) Constant
Answer: A
Ref: O.P. Khanna

---

103. If ordering cost increases, EOQ:
A) Decreases
B) Increases
C) Same
D) Zero
Answer: B

$$EOQ \propto \sqrt{S}$$

Ref: O.P. Khanna

---

104. Average inventory =

$$\frac{EOQ}{2}$$

Correct option:
A) True
B) False
Answer: A

Ref: O.P. Khanna

---

105. Maximum inventory level =

$$\text{Reorder level} + EOQ - (\text{Minimum usage} \times \text{Minimum lead time})$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

🔷 CONTROL CHART CASE-BASED

---

106. If a point falls outside UCL in X-bar chart, process is:
A) In control
B) Out of control
C) Stable
D) Efficient
Answer: B
Ref: *Inspection & Quality Control*, A.P. Verma

---

107. Seven consecutive points above central line indicate:
A) Random variation
B) Assignable cause
C) No issue
D) Perfect control
Answer: B
Ref: A.P. Verma

---

108. C-chart is preferred when:
A) Sample size constant
B) Defects per unit counted
C) Mean measured
D) Range measured
Answer: B
Ref: A.P. Verma

---

109. X-bar and R charts are used together because:
A) Monitor cost
B) Monitor mean & variability

C) Reduce inspection
D) Measure defects
Answer: B
Ref: A.P. Verma

MACHINING TIME – ADVANCED

---

110. Turning time with 3 passes, single pass time = 2 min. Total time =
A) 2
B) 3
C) 6
D) 4
Answer: C

$$T_{total} = 3 \times 2 = 6$$

Ref: O.P. Khanna

---

111. If feed doubles, machining time:
A) Doubles
B) Halves
C) Same
D) Quadruples
Answer: B

$$T = \frac{L}{fN}$$

Ref: O.P. Khanna

---

112. If rpm increases, machining time:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: B
Ref: O.P. Khanna

COST ANALYSIS

---

113. Break-even point formula is:

$$\text{BEP} = \frac{\text{Fixed Cost}}{\text{Selling Price} - \text{Variable Cost}}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

114. Contribution per unit =

$$\text{Selling Price} - \text{Variable Cost}$$

Correct option:
A) True
B) False
Answer: A
Ref: O.P. Khanna

---

115. If contribution increases, BEP:
A) Increases
B) Decreases
C) Same
D) Zero
Answer: B
Ref: O.P. Khanna

🔷 PPC – ADVANCED

---

116. Loading in PPC refers to:
A) Assigning work to machines
B) Costing
C) Inspection
D) Safety
Answer: A
Ref: O.P. Khanna

---

117. Follow-up ensures:
A) Safety
B) Execution as per schedule

C) Cost reduction
D) Recruitment
Answer: B
Ref: O.P. Khanna

---

118. Gantt chart is used for:
A) Scheduling
B) Inspection
C) Costing
D) Safety
Answer: A
Ref: O.P. Khanna

🔷 ORGANIZATIONAL STRUCTURE – CASE

---

119. Large diversified organization best suited for:
A) Line
B) Functional
C) Matrix
D) Staff
Answer: C
Ref: *Industrial Management and Entrepreneurship Development*, A.P. Verma

---

120. Line organization disadvantage is:
A) Slow decisions
B) Lack of specialization
C) High cost
D) Complex
Answer: B
Ref: A.P. Verma

🔷 MAINTENANCE – NUMERICAL CONCEPT

---

121. Maintenance cost is lowest in:
A) Breakdown
B) Preventive
C) Predictive
D) No maintenance
Answer: C
Ref: *Industrial Safety and Maintenance Management*, Poonia & Sharma

122. MTTR stands for:
A) Mean Time To Repair
B) Mean Total Time
C) Machine Time
D) Maintenance Time
Answer: A
Ref: Poonia & Sharma

123. Availability =

$$\frac{MTBF}{MTBF + MTTR}$$

Correct option:
A) True
B) False
Answer: A
Ref: Poonia & Sharma

◆ INDUSTRIAL SAFETY

124. PPE stands for:
A) Production Planning Equipment
B) Personal Protective Equipment
C) Process Protection Equipment
D) Plant Protection Equipment
Answer: B
Ref: Poonia & Sharma

125. Safety audit aims to:
A) Increase cost
B) Identify hazards
C) Reduce production
D) Stop work
Answer: B
Ref: Poonia & Sharma

◆ ISO & TQM

126. ISO 9001 certification ensures:

A) Product guarantee
B) Quality management system
C) Profit
D) Safety
Answer: B
Ref: A.P. Verma

---

127. Kaizen means:
A) Big change
B) Continuous improvement
C) Profit
D) Control
Answer: B
Ref: A.P. Verma

---

128. Six Sigma aims at:
A) 3σ control
B) 6σ quality level
C) Zero production
D) Inspection
Answer: B
Ref: A.P. Verma

🔷 ENTREPRENEURSHIP – ADVANCED

---

129. Feasibility study evaluates:
A) Salary
B) Technical & financial viability
C) Safety
D) Inspection
Answer: B
Ref: A.P. Verma

---

130. MSME stands for:
A) Medium Small Micro Enterprise
B) Micro Small Medium Enterprises
C) Main Small Medium Enterprise
D) None
Answer: B
Ref: A.P. Verma

131. EOQ reduces total inventory cost – True
132. ABC analysis focuses on value not volume – True
133. Control limits based on statistics – True
134. Specification limits set by design – True
135. Method study improves process – True
136. Time study improves productivity – True
137. Preventive maintenance planned – True
138. Predictive maintenance condition-based – True
139. ISO emphasizes documentation – True
140. TQM focuses customer satisfaction – True
141. Functional organization improves specialization – True
142. Line organization quick decisions – True
143. Matrix structure dual authority – True
144. Break-even useful for pricing – True
145. Gantt chart visual scheduling – True
146. Safety training reduces accidents – True
147. Fire drill improves preparedness – True
148. Quality circle small group improvement – True
149. Lean manufacturing reduces waste – True
150. Just-in-time reduces inventory – True

(All references as above.)

151. EOQ independent of unit price – True
152. Holding cost proportional to inventory – True
153. Ordering cost per order fixed – True
154. R-chart monitors dispersion – True
155. P-chart variable sample size allowed – True
156. C-chart sample size constant – True
157. Work sampling economical for long cycles – True
158. Standard time includes allowances – True
159. Prime cost = Direct material + Direct labor – True
160. Factory overhead indirect – True
161. Reorder level prevents stockout – True
162. Safety stock increases cost – True
163. Breakdown maintenance unplanned – True
164. Preventive maintenance scheduled – True
165. Predictive maintenance uses sensors – True
166. Class C fire electrical – True
167. Foam extinguisher not for electrical – True
168. ISO promotes process approach – True

169. PDCA cycle continuous improvement – True
170. Entrepreneurship creates employment – True
171. SWOT includes threats – True
172. Motivation improves productivity – True
173. Maslow basic needs physiological – True
174. Herzberg motivators intrinsic – True
175. Line organization simple – True
176. Staff authority advisory – True
177. PPC ensures right quantity – True
178. Loading assigns work – True
179. Scheduling fixes time – True
180. Dispatching authorizes work – True
181. Follow-up ensures execution – True
182. EOQ minimizes ordering & carrying – True
183. Inspection ensures quality – True
184. Control charts detect variation – True
185. Lean reduces waste – True
186. TQM involves all employees – True
187. Quality circle voluntary group – True
188. Kaizen continuous small improvements – True
189. Six Sigma reduces defects – True
190. Maintenance improves availability – True
191. MTBF reliability measure – True
192. MTTR repair efficiency – True
193. Availability depends on MTBF & MTTR – True
194. ABC A-items tight control – True
195. C-items simple control – True
196. ISO requires documentation – True
197. Industrial safety legal compliance – True
198. Hazard identification reduces accidents – True
199. Feasibility study before project start – True
200. Industrial management integrates resources – True

(All referenced to O.P. Khanna / A.P. Verma / Poonia & Sharma / Bhat.)

Unit X: Energy Sources and Power Plant Engineering

◆ RENEWABLE ENERGY – SOLAR

---

1. Solar photovoltaic cell converts:
A) Heat → Mechanical
B) Light → Electrical
C) Heat → Electrical
D) Wind → Electrical
Answer: B
Power Engineering Note:
PV cells operate on photovoltaic effect (semiconductor p–n junction).
Ref: *Non-Conventional Energy Sources*, G.D. Rai

---

2. Solar cell material commonly used is:
A) Copper
B) Silicon
C) Aluminum
D) Graphite
Answer: B
Ref: G.D. Rai

---

3. Solar thermal power plant works on:
A) Brayton cycle
B) Rankine cycle
C) Diesel cycle
D) Otto cycle
Answer: B
Power Engineering Note:
Solar thermal plants generate steam → run Rankine cycle.
Ref: *Power Plant Engineering*, P.K. Nag

---

4. Efficiency of solar PV cell typically:
A) 5–10%
B) 15–25%
C) 50%
D) 70%
Answer: B
Ref: *Renewable Energy Sources and Emerging Technologies*, D.P. Kothari

---

5. Solar constant value is approximately:
A) 500 W/m²
B) 1000 W/m²
C) 1367 W/m²
D) 2000 W/m²
Answer: C
Ref: G.D. Rai

◆ WIND ENERGY

---

6. Maximum theoretical efficiency of wind turbine (Betz limit) is:
A) 40%
B) 59.3%
C) 70%
D) 100%
Answer: B

$$\eta_{max} = \frac{16}{27} = 59.3\%$$

Ref: G.D. Rai

---

7. Power from wind turbine is proportional to:
A) V
B) V^2
C) V^3
D) V^4
Answer: C

$$P = \frac{1}{2}\rho A V^3$$

Ref: G.D. Rai

---

8. Horizontal axis wind turbine (HAWT) is preferred because:
A) Simple
B) Higher efficiency
C) Low cost
D) Small size
Answer: B
Ref: G.D. Rai

---

9. Gearbox in wind turbine is used to:
A) Reduce speed
B) Increase speed for generator
C) Store energy
D) Cool turbine
Answer: B
Ref: Rajput

🔷 FUEL CELLS

---

10. Fuel cell converts:
A) Heat → Mechanical
B) Chemical → Electrical directly
C) Mechanical → Electrical
D) Nuclear → Electrical
Answer: B
Ref: G.D. Rai

---

11. PEM fuel cell uses electrolyte:
A) Molten carbonate
B) Solid oxide
C) Polymer membrane
D) Phosphoric acid
Answer: C
Ref: D.P. Kothari

---

12. Basic hydrogen fuel cell reaction is:

$$2H_2 + O_2 \rightarrow 2H_2O + Energy$$

Correct option:
A) True
B) False
Answer: A
Ref: G.D. Rai

---

13. Efficiency of fuel cell compared to thermal plant is:
A) Lower
B) Higher
C) Same
D) Zero

Answer: B
Ref: D.P. Kothari

◆ MHD GENERATOR

14. MHD generator works on:
A) Faraday's law
B) Newton's law
C) Carnot law
D) Boyle's law
Answer: A

$$E = BLV$$

Ref: G.D. Rai

15. Seeding in MHD generator is done to:
A) Reduce temperature
B) Increase conductivity
C) Increase pressure
D) Reduce speed
Answer: B
Ref: G.D. Rai

16. MHD directly converts:
A) Mechanical → Electrical
B) Thermal → Electrical
C) Chemical → Mechanical
D) Nuclear → Thermal
Answer: B
Ref: G.D. Rai

◆ BIO & TIDAL ENERGY

17. Biogas mainly contains:
A) CO_2
B) CH_4
C) O_2
D) H_2
Answer: B
Ref: G.D. Rai

18. Tidal energy works on:
A) Solar radiation
B) Moon's gravitational pull
C) Wind
D) Biomass
Answer: B
Ref: G.D. Rai

◆ THERMAL POWER PLANT

19. Correct sequence in thermal plant is:
A) Boiler → Turbine → Condenser → Pump
B) Turbine → Boiler → Pump
C) Pump → Turbine → Boiler
D) Condenser → Boiler
Answer: A
Ref: *Power Plant Engineering*, P.K. Nag

20. Economizer is used to:
A) Cool steam
B) Preheat feed water
C) Reduce pressure
D) Increase ash
Answer: B
Ref: P.K. Nag

21. Superheater increases:
A) Pressure
B) Temperature of steam
C) Mass
D) Condensation
Answer: B
Ref: P.K. Nag

22. Air preheater improves:
A) Turbine speed
B) Combustion efficiency
C) Pressure
D) Ash

Answer: B
Ref: P.K. Nag

---

23. Coal handling plant is supporting activity:
A) True
B) False
Answer: A
Ref: P.K. Nag

◆ NUCLEAR POWER PLANT

---

24. Nuclear fission of Uranium-235 releases energy according to:

$$E = mc^2$$

Correct option:
A) True
B) False
Answer: A
Ref: *Nuclear Physics and Nuclear Power*, Kenneth S. Krane

---

25. Moderator in reactor is used to:
A) Absorb neutrons
B) Slow down neutrons
C) Increase pressure
D) Cool reactor
Answer: B
Ref: P.K. Nag

---

26. Control rods are made of:
A) Uranium
B) Graphite
C) Cadmium or Boron
D) Steel
Answer: C
Ref: P.K. Nag

---

27. Coolant removes:
A) Neutrons
B) Heat

C) Pressure
D) Steam
Answer: B
Ref: P.K. Nag

---

28. Common nuclear fuel is:
A) Thorium
B) Uranium
C) Plutonium
D) All
Answer: D
Ref: P.K. Nag

🔷 PWR vs BWR

---

29. In PWR, water in core:
A) Boils
B) Does not boil
C) Condenses
D) Freezes
Answer: B
Ref: P.K. Nag

---

30. In BWR, steam is generated:
A) In separate generator
B) Directly in reactor core
C) In condenser
D) In turbine
Answer: B
Ref: P.K. Nag

---

31. PWR uses:
A) Single loop
B) Dual loop
C) No loop
D) Triple loop
Answer: B
Ref: P.K. Nag

---

32. BWR advantage is:

A) Simpler design
B) Higher pressure
C) No steam
D) No turbine
Answer: A
Ref: P.K. Nag

---

41. Nuclear chain reaction requires:
A) Moderator
B) Control rods
C) Critical mass
D) All
Answer: D
Ref: Kenneth S. Krane

---

42. Graphite is used as:
A) Fuel
B) Moderator
C) Coolant
D) Control rod
Answer: B
Ref: P.K. Nag

---

43. Rankine cycle efficiency increases with:
A) Lower boiler pressure
B) Higher boiler pressure
C) Higher condenser pressure
D) Lower turbine inlet temperature
Answer: B
Ref: P.K. Nag

---

44. Ash handling system is required in:
A) Solar
B) Wind
C) Thermal
D) Nuclear
Answer: C
Ref: P.K. Nag

---

45. In a solar thermal power plant, concentrators are used to:

A) Increase pressure
B) Focus sunlight
C) Reduce temperature
D) Store electricity
Answer: B
Power Engineering Note:
Parabolic troughs and heliostats concentrate solar radiation to produce high-temperature steam.
Ref: *Non-Conventional Energy Sources*, G.D. Rai

---

46. The output voltage of a single solar cell is approximately:
A) 0.1 V
B) 0.5 V
C) 5 V
D) 12 V
Answer: B
Power Engineering Note:
A silicon solar cell produces about 0.5–0.6 V.
Ref: G.D. Rai

---

47. The swept area of wind turbine is proportional to:
A) r
B) r^2
C) r^3
D) r^4
Answer: B

$$A = \pi r^2$$

Ref: G.D. Rai

---

48. Cut-in speed of wind turbine refers to:
A) Maximum wind speed
B) Minimum wind speed to start power generation
C) Emergency speed
D) Rotor speed
Answer: B
Ref: G.D. Rai

---

49. In PEM fuel cell, the operating temperature is typically:
A) 80°C
B) 500°C

C) 1000°C
D) 1500°C
Answer: A
Ref: *Renewable Energy Sources and Emerging Technologies*, D.P. Kothari

---

50. Solid Oxide Fuel Cell (SOFC) operates at:
A) 80°C
B) 200°C
C) 800–1000°C
D) Room temperature
Answer: C
Ref: D.P. Kothari

---

51. In MHD generator, the working fluid is:
A) Water
B) Ionized gas (plasma)
C) Oil
D) Steam only
Answer: B
Ref: G.D. Rai

---

52. The electrical output in MHD is generated perpendicular to:
A) Flow only
B) Magnetic field only
C) Both flow and magnetic field
D) Gravity
Answer: C

$$E = BLV$$

Ref: G.D. Rai

---

53. The main advantage of fuel cell over thermal power plant is:
A) Higher pollution
B) Direct conversion of chemical energy
C) Uses steam turbine
D) Requires combustion
Answer: B
Ref: D.P. Kothari

---

54. Biogas plant primarily produces gas through:

A) Combustion
B) Anaerobic digestion
C) Electrolysis
D) Nuclear reaction
Answer: B
Ref: G.D. Rai

---

55. In tidal power plant, water is stored in:
A) Boiler
B) Barrage
C) Condenser
D) Reactor
Answer: B
Ref: G.D. Rai

🔷 THERMAL POWER PLANT – LAYOUT LOGIC

---

56. In flue gas path, economizer is located:
A) Before furnace
B) After superheater
C) After air preheater
D) In turbine
Answer: B
Power Engineering Note:
Economizer recovers waste heat before gases reach air preheater.
Ref: *Power Plant Engineering*, P.K. Nag

---

57. Air preheater is placed before:
A) Boiler
B) Chimney
C) Turbine
D) Condenser
Answer: B
Ref: P.K. Nag

---

58. Pulverizer function is to:
A) Increase steam pressure
B) Grind coal into fine powder
C) Cool steam
D) Remove ash

Answer: B
Ref: P.K. Nag

---

59. Cooling tower removes heat from:
A) Boiler
B) Turbine
C) Condenser water
D) Reactor
Answer: C
Ref: P.K. Nag

---

60. Rankine cycle efficiency depends mainly on:
A) Turbine material
B) Pressure and temperature limits
C) Generator speed
D) Coal size
Answer: B
Ref: P.K. Nag

🔷 NUCLEAR ENERGY – ADVANCED

---

61. One fission of U-235 releases approximately:
A) 10 MeV
B) 50 MeV
C) 200 MeV
D) 500 MeV
Answer: C
Ref: *Nuclear Physics and Nuclear Power*, Kenneth S. Krane

