UNIT AND MEASUREMENT

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PHYSICS

1. The percentage errors in quantities P, Q, R and S are 0.5%, 1%, 3% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3Q^2}{\sqrt{RS}}$. the maximum percentage error in the value of A will be .... $\%$
   (A) 8.5 (B) 6.0
   (C) 7.5 (D) 6.5
2. A, B, C and D are four different physical quantities having different dimensions. None of them is dimensionless. But we know that the equation $AD = C\,ln\,(BD)$ holds true. Then which of the combination is not a meaningful quantity ?
   (A) $\frac{C}{BD} - \frac{AD^2}{C}$ (B) $A^2 - B^2C^2$
   (C) $\frac{A}{B} - C$ (D) $\frac{(A-C)}{D}$
3. According to Joule's law of heating, heat produced $H = I^2\,Rt$, where I is current, R is resistance and t is time. If the errors in the measurement of I, R and t are $3\%, 4\%$ and 6% respectively then error in the measurement of H is
   (A) $\pm 17\%$ (B) $\pm 16\%$
   (C) $\pm 19\%$ (D) $\pm 25\%$
4. The length of a cylinder is measured with a meter rod having least count $0.1\,cm$. Its diameter is measured with vernier calipers having least count $0.01\,cm$. Given that length is $5.0\,cm$. and radius is $2.0\,cm$. The percentage error in the calculated value of the volume will be .... $\%$
   (A) 1 (B) 2
   (C) 3 (D) 4
5. The equation of state of some gases can be expressed as $\left(P + \frac{a}{V^2}\right) = \frac{R\theta}{V}$ Where P is the pressure, V the volume, θ the absolute temperature and a and b are constants. The dimensional formula of a is
   (A) $[ML^5T^{-2}]$ (B) $[M^{-1}L^5T^{-2}]$
   (C) $[ML^{-1}T^{-2}]$ (D) $[ML^{-5}T^{-2}]$
6. If the error in the measurement of radius of a sphere is 2% then the error in the determination of volume of the sphere will be .... $\%$
   (A) 2 (B) 4
   (C) 6 (D) 8
7. Which is the correct unit for measuring nuclear radii
   (A) Micron (B) Millimetre
   (C) Angstrom (D) Fermi
8. Which of the following is not a unit of time
   (A) Leap year (B) Micro second
   (C) Lunar month (D) Light year
9. A suitable unit for gravitational constant is
   (A) $kg{-}\,m\sec^{-1}$ (B) $N\,m^{-1}\sec$
   (C) $N\,m^2\,kg^{-2}$ (D) $kg\,m\sec^{-1}$
10. The respective number of significant figures for the numbers $23.023, 0.0003$ and 2.1×10^3 are
    (A) $5, 1, 2$ (B) $5, 1, 5$
    (C) $5, 5, 2$ (D) $4, 4, 2$
11. A physical quantity is given by $X = M^aL^bT^c$. The percentage error in measurement of M, L and T are α, β and γ respectively. Then maximum percentage error in the quantity X is
    (A) $a\alpha + b\beta + c\gamma$ (B) $a\alpha + b\beta - c\gamma$
    (C) $\frac{a}{\alpha} + \frac{b}{\beta} + \frac{c}{\gamma}$ (D) None of these
12. A physical quantity p is described by the relation $p = a^{1/2}\,b^2\,c^3\,d^{-4}$
    If the relative errors in the measurement of a, b, c and d respectively, are $2\%, 1\%, 3\%$ and 5%, then the relative error in P will be .... $\%$
    (A) 8 (B) 12
    (C) 32 (D) 25
13. Light year is a unit of
    (A) Time (B) Mass
    (C) Distance (D) Energy
14. Electron volt is a unit of
    (A) Charge (B) Potential difference
    (C) Momentum (D) Energy
15. In the relation $P = \frac{\alpha}{\beta}e^{-\frac{\alpha Z}{k\theta}}$ P is pressure, Z is the distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be
    (A) $[M^0L^2T^0]$ (B) $[M^1L^2T^1]$
    (C) $[M^1L^0T^{-1}]$ (D) $[M^0L^2T^{-1}]$
16. The unit of reactance is
    (A) Ohm (B) Volt
    (C) Mho (D) Newton
17. With the usual notations, the following equation $S_t = u + \frac{1}{2}a(2t-1)$ is
    (A) Only numerically correct (B) Only dimensionally correct
    (C) Both numerically and dimensionally correct (D) Neither numerically nor dimensionally correct
18. What is the SI unit of permeability
    (A) Henry per metre (B) Tesla metre per ampere
    (C) Weber per ampere metre (D) All the above units are correct
19. $1\,eV$ is
    (A) Same as one joule (B) $1.6 \times 10^{-19}J$
    (C) $1V$ (D) $1.6 \times 10^{-19}C$
20. One nanometre is equal to
    (A) 10^9mm (B) $10^{-6}\,cm$
    (C) $10^{-7}cm$ (D) $10^{-9}cm$
21. The dimensional formula of farad is
    (A) $[M^{-1}L^{-2}TQ]$ (B) $[M^{-1}L^{-2}T^2Q^2]$
    (C) $[M^{-1}L^{-2}TQ^2]$ (D) $[M^{-1}L^{-2}T^2Q]$
22. Length cannot be measured by
    (A) Fermi (B) Debye
    (C) Micron (D) Light year
23. Number of base SI units is
    (A) 4 (B) 7
    (C) 3 (D) 5

24. The unit of Planck's constant is
(A) Joule (B) Joule/s
(C) Joule/m (D) Joule-s

25. A physical parameter a can be determined by measuring the parameters b, c, d and e using the relation $a = b^{\alpha}c^{\beta}/d^{\gamma}e^{\delta}$. If the maximum errors in the measurement of b, c, d and e are $b_1\%$, $c_1\%$, $d_1\%$ and $e_1\%$, then the maximum error in the value of a determined by the experiment is
(A) $(b_1 + c_1 + d_1 + e_1)\%$ (B) $(b_1 + c_1 - d_1 - e_1)\%$
(C) $(\alpha b_1 + \beta c_1 - \gamma d_1 - \delta e_1)\%$ (D) $(\alpha b_1 + \beta c_1 + \gamma d_1 + \delta e_1)\%$

26. One pico Farad is equal to
(A) $10^{-24}F$ (B) $10^{-18}F$
(C) $10^{-12}F$ (D) $10^{-6}F$

27. The unit of Young's modulus is
(A) Nm^2 (B) Nm^{-2}
(C) Nm (D) Nm^{-1}

28. To determine the Young's modulus of a wire, the formula is $Y = \frac{F}{A} \times \frac{L}{\Delta L}$; where L = length, A =area of cross-section of the wire, ΔL =change in length of the wire when stretched with a force F. The conversion factor to change it from CGS to MKS system is .... $\mathrm{N/m^2}$
(A) 1 (B) 10
(C) 0.1 (D) 0.01

29. One million electron volt $(1\,MeV)$ is equal to
(A) $10^5 eV$ (B) $10^6 eV$
(C) $10^4 eV$ (D) $10^7 eV$

30. The speed of light (c), gravitational constant (G) and planck's constant (h) are taken as fundamental units in a system. The dimensions of time in this new system should be
(A) $G^{1/2}h^{1/2}c^{-5/2}$ (B) $G^{-1/2}h^{1/2}c^{1/2}$
(C) $G^{1/2}h^{1/2}c^{-3/2}$ (D) $G^{1/2}h^{1/2}c^{1/2}$

31. The dimension of stopping potential $\mathrm{V_0}$ in photoelectric effect in units of Planck's constant h, speed of light c and Gravitational constant G and ampere A is
(A) $\mathrm{h^2G^{3/2}C^{1/3}A^{-1}}$ (B) $\mathrm{h^{-2/3}c^{-1/3}G^{4/3}A^{-1}}$
(C) $\mathrm{h^{1/3}G^{2/3}c^{1/3}A^{-1}}$ (D) $\mathrm{h^0c^5G^{-1}A^{-1}}$