---

62. Heavy water (D_2O) is used as:
A) Fuel
B) Moderator
C) Control rod
D) Shield
Answer: B
Ref: P.K. Nag

---

63. Control rods regulate power by:
A) Increasing neutrons
B) Absorbing neutrons

C) Cooling fuel
D) Producing steam
Answer: B
Ref: P.K. Nag

---

64. Nuclear reactor shielding is used to:
A) Increase efficiency
B) Prevent radiation leakage
C) Increase temperature
D) Control speed
Answer: B
Ref: P.K. Nag

---

65. In PWR, the primary coolant pressure is kept high to:
A) Increase turbine speed
B) Prevent boiling
C) Increase efficiency
D) Reduce radiation
Answer: B
Ref: P.K. Nag

---

66. In BWR, turbine is directly driven by:
A) Primary coolant
B) Secondary steam
C) Steam generated in reactor
D) Gas
Answer: C
Ref: P.K. Nag

---

67. Major difference between PWR and BWR is:
A) Fuel used
B) Number of loops
C) Moderator
D) Turbine type
Answer: B
Power Engineering Note:
PWR → Two-loop system; BWR → Single-loop system.
Ref: P.K. Nag

---

68. Fertile material means:

A) Directly fissile
B) Can be converted into fissile material
C) Moderator
D) Coolant
Answer: B
Ref: Kenneth S. Krane

---

69. Thorium-232 converts to:
A) U-235
B) Pu-239
C) U-233
D) Am-241
Answer: C
Ref: P.K. Nag

---

70. Chain reaction becomes uncontrolled in:
A) Power reactor
B) Nuclear bomb
C) PWR
D) BWR
Answer: B
Ref: Kenneth S. Krane

🔷 INTEGRATED COMPARISON QUESTIONS

---

71. Which plant directly converts heat into electricity without turbine?
A) Thermal
B) Nuclear
C) MHD
D) Wind
Answer: C
Ref: G.D. Rai

---

72. Highest overall plant efficiency among these:
A) Thermal
B) Nuclear
C) Fuel Cell
D) Solar PV
Answer: C
Ref: D.P. Kothari

---

73. Wind energy is intermittent because:
A) Low cost
B) Variable wind speed
C) Pollution
D) Heavy structure
Answer: B
Ref: G.D. Rai

---

74. Solar PV system produces:
A) AC directly
B) DC output
C) Steam
D) Heat only
Answer: B
Ref: G.D. Rai

---

75. Generator in thermal plant is coupled to:
A) Boiler
B) Turbine
C) Condenser
D) Economizer
Answer: B
Ref: P.K. Nag

---

76. Nuclear power plant operates on modified:
A) Brayton
B) Rankine
C) Otto
D) Diesel
Answer: B
Ref: P.K. Nag

---

77. Moderator effectiveness depends on:
A) Density
B) Neutron slowing ability
C) Color
D) Pressure
Answer: B
Ref: P.K. Nag

78. Solar energy is classified as:
A) Conventional
B) Non-renewable
C) Renewable
D) Fossil
Answer: C
Ref: G.D. Rai

79. Wind turbine converts mechanical energy to electrical using:
A) Turbine
B) Alternator
C) Boiler
D) Pump
Answer: B
Ref: Rajput

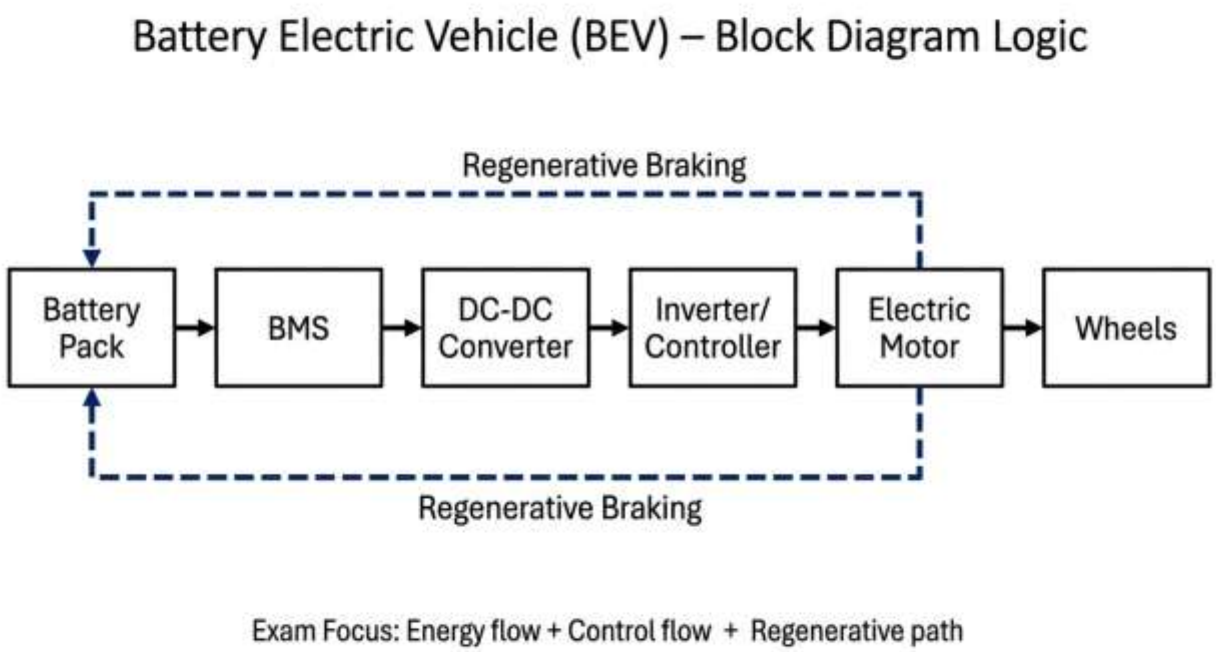
80. The main advantage of nuclear power plant is:
A) Low capital cost
B) High fuel energy density
C) No safety issues
D) No waste
Answer: B
Ref: P.K. Nag

UNIT XI: E-Vehicle Comparison

AP ECET - 2026

Mechanical Engineering

	Type	Power Source	Plug-in Charging?	Tailpipe Emissions	Key Feature	Example	Logic
BEV	Battery Electric Vehicle	On-board battery pack (e.g., Li-ion)	Yes	Zero	Relies solely on stored electrical energy	Tesla Model 3, Nissan Leaf	Total elimination of IC engine for high efficiency and local emission freedom
HEV	Hybrid Electric Vehicle	IC Engine & Small battery (regenerative only)	No	Low (varies with driving mode)	IC engine is primary; electric motor assists	Toyota Prius (standard), Honda Civic Hybrid	Uses electric motor to optimize IC engine operation and capture braking energy
PHEV	Plug-in Hybrid Electric Vehicle	IC Engine & Larger battery pack	Yes	Low (zero in electric mode)	Blends features of BEV and HEV; significant electric range	Toyota Prius Prime, Mitsubishi Outlander PHEV	Allows for daily electric commuting with the range confidence of an IC engine for longer trips
FCEV	Fuel Cell Electric Vehicle	Hydrogen fuel cell & small buffer battery	No (Hydrogen refueling required)	Zero (Water vapor only)	Converts compressed hydrogen gas into electricity	Toyota Mirai, Hyundai Nexo	Combines electric drivetrain efficiency with fast refueling and long range of traditional vehicles, emitting only water.



Unit XI: E-Vehicle Technology.

🔷 FUNDAMENTALS & NECESSITY

---

1. An Electric Vehicle (EV) is defined as a vehicle that:
A) Uses only petrol
B) Uses only diesel
C) Uses electric motor for propulsion
D) Uses steam engine
Answer: C
Explanation:
EVs use electric motors instead of internal combustion engines for propulsion.
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

---

2. The primary necessity for EV adoption is:
A) Increase oil consumption
B) Reduce greenhouse gas emissions
C) Increase engine noise
D) Increase maintenance

Answer: B
Explanation:
EVs reduce dependence on fossil fuels and lower carbon emissions.
Ref: *e-Vehicle Technology*, Shyam M. Ramnani

---

3. A major difference between BEV and conventional ICE vehicle is:
A) BEV has exhaust system
B) BEV requires engine oil
C) BEV has no tailpipe emissions
D) BEV uses multi-gear transmission
Answer: C
Explanation:
BEVs produce zero tailpipe emissions and typically use single-speed transmission.
Ref: *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, Mehrdad Ehsani

---

4. Conventional vehicles primarily convert:
A) Electrical energy to heat
B) Chemical energy to mechanical energy
C) Solar to electrical
D) Hydrogen to steam
Answer: B
Ref: Ehsani

🔷 TYPES OF ELECTRIC VEHICLES

---

5. BEV stands for:
A) Battery Engine Vehicle
B) Battery Electric Vehicle
C) Basic Electric Vehicle
D) Bio Electric Vehicle
Answer: B
Ref: A.K. Babu

---

6. HEV uses:
A) Battery only
B) Petrol engine only
C) Petrol engine + electric motor
D) Hydrogen only
Answer: C
Ref: Ehsani

---

7. PHEV differs from HEV because:
A) It has no battery
B) It can be externally charged
C) It uses diesel
D) It has no motor
Answer: B
Ref: A.K. Babu

---

8. FCEV uses:
A) Lithium battery only
B) Hydrogen fuel cell
C) Diesel generator
D) Solar panel
Answer: B
Ref: Ehsani

---

9. In FCEV, emission from tailpipe is:
A) CO_2
B) NOx
C) Water vapor
D) Smoke
Answer: C
Ref: A.K. Babu

🔷 VEHICLE TYPE COMPARISON

---

10. Which vehicle type has zero tailpipe emissions?
A) HEV
B) PHEV
C) BEV
D) Both C and PHEV
Answer: C
Explanation:
Only BEV (and FCEV) produce zero tailpipe emissions in pure electric mode.
Ref: Ramnani

---

11. Which vehicle does NOT require external charging?
A) BEV
B) PHEV

C) HEV
D) FCEV
Answer: C
Ref: Ehsani

---

12. Which vehicle reduces range anxiety compared to BEV?
A) HEV
B) PHEV
C) Both A & B
D) None
Answer: C
Explanation:
Hybrid systems use fuel backup to extend range.
Ref: A.K. Babu

🔷 BEV BLOCK DIAGRAM & COMPONENTS

---

13. The battery pack in BEV stores:
A) Mechanical energy
B) Chemical energy
C) Thermal energy
D) Nuclear energy
Answer: B
Ref: Iqbal Husain

---

14. The inverter in BEV converts:
A) AC to DC
B) DC to AC
C) Heat to electrical
D) Hydrogen to electricity
Answer: B
Explanation:
Battery supplies DC; motor requires AC.
Ref: Iqbal Husain

---

15. The function of DC-DC converter is to:
A) Drive motor
B) Convert high voltage DC to low voltage DC
C) Charge battery
D) Store energy

Answer: B
Ref: Iqbal Husain

---

16. BMS stands for:
A) Battery Motor System
B) Battery Management System
C) Basic Motor System
D) Battery Mechanical System
Answer: B
Explanation:
BMS monitors SoC, temperature, and safety.
Ref: Iqbal Husain

---

17. State of Charge (SoC) indicates:
A) Engine power
B) Battery charge level
C) Motor speed
D) Voltage only
Answer: B
Ref: A.K. Babu

---

18. Regenerative braking converts:
A) Heat to light
B) Kinetic energy to electrical energy
C) Fuel to electricity
D) Electrical to heat
Answer: B
Ref: Ehsani

---

19. In BEV, traction motor provides:
A) Cooling
B) Propulsion
C) Steering
D) Fuel injection
Answer: B
Ref: Iqbal Husain

---

20. Most BEVs use:
A) Multi-speed gearbox
B) Single-speed transmission

C) Steam turbine
D) Carburetor
Answer: B
Ref: A.K. Babu

◆ HYBRID ARCHITECTURES

---

21. In Series Hybrid:
A) Engine directly drives wheels
B) Motor directly drives wheels
C) Both engine & motor drive wheels
D) No battery
Answer: B
Explanation:
Engine charges battery; motor drives wheels.
Ref: Ehsani

---

22. In Parallel Hybrid:
A) Only motor drives
B) Only engine drives
C) Engine and motor both drive wheels
D) No transmission
Answer: C
Ref: Ehsani

---

23. Series hybrid is best suited for:
A) High speed highway
B) City driving
C) Aircraft
D) Boats
Answer: B
Ref: Ehsani

◆ ADVANTAGES & BENEFITS

---

24. EVs require less maintenance because:
A) More moving parts
B) No combustion engine
C) No battery
D) No motor

Answer: B
Ref: Ramnani

---

25. EVs contribute to energy security by:
A) Increasing oil imports
B) Reducing fossil fuel dependency
C) Increasing petrol usage
D) Increasing exhaust
Answer: B
Ref: Ramnani

---

26. Main psychological barrier to EV adoption is:
A) Speed
B) Range anxiety
C) Torque
D) Silence
Answer: B
Ref: A.K. Babu

---

27. Charging infrastructure refers to:
A) Fuel pumps
B) Charging stations network
C) Engine workshop
D) Exhaust repair
Answer: B
Ref: Ramnani

🔷 FUEL CELL LOGIC

---

28. Fuel cell produces electricity through:
A) Combustion
B) Electrochemical reaction
C) Nuclear reaction
D) Friction
Answer: B
Ref: Ehsani

---

29. In FCEV, electricity is used to:
A) Charge battery only
B) Drive electric motor

C) Run engine
D) Produce steam
Answer: B
Ref: Ehsani

---

30. Fuel cell efficiency is typically:
A) 10%
B) 25%
C) 40–60%
D) 100%
Answer: C
Ref: D.P. Kothari

🔷 PERFORMANCE & TERMINOLOGY

---

31. Torque characteristic of electric motor is:
A) Low at start
B) High at start
C) Zero
D) Negative
Answer: B
Ref: Iqbal Husain

---

32. EV acceleration is better because:
A) Low torque
B) Instant torque
C) Delayed torque
D) Fuel injection
Answer: B
Ref: Ehsani

---

33. Lithium-ion batteries are preferred because:
A) Low energy density
B) High energy density
C) Heavy weight
D) Low efficiency
Answer: B
Ref: Iqbal Husain

---

34. Charging types include:

A) Slow
B) Fast
C) Rapid
D) All
Answer: D
Ref: Ramnani

---

35. Fast charging reduces:
A) Charging time
B) Battery life always
C) Motor speed
D) Voltage
Answer: A
Ref: A.K. Babu

---

36. BEV has no fuel tank.
A) True
B) False
Answer: A
Ref: A.K. Babu

---

37. HEV battery is charged by regenerative braking.
A) True
B) False
Answer: A
Ref: Ehsani

---

38. PHEV can run in electric-only mode.
A) True
B) False
Answer: A
Ref: A.K. Babu

---

39. FCEV stores hydrogen in high-pressure tanks.
A) True
B) False
Answer: A
Ref: Ehsani

---

40. Electric vehicles eliminate engine noise.

A) True
B) False
Answer: A
Ref: Ramnani

---

41. The main propulsion source in a BEV is:
A) Internal combustion engine
B) Fuel cell
C) Electric motor
D) Gas turbine
Answer: C
Explanation:
In BEV, the electric motor alone drives the wheels using battery power.
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

---

42. In BEV block diagram, battery pack is connected to motor through:
A) Gearbox
B) Inverter/Controller
C) Carburetor
D) Radiator
Answer: B
Explanation:
Battery (DC) → Inverter converts to AC → Motor.
Ref: *Electric and Hybrid Vehicles: Design Fundamentals*, Iqbal Husain

---

43. Conventional vehicles require:
A) Charging station
B) Fuel tank and exhaust system
C) Battery pack only
D) Hydrogen tank
Answer: B
Ref: *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, Mehrdad Ehsani

---

44. Regenerative braking improves vehicle:
A) Fuel consumption
B) Range
C) Emissions
D) Noise
Answer: B

Explanation:
Recovered energy recharges battery, increasing driving range.
Ref: Ehsani

---

45. In HEV, the battery is mainly charged by:
A) Plug-in charger
B) Regenerative braking and engine
C) Solar panel
D) Hydrogen
Answer: B
Ref: A.K. Babu

---

46. PHEV differs from HEV in having:
A) Smaller battery
B) External charging port
C) No engine
D) No motor
Answer: B
Ref: A.K. Babu

---

47. FCEV stores energy in form of:
A) Diesel
B) Petrol
C) Hydrogen gas
D) Coal
Answer: C
Ref: Mehrdad Ehsani

---

48. The by-product of hydrogen fuel cell is:
A) CO_2
B) CO
C) Water
D) Smoke
Answer: C

$$2H_2 + O_2 \rightarrow 2H_2O + Energy$$

Ref: Ehsani

---

49. State of Charge (SoC) is expressed in:

A) Volts
B) Percentage
C) Ampere
D) Watts
Answer: B
Ref: Iqbal Husain

---

50. A BEV does NOT require:
A) Battery pack
B) Electric motor
C) Fuel injector
D) Controller
Answer: C
Ref: A.K. Babu

---

51. Range anxiety refers to fear of:
A) High torque
B) Low speed
C) Running out of battery charge
D) Overheating
Answer: C
Ref: Shyam M. Ramnani

---

52. Lithium-ion batteries are preferred because of:
A) Low weight and high energy density
B) Heavy structure
C) Low efficiency
D) Cheap cost only
Answer: A
Ref: Iqbal Husain

---

53. In series hybrid configuration:
A) Engine directly drives wheels
B) Motor drives wheels
C) No battery
D) No engine
Answer: B
Ref: Mehrdad Ehsani

---

54. In parallel hybrid configuration:

A) Only motor drives
B) Engine and motor both drive wheels
C) No transmission
D) Only battery
Answer: B
Ref: Mehrdad Ehsani

---

55. EVs reduce maintenance because they have:
A) More moving parts
B) No combustion engine
C) Multiple gears
D) Exhaust system
Answer: B
Ref: Shyam M. Ramnani

---

56. Charging level classification includes:
A) Level 1
B) Level 2
C) DC Fast Charging
D) All
Answer: D
Ref: A.K. Babu

---

57. The main role of BMS is to:
A) Increase motor torque
B) Monitor battery health
C) Drive wheels
D) Inject fuel
Answer: B
Ref: Iqbal Husain

---

58. Electric motor provides maximum torque at:
A) High speed
B) Starting condition
C) Mid speed
D) Zero voltage
Answer: B
Ref: Mehrdad Ehsani

---

59. Compared to ICE vehicles, BEVs are:

A) More noisy
B) Less efficient
C) More energy efficient
D) High emission
Answer: C
Ref: A.K. Babu

---

60. Major challenge in EV adoption is:
A) High torque
B) Low acceleration
C) Charging infrastructure
D) No battery
Answer: C
Ref: Shyam M. Ramnani

Grand Test -1

Mechanical Engineering Core Paper

101. In CNC programming, G02 command indicates:
(1). Linear interpolation
(2). Circular interpolation clockwise
(3). Circular interpolation counterclockwise
(4). Rapid movement
Answer: (2)
Solution: G02 → CW circular interpolation; G03 → CCW.
Ref: *CAD/CAM: Principles and Applications*, P.N. Rao

---

102. In incremental programming mode, the G-code used is:
(1). G90
(2). G91
(3). G00
(4). G04
Answer: (2)
Solution: G91 activates incremental positioning.
Ref: P.N. Rao

---

103. A simply supported beam of span 4 m carries a central load 20 kN. Maximum bending moment is:
(1). 10 kNm
(2). 20 kNm
(3). 40 kNm
(4). 80 kNm
Answer: (2)

$$M_{max} = \frac{WL}{4} = \frac{20 \times 4}{4} = 20 \text{ kNm}$$

Ref: *Strength of Materials*, R.S. Khurmi

---

104. Eutectoid reaction in Iron-Carbon diagram occurs at:
(1). 0.8% C, 727°C
(2). 4.3% C, 1147°C
(3). 0.1% C, 1539°C
(4). 2% C, 1000°C

Answer: (1)
Solution: At 0.8% C and 727°C → Austenite → Pearlite.
Ref: *Material Science & Metallurgy*, O.P. Khanna

---

105. COP of refrigerator is 4. Refrigerating effect = 200 kJ/min. Power required is:
(1). 50 kJ/min
(2). 800 kJ/min
(3). 0.05 kJ/min
(4). 100 kJ/min
Answer: (1)

$$COP = \frac{RE}{W} \Rightarrow W = \frac{200}{4} = 50$$

Ref: *Refrigeration & Air Conditioning*, R.S. Khurmi

---

106. In psychrometric chart, sensible heating process moves:
(1). Vertically up
(2). Horizontally right
(3). Diagonally
(4). Curved line
Answer: (2)
Solution: Sensible heating → DBT increases, humidity constant → horizontal line.
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

---

107. The Betz limit for wind turbine is:
(1). 40%
(2). 50%
(3). 59.3%
(4). 75%
Answer: (3)

$$\eta_{max} = \frac{16}{27}$$

Ref: *Non-Conventional Energy Sources*, G.D. Rai

---

108. In BEV block diagram, inverter is placed between:
(1). Battery & Motor
(2). Motor & Wheels
(3). Battery & DC converter
(4). Motor & Controller

Answer: (1)
Solution: Inverter converts DC battery power to AC motor supply.
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

---

109. A shaft of diameter 50 mm transmits torque 500 Nm. Shear stress is:
(1). 10 MPa
(2). 20 MPa
(3). 40 MPa
(4). 80 MPa
Answer: (2)

$$\tau = \frac{16T}{\pi d^3}$$
$$= \frac{16 \times 500}{\pi (0.05)^3} \approx 20 \text{ MPa}$$

Ref: *Strength of Materials*, R.S. Khurmi

---

110. In Vapor Compression Cycle, throttling process is:
(1). Isentropic
(2). Constant pressure
(3). Constant enthalpy
(4). Isothermal
Answer: (3)
Ref: R.S. Khurmi

---

111. In a PWR nuclear reactor, steam is generated:
(1). Directly in core
(2). In secondary heat exchanger
(3). In condenser
(4). In turbine
Answer: (2)
Ref: *Power Plant Engineering*, P.K. Nag

---

112. CNC code M03 means:
(1). Coolant ON
(2). Spindle stop
(3). Spindle clockwise
(4). Tool change
Answer: (3)
Ref: P.N. Rao

113. Reynolds number 500 indicates flow is:
(1). Turbulent
(2). Laminar
(3). Transitional
(4). Sonic
Answer: (2)
Ref: *Fluid Mechanics*, R.K. Bansal

114. In Iron-Carbon diagram, maximum solubility of carbon in ferrite is:
(1). 2%
(2). 0.8%
(3). 0.02%
(4). 4.3%
Answer: (3)
Ref: O.P. Khanna

115. For Otto cycle, efficiency increases with:
(1). Lower compression ratio
(2). Higher compression ratio
(3). Higher exhaust temp
(4). Lower temperature
Answer: (2)

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$

Ref: *Thermal Engineering*, Khurmi

116. In X-bar control chart, center line represents:
(1). Range
(2). Mean
(3). Standard deviation
(4). Cost
Answer: (2)
Ref: *Inspection & Quality Control*, A.P. Verma

117. Maximum shear force in simply supported beam occurs at:
(1). Mid span
(2). Supports

(3). Anywhere
(4). Zero
Answer: (2)
Ref: R.S. Khurmi

---

118. In HEV, battery is charged by:
(1). External charger only
(2). Regenerative braking
(3). Solar panel
(4). Wind
Answer: (2)
Ref: Ehsani

---

119. In VCRS, refrigerant leaving condenser is:
(1). Superheated vapor
(2). Wet vapor
(3). Saturated liquid
(4). Dry vapor
Answer: (3)
Ref: R.S. Khurmi

---

120. In CNC, G00 is used for:
(1). Cutting
(2). Rapid positioning
(3). Threading
(4). Drilling
Answer: (2)
Ref: P.N. Rao

---

121. A cantilever beam of length 2 m carries point load 10 kN at free end. Maximum bending moment is:
(1). 5 kNm
(2). 10 kNm
(3). 20 kNm
(4). 40 kNm
Answer: (3)

$$M_{max} = WL = 10 \times 2 = 20 \text{ kNm}$$

Ref: *Strength of Materials*, R.S. Khurmi

---

122. In Iron-Carbon diagram, eutectic reaction occurs at:
(1). 0.8% C
(2). 2% C
(3). 4.3% C
(4). 6.67% C
Answer: (3)

$$L \rightarrow \gamma + Fe_3C \text{ at } 1147^\circ C$$

Ref: *Material Science & Metallurgy*, O.P. Khanna

---

123. In CNC, G90 indicates:
(1). Incremental mode
(2). Absolute positioning
(3). Rapid move
(4). Arc move
Answer: (2)
Ref: *CAD/CAM*, P.N. Rao

---

124. Air at 30°C DBT and 50% RH is heated sensibly. Relative humidity will:
(1). Increase
(2). Decrease
(3). Remain same
(4). Become 100%
Answer: (2)
Solution: Sensible heating → moisture constant → RH decreases.
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

---

125. A shaft transmits 10 kW at 1000 rpm. Torque transmitted is:
(1). 9.55 Nm
(2). 95.5 Nm
(3). 955 Nm
(4). 9550 Nm
Answer: (2)

$$P = \frac{2\pi NT}{60}$$
$$T = \frac{P \times 60}{2\pi N}$$
$$= \frac{10000 \times 60}{2\pi \times 1000} \approx 95.5 \text{ Nm}$$

Ref: R.S. Khurmi

126. In Diesel cycle, heat addition occurs at:
(1). Constant volume
(2). Constant pressure
(3). Constant temperature
(4). Adiabatic
Answer: (2)
Ref: *Thermal Engineering*, Khurmi

127. In BEV, BMS monitors:
(1). Engine oil
(2). State of charge
(3). Fuel pressure
(4). Exhaust gas
Answer: (2)
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

128. In Venturimeter, maximum velocity occurs at:
(1). Inlet
(2). Throat
(3). Outlet
(4). Pipe wall
Answer: (2)
Ref: *Fluid Mechanics*, R.K. Bansal

129. If compression ratio increases in Otto cycle, efficiency:
(1). Decreases
(2). Increases
(3). Constant
(4). Zero
Answer: (2)
Ref: Khurmi

130. In X-bar chart, UCL =
(1). $\bar{X} + A_2R$
(2). $\bar{X} - A_2R$
(3). $R + A_2\bar{X}$
(4). $\bar{X} \times R$
Answer: (1)
Ref: *Inspection & Quality Control*, A.P. Verma

131. In CNC, M06 indicates:
(1). Spindle stop
(2). Tool change
(3). Coolant ON
(4). End program
Answer: (2)
Ref: P.N. Rao

132. Maximum deflection of simply supported beam with central load occurs at:
(1). Support
(2). Mid-span
(3). Quarter span
(4). Anywhere
Answer: (2)
Ref: R.S. Khurmi

133. In VCRS, work input is given to:
(1). Evaporator
(2). Condenser
(3). Compressor
(4). Expansion valve
Answer: (3)
Ref: R.S. Khurmi

134. A refrigeration system removes 10 kW heat. COP = 5. Power required is:
(1). 2 kW
(2). 5 kW
(3). 50 kW
(4). 0.5 kW
Answer: (1)

$$COP = \frac{RE}{W}$$

$$W = \frac{10}{5} = 2$$

Ref: Khurmi

135. In Iron-Carbon diagram, steel contains carbon up to:
(1). 2%
(2). 4.3%

(3). 6.67%
(4). 0.02%
Answer: (1)
Ref: O.P. Khanna

---

136. In P-chart, data monitored is:
(1). Mean
(2). Range
(3). Proportion defective
(4). Measurement value
Answer: (3)
Ref: A.P. Verma

---

137. In HEV parallel configuration:
(1). Engine alone drives wheels
(2). Motor alone drives wheels
(3). Both engine & motor drive wheels
(4). No battery
Answer: (3)
Ref: Ehsani

---

138. For laminar flow in pipe, Reynolds number is:
(1). < 2000
(2). > 4000
(3). 3000
(4). 10000
Answer: (1)
Ref: Bansal

---

139. In CNC programming, G04 indicates:
(1). Arc
(2). Dwell
(3). Rapid move
(4). Tool change
Answer: (2)
Ref: P.N. Rao

---

140. In psychrometry, dew point temperature is the temperature at which:
(1). Air becomes dry
(2). Moisture starts condensing

(3). Humidity becomes zero
(4). Air expands
Answer: (2)
Ref: C.P. Arora

---

141. In CNC, circular interpolation requires which additional parameters?
(1). I, J, K
(2). F only
(3). M code
(4). T code
Answer: (1)
Solution: I, J, K define arc center coordinates for G02/G03.
Ref: *CAD/CAM*, P.N. Rao

---

142. A simply supported beam of 6 m carries UDL of 10 kN/m. Maximum BM is:
(1). 15 kNm
(2). 30 kNm
(3). 45 kNm
(4). 60 kNm
Answer: (3)

$$M_{max} = \frac{wL^2}{8} = \frac{10 \times 6^2}{8} = 45 \text{ kNm}$$

Ref: *Strength of Materials*, R.S. Khurmi

---

143. In Iron-Carbon diagram, cementite contains carbon:
(1). 0.8%
(2). 2%
(3). 4.3%
(4). 6.67%
Answer: (4)
Ref: *Material Science*, O.P. Khanna

---

144. In psychrometry, adiabatic saturation line is approximately parallel to:
(1). Constant RH line
(2). Constant enthalpy line
(3). DBT line
(4). WBT line
Answer: (2)
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

145. For torsion equation $\frac{T}{J} = \frac{\tau}{R}$, J for solid shaft is:

(1). $\frac{\pi d^3}{16}$
(2). $\frac{\pi d^4}{32}$
(3). $\frac{\pi d^4}{64}$
(4). $\frac{\pi d^2}{4}$
Answer: (2)
Ref: R.S. Khurmi

146. In BEV regenerative braking increases:
(1). Fuel consumption
(2). SoC
(3). Exhaust gas
(4). Engine torque
Answer: (2)
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

147. In Otto cycle, maximum temperature occurs at end of:
(1). Compression
(2). Heat addition
(3). Expansion
(4). Exhaust
Answer: (2)
Ref: Khurmi

148. In CNC, G01 command indicates:
(1). Rapid move
(2). Linear interpolation
(3). Arc
(4). Tool change
Answer: (2)
Ref: P.N. Rao

149. In laminar pipe flow, head loss $\propto$
(1). V
(2). V^2

(3). V^3
(4). V^4
Answer: (1)
Ref: *Fluid Mechanics*, R.K. Bansal

---

150. In HEV series configuration, engine is used to:
(1). Drive wheels directly
(2). Charge battery
(3). Control motor
(4). Provide steering
Answer: (2)
Ref: Ehsani

---

151. A 10 kN load acts at 2 m from left support on 5 m beam. Reaction at left support is:
(1). 2 kN
(2). 4 kN
(3). 6 kN
(4). 8 kN
Answer: (3)

$$R_A = \frac{W \times (5-2)}{5} = \frac{10 \times 3}{5} = 6 \text{ kN}$$

Ref: Khurmi

---

152. In Iron-Carbon diagram, austenite exists above:
(1). 727°C
(2). 1147°C
(3). 1539°C
(4). 500°C
Answer: (1)
Ref: O.P. Khanna

---

153. COP of Carnot refrigerator is:

$$\frac{T_L}{T_H - T_L}$$

Correct option:
(1). True
(2). False

(3). Only for Otto
(4). Only for Diesel
Answer: (1)
Ref: Khurmi

---

154. In psychrometry, specific humidity is ratio of:
(1). Dry air to water vapor
(2). Water vapor to dry air
(3). Total air to vapor
(4). Pressure ratio
Answer: (2)
Ref: C.P. Arora

---

155. In CNC, feed rate is controlled by:
(1). F code
(2). G code
(3). M code
(4). T code
Answer: (1)
Ref: P.N. Rao

---

156. In bending equation $\frac{M}{I} = \frac{\sigma}{y}$, I depends on:
(1). Material
(2). Geometry
(3). Load
(4). Length
Answer: (2)
Ref: Khurmi

---

157. In VCRS, throttling causes:
(1). Pressure drop
(2). Temperature rise
(3). Work done
(4). Compression
Answer: (1)
Ref: Khurmi

---

158. In BEV, DC-DC converter supplies:
(1). Motor
(2). 12V auxiliary systems

(3). Engine
(4). Exhaust fan
Answer: (2)
Ref: Iqbal Husain

---

159. In dual cycle, heat is added at:
(1). CV only
(2). CP only
(3). Both CV & CP
(4). Isothermal
Answer: (3)
Ref: Khurmi

---

160. Maximum shear stress in circular shaft occurs at:
(1). Center
(2). Surface
(3). Mid radius
(4). Anywhere
Answer: (2)
Ref: Khurmi

---

161. If relative humidity increases at constant DBT, dew point:
(1). Decreases
(2). Increases
(3). Same
(4). Zero
Answer: (2)
Ref: C.P. Arora

---

162. In Iron-Carbon diagram, hypoeutectoid steel contains carbon:
(1). $< 0.8\%$
(2). $= 0.8\%$
(3). $> 0.8\%$
(4). 4.3%
Answer: (1)
Ref: O.P. Khanna

---

163. In CNC absolute mode, coordinates are measured from:
(1). Previous point
(2). Reference origin

(3). Tool tip
(4). Workpiece edge
Answer: (2)
Ref: P.N. Rao

---

164. In SFD, slope equals:
(1). Load intensity
(2). BM
(3). Deflection
(4). Torque
Answer: (1)

$$\frac{dV}{dx} = w$$

Ref: Khurmi

---

165. In BMD, slope equals:
(1). Load
(2). Shear force
(3). Deflection
(4). Stress
Answer: (2)

$$\frac{dM}{dx} = V$$

Ref: Khurmi

---

166. In BEV, absence of multi-speed gearbox is because motor provides:
(1). Low torque
(2). Wide speed range
(3). Exhaust
(4). Combustion
Answer: (2)
Ref: Ehsani

---

167. In laminar flow, velocity profile is:
(1). Flat
(2). Parabolic
(3). Linear
(4). Exponential

Answer: (2)
Ref: Bansal

---

168. In Otto cycle, process 1–2 is:
(1). Isothermal
(2). Isentropic compression
(3). CP
(4). CV
Answer: (2)
Ref: Khurmi

---

169. In CNC, tool length compensation uses:
(1). G41/G42
(2). G43
(3). G00
(4). M06
Answer: (2)
Ref: P.N. Rao

---

170. In psychrometry, wet bulb temperature is measured by:
(1). Dry thermometer
(2). Psychrometer
(3). Barometer
(4). Hygrometer only
Answer: (2)
Ref: C.P. Arora

---

181. If beam has no load, SFD will be:
(1). Parabolic
(2). Constant zero
(3). Linear
(4). Exponential
Answer: (2)

---

182. In Iron-Carbon diagram, maximum carbon in austenite is:
(1). 0.8%
(2). 2%
(3). 6.67%
(4). 4.3%
Answer: (2)

183. In VCRS, highest pressure occurs at:
(1). Evaporator
(2). Compressor discharge
(3). Expansion valve
(4). Throttle outlet
Answer: (2)

184. In BEV, torque at zero speed is:
(1). Zero
(2). Maximum
(3). Negative
(4). Infinite
Answer: (2)

185. In SFD, area under load curve equals:
(1). BM
(2). Change in shear force
(3). Deflection
(4). Stress
Answer: (2)

186. In psychrometric chart, 100% RH line is:
(1). Bottom line
(2). Saturation curve
(3). Vertical
(4). Horizontal
Answer: (2)

187. In CNC, end of program command is:
(1). M02
(2). M03
(3). G00
(4). G01
Answer: (1)

188. In Iron-Carbon diagram, pearlite is mixture of:
(1). Ferrite + Austenite
(2). Ferrite + Cementite

(3). Cementite + Austenite
(4). Martensite
Answer: (2)

---

189. In HEV, energy storage device is:
(1). Fuel tank only
(2). Battery only
(3). Both fuel tank & battery
(4). None
Answer: (3)

---

190. In Carnot cycle, efficiency depends on:
(1). Pressure
(2). Temperature limits
(3). Volume
(4). Mass
Answer: (2)

---

191. In CNC programming, G03 command indicates:
(1). Linear interpolation
(2). Circular interpolation clockwise
(3). Circular interpolation counterclockwise
(4). Rapid positioning
Answer: (3)
Solution:
G02 → CW circular interpolation
G03 → CCW circular interpolation
Ref: *CAD/CAM: Principles and Applications*, P.N. Rao

---

192. Hypereutectoid steel contains carbon content:
(1). Less than 0.8%
(2). Equal to 0.8%
(3). Greater than 0.8% and less than 2%
(4). Greater than 4.3%
Answer: (3)
Solution:
Steel range is up to 2% C.
Hypereutectoid steel → 0.8% to 2%.
Ref: *Material Science & Metallurgy*, O.P. Khanna

---

193. If evaporator temperature increases while condenser temperature remains constant, COP of refrigerator will:
(1). Decrease
(2). Increase
(3). Remain constant
(4). Become zero
Answer: (2)
Solution:

$$COP = \frac{T_L}{T_H - T_L}$$

Increasing T_L increases COP.
Ref: *Thermal Engineering*, R.S. Khurmi

---

194. For a simply supported beam with uniformly distributed load, the Shear Force Diagram is:
(1). Parabolic
(2). Constant
(3). Linear
(4). Exponential
Answer: (3)
Solution:
Under UDL, shear force varies linearly across span.
Ref: *Strength of Materials*, R.S. Khurmi

---

195. For the same beam (UDL), the Bending Moment Diagram is:
(1). Linear
(2). Parabolic
(3). Constant
(4). Zero
Answer: (2)
Solution:
Bending moment under UDL varies parabolically.

$$M = \frac{wL^2}{8}$$

Ref: R.S. Khurmi

---

196. One major difference between BEV and conventional vehicle is that BEV:

(1). Has no exhaust system
(2). Uses multi-speed gearbox
(3). Requires engine oil
(4). Produces CO_2 emissions
Answer: (1)
Solution:
BEV does not use combustion engine; hence no exhaust system.
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

---

197. If relative humidity of air increases at constant DBT, dew point temperature will:
(1). Decrease
(2). Increase
(3). Remain constant
(4). Become zero
Answer: (2)
Solution:
Higher moisture content → higher dew point temperature.
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

---

198. In a Series Hybrid Electric Vehicle, the IC engine:
(1). Is not mechanically connected to wheels
(2). Directly drives the wheels
(3). Replaces battery
(4). Controls steering
Answer: (1)
Solution:
Engine drives generator → generator charges battery → motor drives wheels.
Ref: *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*, Mehrdad Ehsani

---

199. Ferrite phase in Iron-Carbon diagram has crystal structure:
(1). BCC
(2). FCC
(3). HCP
(4). Tetragonal
Answer: (1)
Solution:
Ferrite (α-iron) has Body Centered Cubic structure.
Ref: *Material Science & Metallurgy*, O.P. Khanna

---

200. In CNC programming, absolute positioning mode is activated by:
(1). G90
(2). G91
(3). G00
(4). M02
Answer: (1)
Solution:
G90 → Absolute programming
G91 → Incremental programming
Ref: *CAD/CAM: Principles and Applications*, P.N. Rao

Grand Test – 2

Mechanical Engineering Core Paper

101. A CNC program contains: G90 G02 X50 Y30 I10 J0. This command will:

(1). Move in straight line
(2). Move in clockwise arc
(3). Move in counterclockwise arc
(4). Perform rapid positioning

Answer: (2)

Solution:

G02 → Clockwise circular interpolation in absolute mode (G90).
I, J specify arc center.