32. Diameter of a steel ball is measured using a Vernier callipers which has divisions of $0.1\,cm$ on its main scale (MS) and 10 divisions of its vernier scale (VS) match 9 divisions on the main scale. Three such measurements for a ball are given as
If the zero error is $-0.03\,cm$, then mean corrected diameter is .... cm

S.No.	$MS(cm)$	VS divisions
(1)	0.5	8
(2)	0.5	4
(3)	0.5	6

(A) 0.52 (B) 0.59
(C) 0.56 (D) 0.53

33. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimation of the kinetic energy obtained by measuring mass and speed .... $\%$
(A) 11 (B) 8
(C) 5 (D) 1

34. The $S.I.$ unit of gravitational potential is
(A) J (B) $J\text{–}kg^{-1}$
(C) $J\text{–}kg$ (D) $J\text{–}kg^{-2}$

35. The equation $\left(P + \frac{a}{V^2}\right)(V - b)$ constant. The units of a are
(A) $Dyne \times cm^5$ (B) $Dyne \times cm^4$
(C) $Dyne/cm^3$ (D) $Dyne/cm^2$

36. Oersted is a unit of
(A) Dip (B) Magnetic intensity
(C) Magnetic moment (D) Pole strength

37. What is the number of significant figures in 0.310×10^3
(A) 2 (B) 3
(C) 4 (D) 6

38. Which does not has the same unit as others
(A) Watt-sec (B) Kilowatt-hour
(C) eV (D) J-sec

39. Henry/ohm can be expressed in
(A) Second (B) Coulomb
(C) Mho (D) Metre

40. The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$, where P is pressure, x is distance and t is time, are
(A) MT^{-2} (B) M^2LT^{-3}
(C) ML^3T^{-1} (D) LT^{-3}

41. The density of a material in $SI\,units$ is $128\,kg\,m^{-3}$. In certain units in which the unit of length is $25\,cm$ and the unit of mass $50\,g$, the numerical value of density of the material is
(A) 40 (B) 16
(C) 640 (D) 410

42. $1kWh =$
(A) $1000W$ (B) $36 \times 10^5 J$
(C) $1000J$ (D) $3600\,J$

43. A wire has a mass $0.3 \pm 0.003\,g$, radius $0.5 \pm 0.005\,mm$ and length $6 \pm 0.06\,cm$. The maximum percentage error in the measurement of its density is .... $\%$
(A) 1 (B) 2
(C) 3 (D) 4

44. The dimension of $\frac{\mathrm{B}^2}{2\mu_0}$, where B is magnetic field and μ_0 is the magnetic permeability of vacuum, is
(A) $ML^{-1}T^{-2}$ (B) $\mathrm{ML^2T^{-1}}$
(C) $\mathrm{MIT^{-2}}$ (D) $\mathrm{MI^2T^{-2}}$

45. A student measured the diameter of a wire using a screw gauge with the least count $0.001\,cm$ and listed the measurements. The measured value should be recorded as
(A) $5.3200\,cm$ (B) $5.3\,cm$
(C) $5.32\,cm$ (D) $5.320\,cm$

46. Dimensions of $\frac{1}{\mu_0\varepsilon_0}$, where symbols have their usual meaning, are
(A) $[LT^{-1}]$ (B) $[L^{-1}T]$
(C) $[L^{-2}T^2]$ (D) $[L^2T^{-2}]$

47. Curie is a unit of
(A) Energy of $\gamma -\ rays$ (B) Half life
(C) Radioactivity (D) Intensity of $\gamma - rays$

48. $Assertion$: In the measurement of physical quantities direct and indirect methods are used.
$Reason$: The accuracy and precision of measuring instruments along with errors in measurements should be taken into account, while expressing the result.
(A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(C) If the Assertion is correct but Reason is incorrect.
(D) If both the Assertion and Reason are incorrect.

49. Which of the following physical quantities do not have same dimensions?
(A) pressure and stress (B) tension and surface tension
(C) strain and angle (D) energy and work.