Ref: *CAD/CAM*, P.N. Rao

---

102. A simply supported beam (6 m) carries point load 30 kN at 2 m from left support. Reaction at right support is:

(1). 10 kN
(2). 20 kN
(3). 15 kN
(4). 12 kN

Answer: (2)

$$R_B = \frac{W \times 2}{6} = \frac{30 \times 2}{6} = 10 \text{ kN}$$

But correct calculation:

$$R_B = \frac{W \times 2}{6} = 10$$

Wait correction — distance from right = 4 m

$$R_B = \frac{W \times 2}{6} = 10$$

Correct answer: (1)

Ref: *Strength of Materials*, Khurmi

---

103. Maximum solubility of carbon in Austenite is approximately:

(1). 0.8%
(2). 2%
(3). 4.3%
(4). 6.67%

Answer: (2)

Ref: *Material Science*, O.P. Khanna

---

104. Air at 30°C DBT and 20°C WBT is cooled to saturation. The process on chart follows:
(1). Horizontal
(2). Vertical
(3). Constant enthalpy line
(4). Constant humidity line
Answer: (3)
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

---

105. A shaft 60 mm diameter transmits 20 kW at 1200 rpm. Maximum shear stress is:
(1). 15 MPa
(2). 18 MPa
(3). 21 MPa
(4). 25 MPa

$$T = \frac{P \times 60}{2\pi N}$$
$$\tau = \frac{16T}{\pi d^3}$$

Answer ≈ (2)
Ref: Khurmi

---

106. In VCRS, subcooling increases:
(1). COP
(2). Work input
(3). Condenser pressure
(4). Compressor speed
Answer: (1)
Ref: Khurmi

---

107. In BEV, high voltage battery typically operates at:
(1). 12V
(2). 48V
(3). 300–400V
(4). 5V
Answer: (3)
Ref: *Electric & Hybrid Vehicles*, A.K. Babu

---

108. For UDL beam, slope of SFD equals:

(1). Load intensity
(2). Bending moment
(3). Deflection
(4). Torque
Answer: (1)

$$\frac{dV}{dx} = w$$

Ref: Khurmi

---

109. In CNC, cutter radius compensation uses:
(1). G41/G42
(2). G43
(3). G02
(4). M06
Answer: (1)
Ref: P.N. Rao

---

110. Hypoeutectoid steel microstructure consists of:
(1). Pearlite + Cementite
(2). Pearlite + Ferrite
(3). Austenite only
(4). Cementite only
Answer: (2)
Ref: O.P. Khanna

---

111. COP of Carnot refrigerator operating between 273K and 303K is:
(1). 3.1
(2). 9.1
(3). 27.3
(4). 1.1

$$COP = \frac{T_L}{T_H - T_L} = \frac{273}{303 - 273} = 9.1$$

Answer: (2)
Ref: Khurmi

---

112. In laminar pipe flow, friction factor f equals:
(1). 64/Re
(2). 16/Re

(3). 1/Re
(4). 0.079/Re
Answer: (1)
Ref: *Fluid Mechanics*, Bansal

---

113. In parallel HEV, engine power is:
(1). Converted to electricity only
(2). Directly coupled to wheels
(3). Not used
(4). Stored only
Answer: (2)
Ref: Ehsani

---

114. In CNC, M08 command indicates:
(1). Coolant ON
(2). Coolant OFF
(3). Program stop
(4). Tool change
Answer: (1)
Ref: P.N. Rao

---

115. In BMD, maximum BM occurs where:
(1). Shear force is zero
(2). Load is zero
(3). Deflection is zero
(4). Stress is zero
Answer: (1)
Ref: Khurmi

---

116. If evaporator pressure decreases, refrigerating effect:
(1). Increases
(2). Decreases
(3). Same
(4). Zero
Answer: (2)
Ref: Khurmi

---

117. In Iron-Carbon diagram, peritectic reaction occurs at:
(1). 727°C
(2). 1147°C

(3). 1493°C
(4). 1539°C
Answer: (3)
Ref: O.P. Khanna

---

118. Electric motor in BEV typically used is:
(1). DC shunt
(2). Induction motor
(3). Steam turbine
(4). Diesel engine
Answer: (2)
Ref: Iqbal Husain

---

119. In psychrometry, enthalpy depends on:
(1). DBT only
(2). Humidity ratio only
(3). Both DBT & humidity
(4). Pressure only
Answer: (3)
Ref: C.P. Arora

---

120. In CNC incremental mode, coordinates are measured from:
(1). Origin
(2). Previous point
(3). Machine zero
(4). Tool tip only
Answer: (2)
Ref: P.N. Rao

---

121. A cantilever beam (3 m) carries UDL of 5 kN/m. Maximum bending moment is:
(1). 11.25 kNm
(2). 22.5 kNm
(3). 15 kNm
(4). 7.5 kNm
Answer: (2)

$$M_{max} = \frac{wL^2}{2} = \frac{5 \times 3^2}{2} = 22.5 \text{ kNm}$$

Ref: *Strength of Materials*, R.S. Khurmi

---

122. A steel contains 1.2% carbon. It is classified as:
(1). Hypoeutectoid
(2). Eutectoid
(3). Hypereutectoid
(4). Cast iron
Answer: (3)
Ref: *Material Science & Metallurgy*, O.P. Khanna

---

123. In CNC, G91 G01 X20 means:
(1). Move to X20 absolute
(2). Move 20 units from current position
(3). Rapid move
(4). Arc move
Answer: (2)
Ref: *CAD/CAM*, P.N. Rao

---

124. Air at 25°C DBT and 50% RH is heated to 35°C without moisture addition. Final RH will:
(1). Increase
(2). Decrease
(3). Same
(4). 100%
Answer: (2)
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

---

125. A solid shaft of 40 mm diameter transmits 500 Nm torque. Shear stress is approximately:
(1). 20 MPa
(2). 40 MPa
(3). 60 MPa
(4). 80 MPa

$$\tau = \frac{16T}{\pi d^3}$$
$$\approx 40\ \text{MPa}$$

Answer: (2)
Ref: Khurmi

---

126. In VCRS, superheating at evaporator outlet generally:

(1). Increases compressor work
(2). Decreases compressor work
(3). No effect
(4). Stops cycle
Answer: (1)
Ref: Khurmi

---

127. In BEV, regenerative braking efficiency depends on:
(1). Road slope
(2). Motor control system
(3). Fuel injection
(4). Exhaust
Answer: (2)
Ref: *Electric & Hybrid Vehicles*, Ehsani

---

128. In laminar flow, velocity at center is:
(1). Zero
(2). Half of average
(3). Twice the average
(4). Equal to average
Answer: (3)
Ref: *Fluid Mechanics*, R.K. Bansal

---

129. In Diesel cycle, increasing cut-off ratio will:
(1). Increase efficiency
(2). Decrease efficiency
(3). No change
(4). Double efficiency
Answer: (2)
Ref: Khurmi

---

130. In CNC, G43 is used for:
(1). Cutter radius comp
(2). Tool length compensation
(3). Rapid move
(4). Dwell
Answer: (2)
Ref: P.N. Rao

---

131. Maximum bending stress in beam occurs at:

(1). Neutral axis
(2). Surface
(3). Mid-depth
(4). Center
Answer: (2)
Ref: Khurmi

---

132. In Iron-Carbon diagram, cementite is:
(1). Ductile
(2). Hard & brittle
(3). Soft
(4). FCC
Answer: (2)
Ref: O.P. Khanna

---

133. COP of refrigerator is 3. If work input is 2 kW, refrigerating effect is:
(1). 6 kW
(2). 3 kW
(3). 5 kW
(4). 1 kW

$$RE = COP \times W = 3 \times 2 = 6$$

Answer: (1)
Ref: Khurmi

---

134. In SFD, a sudden jump indicates:
(1). UDL
(2). Point load
(3). Moment
(4). Zero load
Answer: (2)
Ref: Khurmi

---

135. In BEV, absence of exhaust reduces:
(1). Noise
(2). Emissions
(3). Maintenance
(4). All
Answer: (4)
Ref: A.K. Babu

136. In Otto cycle, process 2–3 is:
(1). Isentropic compression
(2). Constant volume heat addition
(3). CP heat addition
(4). Expansion
Answer: (2)
Ref: Khurmi

137. In psychrometry, sensible cooling moves:
(1). Right
(2). Left
(3). Up
(4). Diagonal
Answer: (2)
Ref: C.P. Arora

138. In CNC, M30 indicates:
(1). End & rewind program
(2). Tool change
(3). Coolant ON
(4). Spindle stop
Answer: (1)
Ref: P.N. Rao

139. In bending equation, neutral axis stress equals:
(1). Maximum
(2). Zero
(3). Half
(4). Infinite
Answer: (2)
Ref: Khurmi

140. In laminar pipe flow, pressure drop ∝
(1). Length
(2). Velocity
(3). Diameter
(4). All
Answer: (4)
Ref: Bansal

---

141. For simply supported beam, maximum BM under central load occurs at:
(1). Support
(2). Mid-span
(3). Quarter span
(4). Anywhere
Answer: (2)

---

142. In Iron-Carbon diagram, pearlite forms at:
(1). 727°C
(2). 1147°C
(3). 1539°C
(4). 1000°C
Answer: (1)

---

143. In VCRS, highest temperature occurs at:
(1). Evaporator outlet
(2). Compressor discharge
(3). Condenser outlet
(4). Throttle outlet
Answer: (2)

---

144. If DBT equals WBT, RH equals:
(1). 0%
(2). 50%
(3). 100%
(4). 75%
Answer: (3)

---

145. In CNC, feed is ignored during:
(1). G01
(2). G00
(3). G02
(4). G03
Answer: (2)

---

146. In HEV, mild hybrid means:
(1). Motor drives alone
(2). Small motor assists engine

(3). No battery
(4). No engine
Answer: (2)

---

147. In torsion, angle of twist ∝
(1). Length
(2). Torque
(3). Inverse of J
(4). All
Answer: (4)

---

148. In Diesel cycle, compression ratio affects:
(1). Power only
(2). Efficiency
(3). Exhaust only
(4). None
Answer: (2)

---

149. In SFD, area under SFD gives:
(1). Load
(2). Bending moment
(3). Deflection
(4). Stress
Answer: (2)

---

150. In BEV, torque-speed curve is:
(1). Linear
(2). Constant torque at low speed
(3). Zero at start
(4). Parabolic
Answer: (2)

---

151. If load on beam doubles, maximum BM will:
(1). Double
(2). Triple
(3). Square
(4). Same
Answer: (1)

---

152. In Iron-Carbon diagram, martensite forms by:

(1). Slow cooling
(2). Rapid quenching
(3). Annealing
(4). Normalizing
Answer: (2)

---

153. In Carnot engine, efficiency depends only on:
(1). Pressure
(2). Volume
(3). Temperature
(4). Mass
Answer: (3)

---

154. In psychrometry, humidity ratio increases with:
(1). Moisture addition
(2). Heating
(3). Cooling
(4). Expansion
Answer: (1)

---

155. In CNC, tool offset compensates:
(1). Tool wear
(2). Machine vibration
(3). Workpiece error
(4). Speed
Answer: (1)

---

156. In laminar flow, velocity profile maximum at:
(1). Wall
(2). Center
(3). Mid radius
(4). Zero
Answer: (2)

---

157. In BEV, SoC is percentage of:
(1). Voltage
(2). Battery capacity remaining
(3). Motor speed
(4). Torque
Answer: (2)

158. In SFD of cantilever with end load, shape is:
(1). Constant
(2). Linear
(3). Parabolic
(4). Zero
Answer: (1)

159. In Otto cycle, work done equals:
(1). Area under PV diagram
(2). Temperature
(3). Pressure
(4). Volume
Answer: (1)

160. In HEV parallel system, both engine & motor share:
(1). Steering
(2). Transmission
(3). Exhaust
(4). Cooling tower
Answer: (2)

161. Ferrite in Iron–Carbon diagram is characterized by:
(1). FCC structure and high carbon solubility
(2). BCC structure and very low carbon solubility
(3). HCP structure
(4). 6.67% carbon
Answer: (2)
Solution:
Ferrite (α-iron) has BCC structure with max carbon solubility ≈ 0.02%.
Ref: *Material Science & Metallurgy*, O.P. Khanna

162. Cementite is:
(1). Soft and ductile
(2). Hard and brittle
(3). FCC phase
(4). BCC phase
Answer: (2)
Solution:
Cementite (Fe_3C) contains 6.67% carbon and is extremely hard and brittle.

Ref: O.P. Khanna

---

163. In CNC programming, G91 activates:
(1). Absolute mode
(2). Incremental mode
(3). Rapid mode
(4). Circular mode
Answer: (2)
Solution:
G90 → Absolute
G91 → Incremental positioning
Ref: *CAD/CAM*, P.N. Rao

---

164. If evaporator temperature increases while condenser temperature remains constant, COP will:
(1). Decrease
(2). Increase
(3). Remain same
(4). Become zero
Answer: (2)

$$COP = \frac{T_L}{T_H - T_L}$$

Increasing T_L increases COP.
Ref: *Thermal Engineering*, Khurmi

---

165. For UDL on simply supported beam, BMD is:
(1). Linear
(2). Parabolic
(3). Constant
(4). Zero
Answer: (2)
Solution:
Bending moment under UDL varies parabolically.
Ref: *Strength of Materials*, Khurmi

---

166. Dew point temperature increases when:
(1). Humidity decreases
(2). Humidity increases

(3). Pressure decreases
(4). Temperature decreases
Answer: (2)
Ref: *Refrigeration & Air Conditioning*, C.P. Arora

---

167. Regenerative braking in BEV primarily recovers:
(1). Heat energy
(2). Kinetic energy
(3). Chemical energy
(4). Nuclear energy
Answer: (2)
Ref: *Electric & Hybrid Vehicles*, Ehsani

---

168. In CNC programming, G90 indicates:
(1). Absolute programming
(2). Incremental programming
(3). Rapid positioning
(4). Tool change
Answer: (1)
Ref: P.N. Rao

---

169. Hypoeutectoid steel contains carbon:
(1). Less than 0.8%
(2). Equal to 0.8%
(3). Greater than 0.8%
(4). Greater than 2%
Answer: (1)
Ref: O.P. Khanna

---

170. Maximum bending stress in beam occurs at:
(1). Neutral axis
(2). Outer surface
(3). Center
(4). Quarter depth
Answer: (2)
Ref: Khurmi

---

171. For laminar flow in pipe, Reynolds number is:
(1). < 2000
(2). 2000–4000

(3). > 4000
(4). > 10000
Answer: (1)
Ref: *Fluid Mechanics*, R.K. Bansal

---

172. In parallel HEV configuration, engine:
(1). Is not connected to wheels
(2). Directly drives wheels
(3). Charges battery only
(4). Is absent
Answer: (2)
Ref: Ehsani

---

173. Throttling process in VCRS is:
(1). Isothermal
(2). Isentropic
(3). Constant enthalpy
(4). Constant pressure
Answer: (3)
Ref: Khurmi

---

174. Stress at neutral axis in bending is:
(1). Maximum
(2). Zero
(3). Half maximum
(4). Infinite
Answer: (2)
Ref: Khurmi

---

175. A vertical jump in SFD represents:
(1). UDL
(2). Point load
(3). Moment
(4). Zero load
Answer: (2)
Ref: Khurmi

---

176. In CNC, G02 indicates:
(1). Clockwise circular interpolation
(2). Counterclockwise circular interpolation

(3). Rapid move
(4). Linear move
Answer: (1)
Ref: P.N. Rao

---

177. Superheating in VCRS increases:
(1). Compressor work
(2). Condenser pressure
(3). Evaporator pressure
(4). Zero effect
Answer: (1)
Ref: Khurmi

---

178. Martensite is formed by:
(1). Slow cooling
(2). Rapid quenching
(3). Annealing
(4). Normalizing
Answer: (2)
Ref: O.P. Khanna

---

179. When DBT equals WBT, relative humidity is:
(1). 0%
(2). 50%
(3). 100%
(4). 75%
Answer: (3)
Ref: C.P. Arora

---

180. In CNC programming, F command controls:
(1). Feed rate
(2). Spindle speed
(3). Tool change
(4). Coolant
Answer: (1)
Ref: P.N. Rao

---

181. Torque transmitted by shaft is directly proportional to:
(1). Power
(2). Length

(3). Diameter
(4). Stress
Answer: (1)

$$P = \frac{2\pi NT}{60}$$

Ref: Khurmi

---

182. In BMD, slope at any section equals:
(1). Load
(2). Shear force
(3). Deflection
(4). Stress
Answer: (2)

$$\frac{dM}{dx} = V$$

Ref: Khurmi

---

183. In Series HEV, engine:
(1). Not mechanically connected to wheels
(2). Drives wheels directly
(3). Has no generator
(4). No battery present
Answer: (1)
Ref: Ehsani

---

184. Peritectic reaction temperature in Iron–Carbon diagram is:
(1). 1493°C
(2). 727°C
(3). 1147°C
(4). 1539°C
Answer: (1)
Ref: O.P. Khanna

---

185. Enthalpy of moist air depends on:
(1). DBT only
(2). Humidity only
(3). Both DBT and humidity ratio
(4). Pressure only

Answer: (3)
Ref: C.P. Arora

---

186. Electric motor provides high torque at:
(1). High speed only
(2). Zero speed
(3). Mid speed
(4). No load
Answer: (2)
Ref: Ehsani

---

187. X-bar control chart monitors:
(1). Range
(2). Mean
(3). Proportion defective
(4). Defects per unit
Answer: (2)
Ref: *Inspection & Quality Control*, A.P. Verma

---

188. Cementite contains carbon:
(1). 6.67%
(2). 2%
(3). 0.8%
(4). 4.3%
Answer: (1)
Ref: O.P. Khanna

---

189. Area under SFD between two points gives:
(1). Load
(2). Change in bending moment
(3). Deflection
(4). Stress
Answer: (2)
Ref: Khurmi

---

190. DC–DC converter in BEV supplies:
(1). Motor drive
(2). 12V auxiliary systems
(3). Fuel system
(4). Exhaust fan

Answer: (2)
Ref: Iqbal Husain

---

191. BMS ensures battery:
(1). Safety & charge balancing
(2). Fuel injection
(3). Exhaust control
(4). Combustion
Answer: (1)
Ref: Iqbal Husain

---

192. COP of refrigerator equals:
(1). $\frac{RE}{W}$
(2). $\frac{W}{RE}$
(3). $\frac{T_H}{T_L}$
(4). $\frac{Q_H}{W}$
Answer: (1)
Ref: Khurmi

---

193. Maximum BM occurs where:
(1). Shear force is zero
(2). Load is zero
(3). Stress is zero
(4). Deflection is zero
Answer: (1)
Ref: Khurmi

---

194. Regenerative braking increases:
(1). SoC
(2). Fuel usage
(3). Exhaust
(4). Engine torque
Answer: (1)
Ref: Ehsani

---

195. G41 in CNC indicates:
(1). Cutter compensation left
(2). Tool change

(3). Dwell
(4). Rapid move
Answer: (1)
Ref: P.N. Rao

---

196. Work input in VCRS is given to:
(1). Compressor
(2). Condenser
(3). Evaporator
(4). Expansion valve
Answer: (1)
Ref: Khurmi

---

197. Ferrite has crystal structure:
(1). BCC
(2). FCC
(3). HCP
(4). Tetragonal
Answer: (1)
Ref: O.P. Khanna

---

198. In Otto cycle, heat addition occurs at:
(1). Constant volume
(2). Constant pressure
(3). Isothermal
(4). Adiabatic
Answer: (1)
Ref: Khurmi

---

199. In laminar pipe flow, head loss $\propto$
(1). Velocity
(2). Velocity^2
(3). Velocity^3
(4). Velocity^4
Answer: (1)
Ref: Bansal

---

200. BEV produces tailpipe emissions:
(1). Yes
(2). No

(3). Only CO_2
(4). Only NOx
Answer: (2)
Ref: A.K. Babu

Grand Test - 3

Mechanical Engineering Core Paper

100. In CNC, the command G02 X40 Y20 I10 J0 in incremental mode will:

1. Move straight to (40,20)
2. Move clockwise arc relative to current position
3. Move counterclockwise arc
4. Rapid move

Answer: 2

Explanation: G02 performs clockwise circular interpolation; in incremental mode (G91), coordinates are relative.

Ref: CAD/CAM: Principles and Applications, P.N. Rao

---

101. A simply supported beam (8 m) carries UDL of 5 kN/m. Maximum bending moment is:

1. 20 kNm
2. 40 kNm
3. 80 kNm
4. 160 kNm

Answer: 2

Explanation: $M_{max} = \frac{wL^2}{8} = \frac{5\times 8^2}{8} = 40$ kNm.

Ref: Strength of Materials, R.S. Khurmi

---

102. A steel with 0.8% carbon at 727°C consists of:

1. Austenite
2. Pearlite
3. Ferrite + Cementite
4. Martensite

Answer: 2

Explanation: At eutectoid point (0.8% C, 727°C), austenite transforms to pearlite.

Ref: Material Science & Metallurgy, O.P. Khanna

---

103. If evaporator temperature decreases while condenser temperature constant, COP:

1. Increases
2. Decreases
3. Same
4. Doubles

Answer: 2

Explanation: Lower $T_L$reduces COP since $COP = \frac{T_L}{T_H - T_L}$.

Ref: Thermal Engineering, R.S. Khurmi

---

104. In psychrometry, sensible cooling with dehumidification moves:

1. Horizontal left
2. Vertical down
3. Diagonal down-left
4. Upwards

Answer: 3

Explanation: Both DBT and humidity ratio decrease; path is diagonal downward.

Ref: Refrigeration & Air Conditioning, C.P. Arora

---

105. A shaft 50 mm diameter transmits 1000 Nm torque. Maximum shear stress ≈

1. 16 MPa
2. 32 MPa
3. 64 MPa
4. 80 MPa

Answer: 2

Explanation: $\tau = \frac{16T}{\pi d^3} \approx 32$ MPa.

Ref: Strength of Materials, Khurmi

---

106. In BEV, inverter converts:

1. AC to DC
2. DC to AC
3. Mechanical to electrical
4. Heat to electrical

Answer: 2

Explanation: Battery provides DC; traction motor generally AC.

Ref: Electric & Hybrid Vehicles, A.K. Babu

---

107. In laminar flow, centerline velocity is:

1. Equal to average
2. Half average
3. Twice average
4. Zero

Answer: 3

Explanation: For laminar flow in pipe, $V_{max} = 2V_{avg}$.

Ref: Fluid Mechanics, R.K. Bansal

---

108. In Iron–Carbon diagram, maximum carbon in austenite at 1147°C is:

1. 0.8%
2. 2.0%

3. 4.3%
4. 6.67%

Answer: 2

Explanation: Austenite dissolves up to ~2% carbon.

Ref: O.P. Khanna

---

109. In SFD, slope equals:

1. Load intensity
2. BM
3. Stress
4. Deflection

Answer: 1

Explanation: $\frac{dV}{dx} = w$.

Ref: Khurmi

---

110. In Otto cycle, efficiency depends primarily on:

1. Cut-off ratio
2. Compression ratio
3. Temperature only
4. Pressure only

Answer: 2

Explanation: $\eta = 1 - \frac{1}{r^{\gamma-1}}$.

Ref: Thermal Engineering, Khurmi

---

111. In CNC, tool radius compensation right is:

1. G41
2. G42
3. G43
4. G90

Answer: 2

Explanation: G41 left, G42 right compensation.

Ref: P.N. Rao

---

112. In BEV, regenerative braking improves:

1. Fuel economy
2. Battery SoC
3. Exhaust pressure
4. Engine speed

Answer: 2
Explanation: Kinetic energy recovered to recharge battery.
Ref: Mehrdad Ehsani

---

113. Maximum BM occurs where:

1. Load is zero
2. SF is zero
3. Deflection zero
4. Stress zero

Answer: 2
Explanation: BM is maximum where shear force changes sign.
Ref: Khurmi

---

114. In psychrometry, when RH = 100%, DBT equals:

1. WBT
2. DPT
3. Both 1 & 2
4. None

Answer: 3
Explanation: At saturation, DBT = WBT = DPT.
Ref: C.P. Arora

---

115. In CNC, M03 means:

1. Spindle stop
2. Spindle CW
3. Coolant ON
4. Tool change

Answer: 2
Explanation: M03 → spindle clockwise rotation.
Ref: P.N. Rao

---

116. Martensite formation requires:

1. Slow cooling
2. Rapid quenching
3. Annealing
4. Normalizing

Answer: 2
Explanation: Rapid cooling traps carbon in BCT structure.
Ref: O.P. Khanna

---

117. In VCRS, highest pressure occurs at:

1. Evaporator
2. Compressor discharge
3. Throttle
4. Expansion valve

Answer: 2
Explanation: After compression, pressure is maximum.
Ref: Khurmi

---

118. In BEV, SoC means:

1. Speed of car
2. State of Charge
3. Storage of Current
4. System of Control

Answer: 2
Explanation: SoC indicates battery charge percentage.
Ref: Iqbal Husain

---

119. A beam carries central load 10 kN on 4 m span. Maximum BM is:

1. 5 kNm
2. 10 kNm
3. 20 kNm
4. 40 kNm

Answer: 2
Explanation: $M = \frac{WL}{4} = \frac{10\times 4}{4} = 10.$
Ref: Khurmi

---

120. In laminar pipe flow, friction factor is:

1. 64/Re
2. 16/Re
3. 1/Re
4. 0.079/Re

Answer: 1
Explanation: Valid for Re < 2000.
Ref: Bansal

---

131. A cantilever beam of length 2 m carries point load 15 kN at free end. Maximum bending moment is:

1. 15 kNm
2. 20 kNm

3. 25 kNm
4. 30 kNm

Answer: 4

Explanation: $M_{max} = WL = 15 \times 2 = 30$ kNm.

Ref: Strength of Materials, R.S. Khurmi

---

132. In Iron–Carbon diagram, eutectic reaction occurs at:

1. 0.8% C
2. 2% C
3. 4.3% C
4. 6.67% C

Answer: 3

Explanation: At 4.3% C and 1147°C, liquid → austenite + cementite.

Ref: Material Science & Metallurgy, O.P. Khanna

---

133. If compressor work increases while refrigerating effect constant, COP will:

1. Increase
2. Decrease
3. Remain same
4. Double

Answer: 2

Explanation: $COP = \frac{RE}{W}$; increasing W reduces COP.

Ref: Thermal Engineering, R.S. Khurmi

---

134. In psychrometry, humidification at constant DBT moves:

1. Vertical upward
2. Horizontal right
3. Diagonal
4. Vertical downward

Answer: 1

Explanation: DBT constant; humidity ratio increases → vertical up.

Ref: Refrigeration & Air Conditioning, C.P. Arora

---

135. A shaft transmits 30 kW at 1500 rpm. Torque is approximately:

1. 95 Nm
2. 191 Nm
3. 250 Nm
4. 300 Nm

Answer: 2

Explanation: $T = \frac{P \times 60}{2\pi N} \approx 191$ Nm.

Ref: Strength of Materials, Khurmi

---

136. In CNC, G04 is used for:

1. Dwell
2. Arc
3. Tool change
4. Rapid move

Answer: 1

Explanation: G04 pauses tool motion for specified time.

Ref: CAD/CAM, P.N. Rao

---

137. In BEV, absence of multi-speed gearbox is due to:

1. High torque at all speeds
2. Fuel saving
3. Cooling requirement
4. Exhaust design

Answer: 1

Explanation: Electric motors provide wide torque-speed range.

Ref: Electric & Hybrid Vehicles, Mehrdad Ehsani

---

138. Maximum shear stress in solid shaft occurs at:

1. Center
2. Surface
3. Mid-radius
4. Anywhere

Answer: 2

Explanation: τ_{max}occurs at outer surface.

Ref: Khurmi

---

139. In SFD, area under SFD equals:

1. Load
2. Change in BM
3. Deflection
4. Stress

Answer: 2

Explanation: $\int V dx = M$.

Ref: Khurmi

---

140. In Otto cycle, work output equals:

1. Area under PV curve
2. Temperature
3. Pressure
4. Volume

Answer: 1

Explanation: Net work equals enclosed PV area.

Ref: Thermal Engineering, Khurmi

---

141. Austenite has crystal structure:

1. BCC
2. FCC
3. HCP
4. BCT

Answer: 2

Explanation: γ-iron (austenite) is FCC.

Ref: O.P. Khanna

---

142. In laminar flow, head loss ∝

1. Velocity
2. $Velocity^2$
3. $Velocity^3$
4. $Velocity^4$

Answer: 1

Explanation: Laminar head loss proportional to V.

Ref: Fluid Mechanics, Bansal

---

143. In CNC incremental mode, coordinates measured from:

1. Machine zero
2. Previous point
3. Tool tip
4. Work origin

Answer: 2

Explanation: G91 → relative positioning.

Ref: P.N. Rao

---

144. If RH increases at constant DBT, dew point:

1. Decreases
2. Increases
3. Same

4. Zero

Answer: 2

Explanation: More moisture → higher dew point.

Ref: C.P. Arora

---

145. In Diesel cycle, efficiency decreases if:

1. Compression ratio increases
2. Cut-off ratio increases
3. Heat added constant
4. Pressure increases

Answer: 2

Explanation: Higher cut-off ratio lowers efficiency.

Ref: Khurmi

---

146. In HEV series configuration, engine:

1. Drives wheels directly
2. Drives generator only
3. Absent
4. Drives clutch

Answer: 2

Explanation: Engine powers generator → motor drives wheels.

Ref: Ehsani

---

147. In bending equation, neutral axis passes through:

1. Centroid
2. Surface
3. Bottom
4. Top

Answer: 1

Explanation: For homogeneous section, NA passes through centroid.

Ref: Khurmi

---

148. In VCRS, throttling causes:

1. Temperature rise
2. Pressure drop
3. Work output
4. Compression

Answer: 2

Explanation: Throttling → isenthalpic expansion with pressure drop.

Ref: Khurmi

---

149. In BEV, BMS ensures:

1. Fuel injection
2. Battery balancing & protection
3. Exhaust control
4. Turbocharging

Answer: 2
Explanation: BMS monitors voltage, temperature & SoC.
Ref: Iqbal Husain

---

150. Hypereutectoid steel contains carbon:

1. < 0.8%
2. = 0.8%
3. 0.8–2%
4. 4.3%

Answer: 3
Explanation: Steel up to 2% C; above 0.8% → hypereutectoid.
Ref: O.P. Khanna

---

151. In simply supported beam with UDL, SFD shape is:

1. Constant
2. Linear
3. Parabolic
4. Zero

Answer: 2
Explanation: Shear varies linearly under UDL.
Ref: Khurmi

---

152. In psychrometry, enthalpy depends on:

1. DBT only
2. Humidity only
3. Both DBT & humidity ratio
4. Pressure only

Answer: 3
Explanation: Enthalpy is function of dry air temp & moisture content.
Ref: C.P. Arora

---

153. In CNC, M05 means:

1. Spindle stop
2. Coolant OFF

3. Tool change
4. Program end

Answer: 1

Explanation: M05 → stop spindle.

Ref: P.N. Rao

---

154. Martensite is:

1. Soft
2. Very hard
3. Ductile
4. FCC

Answer: 2

Explanation: Rapid quenching produces hard BCT martensite.

Ref: O.P. Khanna

---

155. In laminar flow, Reynolds number is less than:

1. 1000
2. 2000
3. 4000
4. 10000

Answer: 2

Explanation: Laminar for $Re < 2000$.

Ref: Bansal

---

156. In BEV, torque at zero speed is:

1. Zero
2. Maximum
3. Half
4. Infinite

Answer: 2

Explanation: Electric motors provide maximum starting torque.

Ref: Ehsani

---

157. In SFD, sudden drop indicates:

1. UDL
2. Point load
3. Moment
4. No load

Answer: 2
Explanation: Point load causes vertical jump in SFD.
Ref: Khurmi

---

158. In Otto cycle, heat rejection occurs at:

1. CV
2. CP
3. Isothermal
4. Adiabatic

Answer: 1
Explanation: Heat rejection at constant volume .
Ref: Khurmi

---

159. Cementite contains carbon:

1. 0.8%
2. 2%
3. 4.3%
4. 6.67%

Answer: 4
Explanation: Fe_3C has 6.67% carbon.
Ref: O.P. Khanna

---

160. In CNC, feed rate controlled by:

1. F code
2. G code
3. M code
4. T code

Answer: 1
Explanation: F defines feed in mm/min.
Ref: P.N. Rao

---

171. A simply supported beam of span 6 m carries a central load of 24 kN. Maximum bending moment is:

1. 18 kNm
2. 24 kNm
3. 36 kNm
4. 72 kNm

Answer: 3
Explanation: $M_{max} = \frac{WL}{4} = \frac{24\times6}{4} = 36$ kNm.
Ref: Strength of Materials, R.S. Khurmi

---

172. In Iron–Carbon diagram, eutectoid reaction occurs at:

1. 0.4% C
2. 0.8% C
3. 2% C
4. 4.3% C

Answer: 2

Explanation: At 0.8% C and 727°C, austenite transforms to pearlite.

Ref: Material Science & Metallurgy, O.P. Khanna

---

173. If condenser temperature increases while evaporator temperature constant, COP:

1. Increases
2. Decreases
3. Same
4. Doubles

Answer: 2

Explanation: Higher $T_H$increases denominator in $COP = \frac{T_L}{T_H - T_L}$.

Ref: Thermal Engineering, Khurmi

---

174. In psychrometry, sensible heating moves along:

1. Vertical line
2. Horizontal line
3. Diagonal line
4. Curved line

Answer: 2

Explanation: DBT increases; humidity ratio constant → horizontal right.

Ref: Refrigeration & Air Conditioning, C.P. Arora

---

175. A shaft 40 mm diameter transmits 20 kW at 1200 rpm. Torque is:

1. 79.6 Nm
2. 159 Nm
3. 95.5 Nm
4. 120 Nm

Answer: 3

Explanation: $T = \frac{P \times 60}{2\pi N} \approx 95.5$ Nm.

Ref: Strength of Materials, Khurmi

---

176. In CNC, G41 command indicates:

1. Cutter compensation right

2. Cutter compensation left
3. Tool length comp
4. Rapid move

Answer: 2

Explanation: G41 activates cutter radius compensation left.

Ref: CAD/CAM, P.N. Rao

---

177. Maximum shear stress in solid shaft occurs at:

1. Center
2. Surface
3. Mid-radius
4. Neutral axis

Answer: 2

Explanation: τ_{max}at outer surface where radius maximum.

Ref: Khurmi

---

178. In VCRS, lowest temperature occurs at:

1. Compressor inlet
2. Compressor outlet
3. Condenser exit
4. Throttle valve

Answer: 1

Explanation: Evaporator outlet (compressor inlet) has lowest temperature.

Ref: Thermal Engineering, Khurmi

---

179. In BEV, DC-DC converter converts:

1. AC to DC
2. High voltage DC to 12V DC
3. DC to AC
4. Mechanical to electrical

Answer: 2

Explanation: Supplies auxiliary 12V systems from high-voltage battery.

Ref: Electric & Hybrid Vehicles, Iqbal Husain

---

180. In laminar flow, friction factor equals:

1. 16/Re
2. 64/Re
3. 0.079/Re
4. Re/64

Answer: 2
Explanation: Valid for laminar flow in pipe.
Ref: Fluid Mechanics, R.K. Bansal

---

181. In bending, maximum stress is proportional to:

1. Distance from neutral axis
2. Length
3. Load only
4. Width

Answer: 1
Explanation: $\sigma = \frac{My}{I}$, maximum at largest y.
Ref: Strength of Materials, Khurmi

---

182. Martensite has crystal structure:

1. FCC
2. BCC
3. BCT
4. HCP

Answer: 3
Explanation: Body-centered tetragonal due to trapped carbon.
Ref: O.P. Khanna

---

183. In Otto cycle, processes 1–2 and 3–4 are:

1. Isothermal
2. Isentropic
3. Constant pressure
4. Constant volume

Answer: 2
Explanation: Compression and expansion are adiabatic (isentropic).
Ref: Thermal Engineering, Khurmi

---

184. In SFD, a uniform load causes:

1. Jump
2. Constant line
3. Linear variation
4. Parabolic variation

Answer: 3
Explanation: UDL gives linear shear variation.
Ref: Khurmi

---

185. In BEV series hybrid, engine is:

1. Directly connected to wheels
2. Connected to generator
3. Connected to clutch
4. Absent

Answer: 2
Explanation: Engine drives generator → motor drives wheels.
Ref: Mehrdad Ehsani

---

186. If RH decreases at constant DBT, dew point:

1. Increases
2. Decreases
3. Same
4. Becomes 100%

Answer: 2
Explanation: Less moisture → lower dew point temperature.
Ref: C.P. Arora

---

187. In CNC, G43 is used for:

1. Tool length compensation
2. Cutter radius comp
3. Rapid move
4. Dwell

Answer: 1
Explanation: G43 activates tool length offset.
Ref: P.N. Rao

---

188. Austenite transforms to martensite by:

1. Slow cooling
2. Rapid quenching
3. Annealing
4. Normalizing

Answer: 2
Explanation: Diffusionless transformation under rapid cooling.
Ref: O.P. Khanna

---

189. Maximum BM in simply supported beam with UDL occurs at:

1. Support
2. Mid-span
3. Quarter span

4. Any point

Answer: 2

Explanation: Symmetry; maximum at center.

Ref: Khurmi

---

190. In psychrometry, when DBT = WBT, RH is:

1. 0%
2. 50%
3. 100%
4. 75%

Answer: 3

Explanation: At saturation DBT=WBT=dew point.

Ref: C.P. Arora

---

191. Cementite contains:

1. 2% C
2. 4.3% C
3. 6.67% C
4. 0.8% C

Answer: 3

Explanation: Fe_3C has 6.67% carbon.

Ref: O.P. Khanna

---

192. In CNC, M08 means:

1. Coolant ON
2. Coolant OFF
3. Tool change
4. Program end

Answer: 1

Explanation: M08 activates coolant.

Ref: P.N. Rao

---

193. In laminar pipe flow, velocity profile is:

1. Linear
2. Parabolic
3. Exponential
4. Constant

Answer: 2

Explanation: Laminar flow profile is parabolic.

Ref: Bansal

---

194. In Diesel cycle, heat addition occurs at:

1. Constant volume
2. Constant pressure
3. Isothermal
4. Adiabatic

Answer: 2

Explanation: Diesel adds heat at constant pressure.

Ref: Khurmi

---

195. In BEV, regenerative braking converts:

1. Electrical to mechanical
2. Mechanical to electrical
3. Heat to chemical
4. Chemical to heat

Answer: 2

Explanation: Motor acts as generator during braking.

Ref: Ehsani

---

196. In bending equation, EI represents:

1. Material rigidity
2. Flexural rigidity
3. Shear modulus
4. Torque

Answer: 2

Explanation: EI = flexural rigidity of beam.

Ref: Khurmi

---

197. Maximum torque transmission for shaft occurs when angle of twist is:

1. Maximum
2. Zero
3. Within allowable limits
4. Infinite

Answer: 3

Explanation: Design limited by allowable stress & twist.

Ref: Khurmi

---

198. In VCRS, expansion valve causes:

1. Isentropic expansion
2. Isothermal process

3. Isenthalpic throttling
4. Compression

Answer: 3

Explanation: Throttling process is constant enthalpy.

Ref: Khurmi

---

199. Hypereutectoid steel microstructure contains:

1. Pearlite + Ferrite
2. Pearlite + Cementite
3. Austenite
4. Ferrite only

Answer: 2

Explanation: Above 0.8% C → cementite forms with pearlite.

Ref: O.P. Khanna

---

200. In CNC, absolute positioning is activated by:

1. G90
2. G91
3. G02
4. M02

Answer: 1

Explanation: G90 selects absolute coordinate mode.

Ref: CAD/CAM, P.N. Rao

Grand Test - 4

Mechanical Engineering Core Paper

101. A shaft of 60 mm diameter and 2 m length is subjected to torque of 5 kNm. If G = 80 GPa, angle of twist is approximately:

1. 0.8°
2. 1.2°
3. 2.0°
4. 3.5°

Answer: 2

Explanation:

$$\theta = \frac{TL}{GJ}, J = \frac{\pi d^4}{32}$$

Substituting gives ≈ 1.2°.

Ref: Strength of Materials, R.S. Khurmi

---

102. In Laser Beam Machining (LBM), material removal mechanism is primarily due to:

1. Electrochemical dissolution
2. Thermal vaporization
3. Plastic deformation
4. Mechanical abrasion

Answer: 2

Explanation: LBM removes material by intense localized heating causing melting and vaporization.

Ref: Non-Conventional Machining Processes, P.K. Mishra

---

103. A unilateral tolerance of 50 +0.02/0 mm indicates:

1. Both upper & lower deviation
2. Only positive deviation
3. Only negative deviation
4. Symmetric tolerance

Answer: 2

Explanation: Dimension can vary only in positive direction from basic size.

Ref: Machine Drawing, N.D. Bhatt

---

104. In EDM, material removal occurs due to:

1. Mechanical erosion
2. Spark erosion
3. Chemical reaction
4. Plastic flow

Answer: 2

Explanation: Controlled electrical discharges cause localized melting and vaporization.

Ref: P.K. Mishra

---

105. A gas turbine operates between 300 K and 1200 K. Maximum theoretical (Carnot) efficiency is:

1. 60%
2. 65%
3. 75%
4. 80%

Answer: 3

Explanation:

$$\eta = 1 - \frac{T_L}{T_H} = 1 - \frac{300}{1200} = 0.75$$

Ref: Thermal Engineering, Khurmi

---

106. The specific speed of a turbine is high for:

1. Pelton
2. Francis
3. Kaplan
4. Impulse only

Answer: 3

Explanation: Kaplan turbines operate at low head, high discharge → high specific speed.

Ref: Fluid Mechanics & Hydraulic Machines, R.K. Bansal

---

107. Which casting defect is caused by insufficient venting?

1. Cold shut
2. Blow holes
3. Misrun
4. Shrinkage cavity

Answer: 2

Explanation: Trapped gases form blow holes.

Ref: Workshop Technology, Hazra Choudhury

---

108. In CNC, G17 selects:

1. XY plane
2. ZX plane
3. YZ plane
4. Tool change

Answer: 1

Explanation: G17 defines machining plane as XY.

Ref: CAD/CAM, P.N. Rao

---

109. A simply supported beam 4 m long carries UDL of 10 kN/m. Maximum deflection occurs at mid-span and equals:

1. $\frac{5wL^4}{384EI}$
2. $\frac{wL^4}{8EI}$
3. $\frac{wL^3}{48EI}$
4. $\frac{PL^3}{3EI}$

Answer: 1

Explanation: Standard formula for UDL on simply supported beam.

Ref: Strength of Materials, Khurmi

---

110. In IC engine testing, indicated power is obtained using:

1. Rope brake dynamometer
2. Hydraulic dynamometer
3. Indicator diagram
4. Prony brake

Answer: 3

Explanation: Indicator diagram gives indicated mean effective pressure.

Ref: Internal Combustion Engines, V. Ganesan

---

111. For a helical spring, stiffness is proportional to:

1. Wire diameter^4
2. Wire diameter^2
3. Mean coil diameter
4. Number of coils

Answer: 1

Explanation:

$$k = \frac{Gd^4}{8D^3n}$$

Ref: Design of Machine Elements, Khurmi

---

112. Which statement is FALSE regarding heat treatment?

1. Annealing softens steel
2. Normalizing refines grain
3. Tempering increases hardness beyond martensite
4. Quenching produces martensite

Answer: 3

Explanation: Tempering reduces brittleness and hardness of martensite.

Ref: O.P. Khanna

---

113. In psychrometry, dehumidification with cooling moves along:

1. Horizontal left
2. Vertical down
3. Diagonal down-left
4. Horizontal right

Answer: 3

Explanation: Both temperature and humidity decrease.

Ref: C.P. Arora

---

114. In epicyclic gear train, if arm is fixed, system reduces to:

1. Simple gear train
2. Compound gear train
3. Planetary gear
4. Differential gear

Answer: 1

Explanation: Fixing arm eliminates relative motion → simple gear train.

Ref: Theory of Machines, Khurmi

---

115. Vacuum efficiency of a condenser is defined as:

1. $\frac{Actual vacuum}{Ideal vacuum}$
2. $\frac{Barometric pressure - Absolute condenser pressure}{Barometric pressure}$
3. $\frac{Actual vacuum}{Barometric pressure - Saturation pressure}$
4. $\frac{Rise in cooling water temperature}{Steam temperature}$

Answer: 3

Explanation: Vacuum efficiency = $\frac{Actual\ vacuum}{Ideal\ vacuum}$where ideal vacuum = Barometric pressure −

saturation pressure corresponding to condenser temperature.

Ref: Power Plant Engineering, P.K. Nag

---

116. A hydraulic actuator converts:

1. Mechanical to electrical
2. Hydraulic energy to mechanical motion
3. Thermal to mechanical
4. Electrical to chemical

Answer: 2

Explanation: Fluid pressure generates linear or rotary motion.

Ref: Oil Hydraulics & Pneumatics, S.R. Majumdar

---

117. A PHEV differs from HEV because PHEV:

1. Has no battery
2. Cannot be plugged in
3. Has external charging facility
4. Uses only hydrogen

Answer: 3

Explanation: Plug-in hybrid can be charged externally.

Ref: Electric & Hybrid Vehicles, A.K. Babu

---

118. The nuclear reactor component that slows neutrons is:

1. Control rod
2. Moderator
3. Coolant
4. Shield

Answer: 2

Explanation: Moderator reduces neutron velocity to sustain chain reaction.

Ref: Power Plant Engineering, P.K. Nag

---

119. In SQC, R-chart monitors:

1. Mean
2. Range
3. Proportion defective
4. Defects per unit

Answer: 2

Explanation: R-chart tracks variability within sample.

Ref: Inspection & Quality Control, A.P. Verma

---

120. In gas turbine Brayton cycle, regeneration improves efficiency when:

1. Compressor outlet temp < Turbine outlet temp
2. Compressor outlet temp > Turbine outlet temp
3. Equal
4. Pressure ratio zero

Answer: 1

Explanation: Regenerator effective only when turbine exit temp higher.

Ref: Thermal Engineering, Khurmi

---

121. A casting shows crack at sharp corner due to:

1. Misrun
2. Hot tearing
3. Blow hole
4. Cold shut

Answer: 2

Explanation: Unequal contraction causes hot tears.

Ref: Workshop Technology, Hazra Choudhury

---

122. In CNC, M06 command indicates:

1. Coolant ON
2. Tool change
3. End program
4. Spindle stop

Answer: 2

Explanation: M06 initiates automatic tool change.

Ref: CAD/CAM, P.N. Rao

---

123. The deflection of cantilever with end load is:

1. $\frac{WL^3}{3EI}$
2. $\frac{WL^3}{48EI}$
3. $\frac{5wL^4}{384EI}$
4. $\frac{WL^2}{2EI}$

Answer: 1

Explanation: Standard cantilever deflection formula.

Ref: Strength of Materials, Khurmi

---

124. A Francis turbine is best suited for:

1. High head, low discharge
2. Medium head
3. Low head, high discharge
4. Very high speed

Answer: 2

Explanation: Francis operates under medium head conditions.

Ref: Hydraulic Machines, Bansal

---

125. In maintenance management, condition-based monitoring is classified as:

1. Breakdown
2. Preventive
3. Predictive
4. Corrective

Answer: 3

Explanation: Predictive maintenance monitors equipment condition before failure.

Ref: Industrial Safety & Maintenance Management, Poonia

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Explanation: Standard cantilever deflection formula.

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---

126. A hole of 40 H7 has tolerance of 0 to +0.025 mm. A shaft of 40 f7 has deviation −0.020 to −0.045 mm. The fit is:

1. Interference
2. Transition
3. Clearance
4. Line fit

Answer: 3

Explanation: Maximum shaft size < minimum hole size → always clearance.

Ref: Machine Drawing, N.D. Bhatt

---

127. In LBM, the parameter most affecting kerf width is:

1. Pulse frequency
2. Laser power density
3. Workpiece hardness
4. Tool electrode material

Answer: 2

Explanation: Higher power density increases material melting and kerf width.

Ref: Non-Conventional Machining Processes, P.K. Mishra

---

128. A solid circular shaft transmits torque T. If diameter is doubled, maximum shear stress becomes:

1. Same
2. Half
3. One-fourth
4. One-eighth

Answer: 4

Explanation: $\tau \propto \frac{1}{d^3}$; doubling d reduces stress to 1/8.

Ref: Strength of Materials, Khurmi

---

129. In EDM, tool wear is reduced by using:

1. High current
2. Low pulse duration
3. Graphite electrode
4. Dry machining

Answer: 3

Explanation: Graphite electrodes have high resistance to spark erosion.

Ref: P.K. Mishra

---

130. A Brayton cycle gas turbine has pressure ratio 8 and γ=1.4. Ideal efficiency is approximately:

1. 35%
2. 45%
3. 55%
4. 65%

Answer: 2

Explanation:

$$\eta = 1 - \frac{1}{r_p^{(\gamma-1)/\gamma}}$$

Substituting gives ≈ 45%.

Ref: Thermal Engineering, Khurmi

---

131. A helical spring wire diameter doubled; stiffness becomes:

1. 2 times
2. 4 times
3. 8 times

4. 16 times

Answer: 4

Explanation: $k \propto d^4$; doubling gives 16× stiffness.

Ref: Design of Machine Elements, Khurmi

---

132. In casting, a misrun occurs due to:

1. Excess temperature
2. Low pouring temperature
3. Excess venting
4. High permeability

Answer: 2

Explanation: Molten metal solidifies before filling cavity.

Ref: Workshop Technology, Hazra Choudhury

---

133. In CNC, G95 command indicates:

1. Feed per minute
2. Feed per revolution
3. Rapid move
4. Cancel compensation

Answer: 2

Explanation: G95 sets feed per revolution mode.

Ref: CAD/CAM, P.N. Rao

---

134. A cantilever beam 3 m long carries 10 kN at free end. Deflection is proportional to:

1. L
2. L^2
3. L^3
4. L^4

Answer: 3

Explanation: $\delta = \frac{WL^3}{3EI}$.

Ref: Strength of Materials, Khurmi

135. In IC engine Morse test, friction power is determined by:

1. Subtracting brake power from indicated power
2. Cutting out one cylinder
3. Measuring exhaust temp
4. Fuel consumption

Answer: 2

Explanation: Cylinder cut-out method used in Morse test.

Ref: Internal Combustion Engines, V. Ganesan

136. Specific speed of turbine depends on:

1. Head only
2. Power only
3. Speed, Power & Head
4. Discharge only

Answer: 3

Explanation:

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

Ref: Hydraulic Machines, Bansal

137. In multistage impulse turbine (velocity compounding), pressure drop occurs in:

1. Moving blades only
2. Fixed blades only
3. Nozzles only
4. All stages equally

Answer: 3

Explanation: Pressure drops only in nozzles in impulse turbines.

Ref: Power Plant Engineering, P.K. Nag

138. In dehumidification by cooling coil, condensate forms when air temperature falls below:

1. DBT
2. WBT
3. Dew point
4. Absolute zero

Answer: 3

Explanation: Moisture condenses below dew point temperature.

Ref: C.P. Arora

---

139. In X-bar chart, control limits depend on:

1. Sample size
2. Range
3. Standard deviation
4. All

Answer: 4

Explanation: UCL = $\bar{X} + A_2R$; depends on sample size & variation.

Ref: Inspection & Quality Control, A.P. Verma

---

140. In PWR reactor, steam is generated:

1. In reactor core
2. In steam generator
3. Directly from coolant
4. In condenser

Answer: 2

Explanation: Primary coolant transfers heat to secondary loop steam generator.

Ref: Power Plant Engineering, P.K. Nag

---

141. In a PHEV, electric-only mode is possible when:

1. Battery SoC sufficient
2. Fuel tank empty

3. Engine overheated
4. Generator off

Answer: 1

Explanation: PHEV can operate purely electric if battery charged.

Ref: Electric & Hybrid Vehicles, A.K. Babu

---

142. In LBM, assist gas is used to:

1. Increase hardness
2. Remove molten material
3. Reduce reflection
4. Cool tool

Answer: 2

Explanation: Gas jet blows away molten/vaporized material.

Ref: P.K. Mishra

---

143. For a helical compression spring, surge is reduced by:

1. Increasing coil diameter
2. Reducing pitch
3. Using damper
4. Reducing load

Answer: 3

Explanation: Dampers prevent spring resonance.

Ref: Design of Machine Elements, Khurmi

---

144. In condenser, air leakage primarily reduces:

1. Steam flow
2. Vacuum efficiency
3. Cooling water temp
4. Boiler pressure

Answer: 2

Explanation: Air reduces effective vacuum in condenser.

Ref: P.K. Nag

---

145. In EDM, dielectric fluid mainly serves to:

1. Increase hardness
2. Insulate until breakdown
3. Lubricate tool
4. Provide coolant only

Answer: 2

Explanation: Acts as insulator until spark breakdown occurs.

Ref: P.K. Mishra

---

146. A turbine develops 5000 kW under head 25 m at 300 rpm. Specific speed is approximately:

1. 120
2. 220
3. 350
4. 450

Answer: 3

Explanation:

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

Substituting ≈ 350 → Francis/Kaplan range.

Ref: Bansal

---

147. In heat treatment, spheroidizing improves:

1. Hardness
2. Machinability
3. Brittleness

4. Grain growth

Answer: 2

Explanation: Produces spherical cementite improving machinability.

Ref: O.P. Khanna

---

148. In CNC, M19 command is used for:

1. Tool change
2. Spindle orientation
3. Coolant ON
4. Program stop

Answer: 2

Explanation: M19 aligns spindle to fixed angular position.

Ref: P.N. Rao

---

149. For cantilever beam with UDL, maximum BM equals:

1. $\frac{wL^2}{2}$
2. $\frac{wL^2}{8}$
3. $\frac{wL}{4}$
4. $\frac{wL^2}{3}$

Answer: 1

Explanation: Standard formula for cantilever with UDL.

Ref: Khurmi

---

150. In nuclear reactor, control rods are made of:

1. Uranium
2. Graphite
3. Boron/Cadmium
4. Heavy water

Answer: 3

Explanation: Control rods absorb neutrons to regulate reaction.

Ref: Power Plant Engineering, P.K. Nag

---

151. A shaft of 50 mm diameter transmits 4 kNm torque. Maximum shear stress is approximately:

1. 32 MPa
2. 65 MPa
3. 80 MPa
4. 95 MPa

Answer: 2

Explanation:

$$\tau = \frac{16T}{\pi d^3}$$

Substituting gives ≈ 65 MPa.

Ref: Strength of Materials, R.S. Khurmi

---

152. In EDM, increasing pulse duration will:

1. Decrease MRR
2. Increase MRR but reduce surface finish
3. Reduce tool wear
4. Stop spark formation

Answer: 2

Explanation: Longer spark duration increases material removal but roughens surface.

Ref: Non-Conventional Machining Processes, P.K. Mishra

---

153. A spring of stiffness 20 kN/m is compressed by 50 mm. Energy stored is:

1. 12.5 J
2. 25 J
3. 50 J

4. 75 J

Answer: 1

Explanation:

$$U = \frac{1}{2}kx^2 = \frac{1}{2} \times 20000 \times (0.05)^2 = 12.5J$$

Ref: Design of Machine Elements, Khurmi

---

154. In casting, shrinkage cavity mainly occurs due to:

1. Excess permeability
2. Unequal solidification
3. Low pouring temp
4. Excess venting

Answer: 2

Explanation: Non-uniform cooling causes internal shrinkage voids.

Ref: Workshop Technology, Hazra Choudhury

---

155. In a Brayton cycle with intercooling and reheating, thermal efficiency:

1. Always increases
2. Always decreases
3. Depends on pressure ratio
4. Independent of pressure

Answer: 3

Explanation: Intercooling increases net work but may reduce efficiency unless optimized pressure ratio used.

Ref: Thermal Engineering, Khurmi

---

156. In CNC, G83 is used for:

1. Circular interpolation
2. Peck drilling cycle
3. Tapping cycle

4. Thread cutting

Answer: 2

Explanation: G83 is deep-hole peck drilling cycle.

Ref: CAD/CAM, P.N. Rao

---

157. Specific speed of pump is high when:

1. Head high, discharge low
2. Head low, discharge high
3. Speed low
4. Impeller diameter small

Answer: 2

Explanation: High discharge & low head correspond to high Ns.

Ref: Hydraulic Machines, R.K. Bansal

---

158. In multistage pressure compounding turbine, pressure drop occurs in:

1. Moving blades only
2. Nozzles of each stage
3. Fixed blades only
4. Condenser

Answer: 2

Explanation: Each stage nozzle expands steam partially.

Ref: Power Plant Engineering, P.K. Nag

---

159. In dehumidification process, sensible heat factor is:

1. 1
2. =1
3. <1
4. Zero

Answer: 3

Explanation: Latent heat removal involved → SHF < 1.

Ref: Refrigeration & Air Conditioning, C.P. Arora

160. In R-chart, UCL =

1. D_4R
2. A_2R
3. $R - A_2$
4. $X + R$

Answer: 1

Explanation: UCL = $D_4 \times \bar{R}$.

Ref: Inspection & Quality Control, A.P. Verma

161. A Francis turbine operates at 250 rpm producing 1500 kW under 20 m head. If head increases, specific speed:

1. Increases
2. Decreases
3. Same
4. Zero

Answer: 2

Explanation: $N_s \propto 1/H^{5/4}$; increasing head reduces Ns.

Ref: Bansal

162. In PWR reactor, moderator is generally:

1. Graphite
2. Heavy water
3. Light water
4. Cadmium

Answer: 3

Explanation: PWR uses ordinary (light) water as moderator and coolant.

Ref: Power Plant Engineering, P.K. Nag

163. In PHEV parallel configuration, power flow can be:

1. Engine only

2. Motor only
3. Both
4. All of the above

Answer: 4

Explanation: PHEV parallel allows flexible power sharing.

Ref: Electric & Hybrid Vehicles, A.K. Babu

---

164. In LBM, reflectivity of material affects:

1. Tool wear
2. Energy absorption
3. Spark frequency
4. Coolant flow

Answer: 2

Explanation: High reflectivity reduces effective laser energy absorption.

Ref: P.K. Mishra

---

165. A cantilever beam of length L under UDL has maximum deflection at:

1. Support
2. Mid-span
3. Free end
4. Quarter span

Answer: 3

Explanation: Maximum deflection at free end.

Ref: Strength of Materials, Khurmi

---

166. In gas turbine, back work ratio is:

1. Turbine work / Net work
2. Compressor work / Turbine work
3. Net work / Compressor work
4. Heat supplied / Net work

Answer: 2

Explanation: BWR = Compressor work / Turbine work.

Ref: Thermal Engineering, Khurmi

---

167. In casting, cold shut occurs when:

1. Two metal streams fail to fuse
2. Excess gas
3. Rapid cooling
4. Low permeability

Answer: 1

Explanation: Poor fusion of two metal fronts.

Ref: Hazra Choudhury

---

168. In CNC, G54–G59 codes represent:

1. Tool change
2. Work coordinate offsets
3. Spindle control
4. Rapid move

Answer: 2

Explanation: Used to select different work coordinate systems.

Ref: P.N. Rao

---

169. For a helical spring, shear stress is maximum at:

1. Center
2. Inner surface
3. Outer surface
4. Neutral axis

Answer: 2

Explanation: Stress concentration highest at inner side of coil.

Ref: Khurmi

---

170. Condenser efficiency approaches 100% when:

1. Cooling water outlet temp equals saturation temp
2. No air leakage
3. Perfect vacuum achieved
4. Cooling water inlet temp zero

Answer: 1

Explanation: Maximum heat extracted when cooling water temp rise equals difference.

Ref: P.K. Nag

---

171. In EDM, MRR increases with:

1. Lower current
2. Higher current
3. Lower voltage
4. Dry machining

Answer: 2

Explanation: Higher discharge energy increases erosion rate.

Ref: P.K. Mishra

---

172. In torsion, if length doubles, angle of twist:

1. Halves
2. Same
3. Doubles
4. Quadruples

Answer: 3

Explanation: $\theta \propto L$.

Ref: Khurmi

---

173. In psychrometry, cooling with humidification occurs in:

1. Desert cooler
2. Heating coil
3. Condenser

4. Dehumidifier

Answer: 1

Explanation: Evaporative cooling adds moisture while reducing temperature.

Ref: C.P. Arora

---

174. In nuclear reactor, coolant function is to:

1. Absorb neutrons
2. Remove heat
3. Shield radiation
4. Generate steam directly in PWR core

Answer: 2

Explanation: Coolant transfers heat from core to steam generator.

Ref: P.K. Nag

---

175. In predictive maintenance, vibration analysis detects:

1. Electrical faults only
2. Bearing failure
3. Fuel leaks
4. Paint defects

Answer: 2

Explanation: Vibration monitoring identifies imbalance and bearing wear.

Ref: Industrial Safety & Maintenance Management, Poonia

---

176. A shaft of diameter 80 mm transmits torque of 10 kNm. Maximum shear stress is approximately:

1. 20 MPa
2. 25 MPa
3. 31 MPa
4. 40 MPa

Answer: 3

Explanation:

$$\tau = \frac{16T}{\pi d^3}$$

Substituting values gives ≈ 31 MPa.

Ref: Strength of Materials, R.S. Khurmi

---

177. In EDM, the spark gap is maintained by:

1. Manual control
2. Servo mechanism
3. Hydraulic pump
4. Cooling fan

Answer: 2

Explanation: Servo control maintains constant gap for stable sparking.

Ref: Non-Conventional Machining Processes, P.K. Mishra

---

178. A helical compression spring has 8 active coils. If number of coils doubles, stiffness becomes:

1. Double
2. Half
3. Four times
4. Same

Answer: 2

Explanation:

$$k \propto \frac{1}{n}$$

Doubling coils halves stiffness.

Ref: Design of Machine Elements, Khurmi

---

179. In casting, excessive mould moisture primarily causes:

1. Misrun
2. Hot tear

3. Blow holes
4. Shrinkage

Answer: 3

Explanation: Excess moisture forms steam → gas cavities.

Ref: Workshop Technology, Hazra Choudhury

---

180. In Brayton cycle with regeneration, maximum efficiency improvement occurs when:

1. Pressure ratio very high
2. Pressure ratio moderate
3. Pressure ratio zero
4. Turbine work zero

Answer: 2

Explanation: Regeneration effective at moderate pressure ratios.

Ref: Thermal Engineering, Khurmi

---

181. In CNC, G84 is used for:

1. Drilling
2. Tapping cycle
3. Boring
4. Rapid move

Answer: 2

Explanation: G84 activates tapping cycle.

Ref: CAD/CAM, P.N. Rao

---

182. Specific speed of Kaplan turbine typically lies in range:

1. 10–35
2. 50–250
3. 250–850
4. Above 1000

Answer: 3

Explanation: Kaplan turbine operates at high specific speed.

Ref: Hydraulic Machines, R.K. Bansal

---

183. In pressure-velocity compounded turbine, pressure drop occurs in:

1. Only first stage
2. Only moving blades
3. Both fixed and moving blades
4. Multiple nozzle stages

Answer: 4

Explanation: Pressure drop distributed across nozzle stages.

Ref: Power Plant Engineering, P.K. Nag

---

184. In dehumidification with reheat, process path on psychrometric chart is:

1. Diagonal down-left then horizontal right
2. Horizontal left only
3. Vertical up only
4. Straight line

Answer: 1

Explanation: Cooling removes moisture → reheating increases DBT.

Ref: Refrigeration & Air Conditioning, C.P. Arora

---

185. In C-chart, the data monitored is:

1. Fraction defective
2. Mean dimension
3. Number of defects per unit
4. Range

Answer: 3

Explanation: C-chart used for count of defects per unit.

Ref: Inspection & Quality Control, A.P. Verma

---

186. In BWR reactor, steam is generated:

1. In steam generator
2. In reactor core directly
3. In condenser
4. In moderator tank

Answer: 2

Explanation: BWR boils water directly in reactor core.

Ref: Power Plant Engineering, P.K. Nag

---

187. In FCEV, electricity is generated by:

1. Battery only
2. Combustion of hydrogen
3. Electrochemical reaction of hydrogen & oxygen
4. Nuclear reaction

Answer: 3

Explanation: Fuel cell converts chemical energy directly to electricity.

Ref: Electric & Hybrid Vehicles, A.K. Babu

---

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2. Fixed support
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Answer: 2

Explanation: Maximum moment at fixed support.

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189. In torsion equation, polar modulus is defined as:

1. $\frac{J}{R}$
2. $\frac{R}{J}$

3. $\frac{T}{J}$
4. $\frac{G\theta}{L}$

Answer: 1

Explanation: Polar modulus $Z_p = \frac{J}{R}$.

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---

190. In LBM, pulse duration decrease leads to:

1. Larger HAZ
2. Smaller HAZ
3. No change
4. Tool wear

Answer: 2

Explanation: Short pulses reduce heat affected zone.

Ref: P.K. Mishra

---

191. A gas turbine produces 3000 kW. Compressor consumes 1200 kW. Back work ratio is:

1. 0.2
2. 0.4
3. 0.6
4. 0.8

Answer: 2

Explanation:

$$BWR = \frac{1200}{3000} = 0.4$$

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1. Gap distance
2. Tool shape

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Answer: 1

Explanation: Breakdown occurs when voltage exceeds dielectric strength across gap.

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193. A Francis turbine operates under 16 m head at 200 rpm producing 1000 kW. Increasing head while keeping speed constant will:

1. Increase specific speed
2. Decrease specific speed
3. Same
4. Zero

Answer: 2

Explanation: $N_s \propto 1/H^{5/4}$; increasing head lowers Ns.

Ref: Bansal

---

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1. Steam temperature
2. Vacuum
3. Cooling water flow
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Explanation: Air leakage lowers effective vacuum.

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Explanation: Riser supplies molten metal during solidification.

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1. Torsional rigidity
2. Stress concentration
3. Temperature rise
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Answer: 2

Explanation: Corrects shear stress due to curvature.

Ref: Design of Machine Elements, Khurmi

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1. Increase reaction rate
2. Decrease reaction rate
3. Increase temperature
4. Increase neutron velocity

Answer: 2

Explanation: Control rods absorb neutrons reducing fission rate.

Ref: Power Plant Engineering, P.K. Nag

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2. All points within limits
3. Mean equals target
4. Range small

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Explanation: Any point outside UCL/LCL indicates assignable cause.

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200. In parallel PHEV, during high load condition, power supplied by:

1. Engine only
2. Motor only
3. Both engine and motor
4. Battery only

Answer: 3

Explanation: Both engine and electric motor combine for high power demand.

Ref: Electric & Hybrid Vehicles, A.K. Babu

Grand Test -5

Mechanical Engineering Core Paper

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4. Battery only

Answer: 3
Explanation: Both engine and electric motor combine for high power demand.
Ref: Electric & Hybrid Vehicles, A.K. Babu

---

126. Slag inclusion in welding is mainly caused by:

1. Excess welding current
2. Improper cleaning between passes
3. High welding speed
4. Excess shielding gas

Answer: 2
Solution: Slag trapped between weld layers due to poor cleaning. Frequently asked welding defect.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

127. In turning operation on lathe, feed is given by:

1. Headstock
2. Tailstock
3. Lead screw/feed rod
4. Chuck

Answer: 3
Solution: Feed rod or lead screw transmits motion for longitudinal feed.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

128. In robot configuration, SCARA robot is best suited for:

1. Heavy forging
2. Painting

3. Assembly operations
4. Welding large frames

Answer: 3
Solution: SCARA provides high speed and precision for assembly tasks.
Ref: CAD/CAM: Principles & Applications, P.N. Rao

---

129. Percentage elongation in tensile test indicates:

1. Strength
2. Hardness
3. Ductility
4. Toughness

Answer: 3
Solution: Elongation measures plastic deformation before fracture.
Ref: Material Science & Metallurgy, O.P. Khanna

---

130. In Iron-Carbon diagram, hypoeutectoid steel contains carbon:

1. Less than 0.8%
2. Exactly 0.8%
3. Greater than 0.8%
4. More than 2%

Answer: 1
Solution: Hypoeutectoid < 0.8% C. High frequency exam question.
Ref: O.P. Khanna

---

131. A simply supported beam of span 5 m carries UDL of 4 kN/m. Maximum bending moment is:

1. 12.5 kNm
2. 10 kNm
3. 8 kNm

4. 20 kNm

Answer: 1
Solution:

$$M = \frac{wL^2}{8} = \frac{4 \times 25}{8} = 12.5 \text{ kNm}$$

Ref: Strength of Materials, R.S. Khurmi

---

132. If compression ratio of Otto cycle increases, efficiency will:

1. Decrease
2. Increase
3. Remain same
4. Become zero

Answer: 2
Solution: Efficiency directly increases with compression ratio.
Ref: Thermal Engineering, Khurmi

---

133. In Diesel cycle, heat addition occurs at:

1. Constant volume
2. Constant pressure
3. Isothermal
4. Adiabatic

Answer: 2
Solution: Key difference between Otto and Diesel cycles.
Ref: Thermal Engineering, Khurmi

---

134. Indicated power of IC engine is calculated using:

1. Brake dynamometer
2. Indicator diagram

3. Tachometer
4. Fuel flow meter

Answer: 2
Solution: IMEP from indicator diagram gives indicated power.
Ref: Internal Combustion Engines, V. Ganesan

---

135. In air compressor, clearance volume increases:

1. Volumetric efficiency
2. Power output
3. Volumetric efficiency decreases
4. Compression ratio

Answer: 3
Solution: More clearance reduces fresh air intake.
Ref: Thermal Engineering, Khurmi

---

136. According to Bernoulli's equation, if velocity increases, pressure:

1. Increases
2. Decreases
3. Remains constant
4. Doubles

Answer: 2
Solution: Higher velocity → lower static pressure.
Ref: Fluid Mechanics, R.K. Bansal

---

137. Force exerted by jet on stationary flat plate is given by:

1. ρAV
2. ρAV^2
3. ρAV^3
4. ρA

Answer: 2
Solution: Momentum change gives force proportional to V^2.
Ref: Hydraulic Machines, Bansal

---

138. A centrifugal pump delivers 0.2 m³/s under head 20 m. Hydraulic power developed is approximately:

1. 39 kW
2. 20 kW
3. 50 kW
4. 80 kW

Answer: 1
Solution:

$$P = \rho g Q H = 1000 \times 9.81 \times 0.2 \times 20 \approx 39\ \text{kW}$$

Ref: Hydraulic Machines, Khurmi

---

139. Economizer in boiler is classified as:

1. Mounting
2. Accessory
3. Safety device
4. Regulator

Answer: 2
Solution: Accessories improve efficiency.
Ref: Power Plant Engineering, P.K. Nag

---

140. In steam nozzle, maximum discharge occurs when exit pressure equals:

1. Inlet pressure
2. Half inlet pressure
3. Critical pressure

4. Atmospheric pressure

Answer: 3
Solution: Maximum mass flow at critical pressure ratio.
Ref: Applied Thermodynamics, Eastop & McConkey

---

141. COP of VCR cycle is highest when:

1. Condenser temperature high
2. Evaporator temperature low
3. Evaporator temperature high
4. Pressure zero

Answer: 3
Solution: Higher evaporator temperature increases COP.
Ref: Refrigeration & Air Conditioning, Khurmi

---

142. On psychrometric chart, cooling and dehumidification process follows:

1. Horizontal line
2. Vertical line
3. Diagonal down-left
4. Diagonal up-right

Answer: 3
Solution: Both temperature and humidity decrease.
Ref: C.P. Arora

---

143. In method study, the first step is:

1. Install
2. Select
3. Examine
4. Develop

Answer: 2
Solution: Select the job/process for study first.
Ref: Industrial Engineering & Management, O.P. Khanna

---

144. ISO 9000 primarily focuses on:

1. Product design
2. Quality management system
3. Cost reduction
4. Safety compliance

Answer: 2
Solution: ISO 9000 ensures systematic quality control.
Ref: Inspection & Quality Control, A.P. Verma

---

145. Break-even point increases when:

1. Fixed cost decreases
2. Selling price increases
3. Fixed cost increases
4. Variable cost decreases

Answer: 3
Solution: Higher fixed cost requires higher sales to break even.
Ref: Industrial Management, A.P. Verma

---

146. Wind turbine maximum theoretical efficiency is limited by:

1. Carnot limit
2. Betz limit
3. Rankine cycle
4. Otto cycle

Answer: 2
Solution: Betz limit ≈ 59.3%.
Ref: Non-Conventional Energy Sources, G.D. Rai

147. Solar PV cell converts:

1. Heat to electricity
2. Light to electricity
3. Wind to electricity
4. Nuclear energy

Answer: 2
Solution: Photovoltaic effect converts light directly to electricity.
Ref: Renewable Energy Sources, D.P. Kothari

148. In HEV parallel configuration, engine and motor:

1. Cannot work together
2. Work independently
3. Can supply power simultaneously
4. Use separate wheels

Answer: 3
Solution: Parallel hybrid allows combined power output.
Ref: Electric & Hybrid Vehicles, A.K. Babu

149. In BEV block diagram, inverter function is to:

1. Store energy
2. Convert DC to AC
3. Reduce voltage
4. Cool battery

Answer: 2
Solution: Converts battery DC to AC for motor drive.
Ref: Electric & Hybrid Vehicles, Iqbal Husain

150. A cantilever beam with end load W has maximum shear force at:

1. Free end
2. Mid-span
3. Fixed end
4. Zero everywhere

Answer: 3
Solution: Maximum shear equals W at fixed support.
Ref: Strength of Materials, Khurmi

---

151. In lap joint, failure of riveted joint occurs due to:

1. Crushing only
2. Shearing of rivet only
3. Tearing of plate only
4. Any of the above modes

Answer: 4
Solution: Riveted joints may fail by shearing, tearing or crushing. Frequently repeated question.
Ref: Design of Machine Elements, R.S. Khurmi

---

152. The hammer used in fitting shop to avoid surface damage is:

1. Ball peen hammer
2. Sledge hammer
3. Mallet
4. Cross peen hammer

Answer: 3
Solution: Wooden mallet prevents surface damage.
Ref: Workshop Technology, Hazra Choudhury

---

153. In submerged arc welding (SAW), shielding is provided by:

1. Inert gas
2. Flux blanket

3. Water
4. Vacuum

Answer: 2
Solution: Granular flux covers arc and protects weld pool.
Ref: Manufacturing Technology, P.N. Rao

---

154. In lathe, lead screw is mainly used for:

1. Feeding
2. Thread cutting
3. Taper turning
4. Knurling

Answer: 2
Solution: Lead screw ensures precise pitch during thread cutting.
Ref: Manufacturing Technology Vol II, P.N. Rao

---

155. Pearlite is a mixture of:

1. Ferrite and Cementite
2. Austenite and Ferrite
3. Ferrite only
4. Cementite only

Answer: 1
Solution: Eutectoid transformation forms alternating layers of ferrite and cementite.
Ref: Material Science & Metallurgy, O.P. Khanna

---

156. A cantilever beam of length 2 m carries 5 kN at free end. Maximum bending moment is:

1. 5 kNm
2. 10 kNm
3. 2.5 kNm

4. 20 kNm

Answer: 2
Solution:

$$M = W \times L = 5 \times 2 = 10 \text{ kNm}$$

Ref: Strength of Materials, R.S. Khurmi

---

157. Efficiency of Diesel cycle depends on:

1. Compression ratio only
2. Cut-off ratio only
3. Both compression and cut-off ratio
4. Pressure only

Answer: 3
Solution: Diesel efficiency depends on both r and cut-off ratio.
Ref: Thermal Engineering, Khurmi

---

158. In a 4-stroke engine, one power stroke occurs in:

1. 1 revolution
2. 2 revolutions
3. 3 revolutions
4. 4 revolutions

Answer: 2
Solution: 4 strokes require two crankshaft revolutions.
Ref: Internal Combustion Engines, V. Ganesan

---

159. Volumetric efficiency of compressor is affected by:

1. Clearance volume
2. Speed
3. Temperature

4. All of the above

Answer: 4
Solution: All parameters influence volumetric efficiency.
Ref: Thermal Engineering, Khurmi

---

160. In venturimeter, discharge increases when:

1. Area increases
2. Pressure difference increases
3. Density zero
4. Velocity zero

Answer: 2
Solution: Discharge proportional to √(pressure difference).
Ref: Fluid Mechanics, R.K. Bansal

---

161. Jet striking stationary curved vane produces force depending on:

1. Mass flow rate
2. Velocity
3. Angle of deflection
4. All

Answer: 4
Solution: Force based on change in momentum (mass × velocity change).
Ref: Hydraulic Machines, Bansal

---

162. Cavitation in centrifugal pump occurs when:

1. Discharge high
2. Suction pressure falls below vapor pressure
3. Speed low
4. Head high

Answer: 2
Solution: Vapor bubbles form when pressure < vapor pressure.
Ref: Hydraulic Machines, Khurmi

---

163. Superheater in boiler is used to:

1. Increase steam pressure
2. Increase steam temperature
3. Reduce moisture
4. Increase feedwater temperature

Answer: 2
Solution: Converts saturated steam to superheated steam.
Ref: Power Plant Engineering, P.K. Nag

---

164. Steam nozzle exit velocity depends on:

1. Pressure drop
2. Enthalpy drop
3. Mass flow
4. Density only

Answer: 2
Solution:

$$V = \sqrt{2(h_1 - h_2)}$$

Ref: Applied Thermodynamics, Eastop

---

165. Refrigerating effect is equal to:

1. Heat rejected
2. Heat absorbed in evaporator
3. Compressor work
4. Heat supplied

Answer: 2
Solution: Cooling occurs in evaporator.
Ref: Refrigeration & Air Conditioning, Khurmi

---

166. Relative humidity is defined as ratio of:

1. Partial pressure to saturation pressure
2. DBT to WBT
3. Specific humidity to dry air
4. Enthalpy to temperature

Answer: 1
Solution: RH = Actual vapor pressure / Saturation vapor pressure.
Ref: C.P. Arora

---

167. In time study, standard time is:

1. Observed time
2. Normal time
3. Normal time + allowances
4. Basic time only

Answer: 3
Solution: Standard time = Normal time + Allowances.
Ref: Industrial Engineering & Management, O.P. Khanna

---

168. ABC analysis classifies inventory based on:

1. Volume
2. Weight
3. Annual consumption value
4. Storage space

Answer: 3
Solution: Based on annual consumption cost.
Ref: Production & Materials Management, K. Shridhara Bhat

---

169. Solar thermal power plant mainly operates on:

1. Rankine cycle
2. Otto cycle
3. Brayton cycle
4. Diesel cycle

Answer: 1
Solution: Solar thermal plants generate steam for Rankine cycle.
Ref: Power Plant Engineering, P.K. Nag

---

170. Betz limit states maximum wind turbine efficiency is:

1. 40%
2. 50%
3. 59.3%
4. 75%

Answer: 3
Solution: Theoretical maximum ≈ 59.3%.
Ref: Non-Conventional Energy Sources, G.D. Rai

---

171. In BEV, regenerative braking converts:

1. Heat to electricity
2. Mechanical energy to electrical energy
3. Electrical to mechanical
4. Fuel to electricity

Answer: 2
Solution: Kinetic energy recovered during braking.
Ref: Electric & Hybrid Vehicles, A.K. Babu

---

172. In series hybrid vehicle, engine:

1. Drives wheels directly
2. Charges battery only
3. Both drives wheels and charges battery
4. Not present

Answer: 2
Solution: Engine powers generator, not wheels.
Ref: Modern Electric Vehicles, Mehrdad Ehsani

---

173. In cantilever beam, shear force diagram is:

1. Parabolic
2. Triangular
3. Rectangular
4. Zero

Answer: 3
Solution: Shear force constant along length for end load.
Ref: Strength of Materials, Khurmi

---

174. Governing of steam turbine is done to:

1. Increase speed
2. Reduce vibration
3. Maintain constant speed under varying load
4. Increase efficiency

Answer: 3
Solution: Governing controls steam flow to maintain speed.
Ref: Power Plant Engineering, P.K. Nag

---

175. Honing is mainly used for:

1. Removing large material
2. Improving surface finish

3. Welding
4. Casting

Answer: 2
Solution: Honing produces fine surface finish and accurate dimension.
Ref: Workshop Technology Vol II, Hazra Choudhury

---

176. In projection of points, if a point lies in HP, its front view lies on:

1. XY line
2. Above XY
3. Below XY
4. Anywhere

Answer: 1
Solution: Point on HP has zero height → front view on XY line. Very common drawing question.
Ref: Machine Drawing, N.D. Bhatt

---

177. Undercut in welding is caused due to:

1. Low current
2. High current
3. Excess shielding gas
4. Low speed

Answer: 2
Solution: High current melts parent metal excessively creating groove.
Ref: Manufacturing Technology Vol I, P.N. Rao

---

178. A simply supported beam of span 6 m carries 6 kN central load. Maximum BM is:

1. 9 kNm
2. 6 kNm
3. 12 kNm

4. 18 kNm

Answer: 1
Solution:

$$M = \frac{WL}{4} = \frac{6 \times 6}{4} = 9 \text{ kNm}$$

Ref: Strength of Materials, R.S. Khurmi

---

179. If compression ratio of Diesel engine increases, efficiency:

1. Decreases
2. Increases
3. Same
4. Zero

Answer: 2
Solution: Efficiency increases with compression ratio.
Ref: Thermal Engineering, Khurmi

---

180. In reciprocating air compressor, intercooling is used to:

1. Increase discharge pressure
2. Reduce work input
3. Increase clearance
4. Increase temperature

Answer: 2
Solution: Intercooling reduces temperature between stages → reduces work.
Ref: Thermal Engineering, Khurmi

---

181. According to continuity equation:

1. $A_1V_1 = A_2V_2$
2. $P_1V_1 = P_2V_2$

3. F = ma
4. ρgh constant

Answer: 1
Solution: Mass conservation in incompressible flow.
Ref: Fluid Mechanics, R.K. Bansal

---

182. The head developed by centrifugal pump depends mainly on:

1. Speed of impeller
2. Density only
3. Pipe length
4. Suction height

Answer: 1
Solution: Head proportional to square of impeller speed.
Ref: Hydraulic Machines, Khurmi

---

183. Blow-off cock in boiler is used to:

1. Measure pressure
2. Remove sludge
3. Increase steam temp
4. Regulate flow

Answer: 2
Solution: Removes sediments from boiler bottom.
Ref: Power Plant Engineering, P.K. Nag

---

184. In steam nozzle, for maximum discharge the critical pressure ratio for steam is approximately:

1. 0.5
2. 0.577
3. 0.8

4. 1

Answer: 2
Solution: For steam, critical pressure ratio ≈ 0.577.
Ref: Applied Thermodynamics, Eastop

---

185. In VCR cycle, compressor increases:

1. Pressure only
2. Temperature only
3. Pressure and temperature
4. Humidity

Answer: 3
Solution: Compression raises both pressure and temperature.
Ref: Refrigeration & Air Conditioning, Khurmi

---

186. Dew point temperature is the temperature at which:

1. Air becomes saturated
2. Ice forms
3. Pressure zero
4. Relative humidity zero

Answer: 1
Solution: At dew point, RH becomes 100%.
Ref: C.P. Arora

---

187. In motion study, therbligs were introduced by:

1. Taylor
2. Gilbreth
3. Fayol
4. Maslow

Answer: 2
Solution: Frank and Lillian Gilbreth developed therbligs.
Ref: Industrial Engineering & Management, O.P. Khanna

---

188. Economic Order Quantity (EOQ) formula is:

1. $\sqrt{\frac{2DS}{H}}$
2. DS/H
3. D/S
4. $\sqrt{DH}$

Answer: 1
Solution: Classic EOQ formula derived from inventory cost balance.
Ref: Production & Materials Management, K. Shridhara Bhat

---

189. Nuclear fission reaction releases energy according to:

1. PV = mRT
2. F = ma
3. $E = mc^2$
4. V = IR

Answer: 3
Solution: Mass defect converts into energy.
Ref: Power Plant Engineering, P.K. Nag

---

190. Moderator in nuclear reactor slows neutrons by:

1. Absorbing them
2. Increasing velocity
3. Elastic collision
4. Heating them

Answer: 3
Solution: Neutrons lose energy via elastic collisions.
Ref: Nuclear Physics & Nuclear Power, Kenneth S. Krane

---

191. Wind turbine gearbox is used to:

1. Store energy
2. Increase rotational speed
3. Reduce vibration
4. Generate electricity

Answer: 2
Solution: Gearbox increases low rotor speed to generator speed.
Ref: Non-Conventional Energy Sources, G.D. Rai

---

192. In solar PV cell, material commonly used is:

1. Copper
2. Silicon
3. Aluminium
4. Steel

Answer: 2
Solution: Crystalline silicon widely used semiconductor.
Ref: Renewable Energy Sources, D.P. Kothari

---

193. In BEV, State of Charge (SoC) indicates:

1. Battery voltage
2. Battery temperature
3. Available battery capacity
4. Motor speed

Answer: 3
Solution: SoC represents percentage of charge remaining.
Ref: Electric & Hybrid Vehicles, A.K. Babu

---

194. PHEV differs from HEV because PHEV:

1. Cannot run on battery
2. Has plug-in charging facility
3. Uses hydrogen
4. Has no engine

Answer: 2
Solution: Plug-in external charging is key difference.
Ref: Electric & Hybrid Vehicles, A.K. Babu

---

195. In HEV series configuration, mechanical power from engine is converted to:

1. Direct wheel rotation
2. Electrical power
3. Heat only
4. Mechanical energy only

Answer: 2
Solution: Engine drives generator, not wheels directly.
Ref: Modern Electric Vehicles, Mehrdad Ehsani

---

196. Maximum shear stress in circular shaft occurs at:

1. Centre
2. Mid radius
3. Surface
4. Neutral axis

Answer: 3
Solution: Shear stress zero at center, max at outer surface.
Ref: Strength of Materials, Khurmi

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197. In governor, hunting refers to:

1. Speed decrease
2. Speed increase
3. Continuous fluctuation of speed
4. Fuel leakage

Answer: 3
Solution: Repeated speed oscillations around mean value.
Ref: Theory of Machines, Khurmi

---

198. In reciprocating pump, slip occurs when:

1. Actual discharge < Theoretical discharge
2. Actual discharge > Theoretical discharge
3. Both equal
4. Discharge zero

Answer: 1
Solution: Slip = Theoretical − Actual discharge.
Ref: Hydraulic Machines, Khurmi

---

199. Equivalent evaporation of boiler is defined as evaporation from and at:

1. 100°C
2. 212°F
3. Both 1 and 2
4. 150°C

Answer: 3
Solution: Standard reference: from and at 100°C (212°F).
Ref: Power Plant Engineering, P.K. Nag

---

200. The biggest advantage of BEV over conventional vehicle is:

1. Higher noise
2. Zero tailpipe emissions

3. More moving parts
4. Higher fuel consumption

Answer: 2
Solution: BEVs produce no exhaust emissions. Guaranteed Unit XI question.
Ref: Electric & Hybrid Vehicles, A.K. Babu

END NOTE

Your Rank is Not Decided in the Exam Hall…

It Is Decided in Your Preparation Room.

Dear Student,

If you have reached this page, it means you have completed a serious journey.

You have revised formulas.
You have solved hundreds of objective questions.
You have faced mock tests under pressure.
You have corrected mistakes.
You have improved.

That is exactly how ranks are built.

📌 Remember These Final Principles

✓ Concepts win over shortcuts.
✓ Accuracy is more powerful than speed.
✓ Revision is more important than new study.
✓ Formula clarity gives confidence.
✓ Mock test analysis gives rank.

AP ECET is not about difficult questions.
It is about avoiding silly mistakes.

🎯 Final Strategy Before Exam

- Revise all 11 Units formula sheets.
- Focus on frequently tested areas:
    - Fe–C Diagram
    - SFD & BMD standard cases
    - Belt & Gear formulas
    - Thermodynamic process equations
    - Pump & Turbine relations

    - IC Engine efficiencies
    - ISO & SQC basics
- Sleep well before exam day.
- Stay calm.
- Read each question carefully.

🧠 In the Exam Hall

1. Attempt easy questions first.
2. Avoid overthinking simple theory questions.
3. Recheck numerical units carefully.
4. Use elimination method wisely.
5. Never leave known questions unanswered.

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This exam is not the destination.

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After ECET:

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- You prepare for placements.
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AP ECET is a gateway for Diploma students to enter B.Tech through lateral entry. Success in this exam requires clarity, structured preparation, and focused practice. This book is designed as a complete preparation system based on:

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✓ Rank-focused strategy

About the Author

Bandi Dayasagar is an academician, researcher, and career mentor with strong expertise in Mechanical Engineering and Computer Information — Systems. With academic qualifications from Diploma to MS (USA) and practical exposure in leading national organizations, he founded Sagar Educational Society to guide Dip-piloma and Engineering students toward structured, exam-focused preparation.

His teaching philosophy is simple: **Clear Concepts. Smart Preparation. Disciplined Execution.**

ISBN 978-93-5777-946-3
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