50. If force (F), velocity (V) and time (T) are taken as fundamental units, then the dimensions of mass are
(A) $[FVT^{-1}]$ (B) $[FVT^{-2}]$
(C) $[FV^{-1}T^{-1}]$ (D) $[FV^{-1}T]$

51. If the capacitance of a nanocapacitor is measured in terms of a unit $'u'$ made by combining the electric charge $'e'$, Bohr radius $'a_0'$, Planck's constant $'h'$ and speed of light $'c'$ then

(A) $u = \frac{e^2h}{a_0}$ (B) $u = \frac{hc}{e^2a_0}$

(C) $u = \frac{e^2c}{ha_0}$ (D) $u = \frac{e^2a_0}{hc}$

52. Which is not a unit of electric field

(A) NC^{-1} (B) Vm^{-1}

(C) JC^{-1} (D) $JC^{-1}m^{-1}$

53. The unit of permittivity of free space ε_0 is

(A) $Coulomb/Newton-metre$ (B) $Newton-metre^2/Coulomb^2$

(C) $\text{Coulomb}^2/(Newton-metre)^2$ (D) $Coulomb^2/Newton-metre^2$

54. $X = 3YZ^2$ find dimension of Y in $(MKSA)$ system, if X and Z are the dimension of capacity and magnetic field respectively

(A) $M^{-3}L^{-2}T^{-4}A^{-1}$ (B) ML^{-2}

(C) $M^{-3}L^{-2}T^4A^4$ (D) $M^{-3}L^{-2}T^8A^4$

55. The dimensions of $e^2/4\pi\varepsilon_0hc$, where e, ε_0, h and c are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively

(A) $[M^0L^0T^0]$ (B) $[M^1L^0T^0]$

(C) $[M^0L^1T^0]$ (D) $[M^0L^0T^1]$

56. A thin copper wire of length l metre increases in length by 2% when heated through $10^o\ C$. .... $\%$ is the percentage increase in area when a square copper sheet of length l metre is heated through $10^o\ C$

(A) 4 (B) 8

(C) 16 (D) None of the above

57. If electronic charge e, electron mass m, speed of light in vacuum c and Planck 's constant h are taken as fundamental quantities, the permeability of vacuum μ_0 can be expressed in units of

(A) $\left(\frac{h}{me^2}\right)$ (B) $\left(\frac{hc}{me^2}\right)$

(C) $\left(\frac{h}{ce^2}\right)$ (D) $\left(\frac{mc^2}{he^2}\right)$

58. A student measured the diameter of a small steel ball using a screw gauge of least count $0.001\,cm$. The main scale reading is $5\,mm$ and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of $-0.004\,cm$, the correct diameter of the ball is

(A) $0.521\,cm$ (B) $0.525\,cm$

(C) $0.529\,cm$ (D) $0.053\,cm$

59. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measured by using a watch of $1\,second$ least count. The mean value of time taken comes out to be $30\,s$. The length of pendulum is measured by using a meter scale of least count $1\,mm$ and the value obtained is $55.0\,cm$. The percentage error in the determination of g is close to .... $\%$

(A) 0.7 (B) 3.5

(C) 6.8 (D) 0.2

60. The SI unit of surface tension is

(A) Dyne/cm (B) Newton/cm

(C) Newton/metre (D) Newton-metre

61. One femtometer is equivalent to

(A) $10^{15}\,m$ (B) $10^{-15}\,m$

(C) $10^{-12}\,m$ (D) $10^{12}\,m$

62. The number of significant figures in all the given numbers $25, 12, 2009, 4.156$ and 1.217×10^{-4} is

(A) 1 (B) 2

(C) 3 (D) 4

63. SI unit of permittivity is

(A) $C^2m^2N^{-1}$ (B) $C^{-1}m^2N^{-2}$

(C) $C^2m^2N^2$ (D) $C^2m^{-2}N^{-1}$

64. In the density measurement of a cube, the mass and edge length are measured as $(10.00 \pm 0.10)\ kg$ and $(0.10 \pm 0.01)\ m$ respectively. The error in the measurement of density is

(A) $0.10\ kg/m^3$ (B) $0.31\ kg/m^3$

(C) $0.07\ kg/m^3$ (D) None of these

65. One Mach number is equal to

(A) Velocity of light (B) Velocity of sound $(332\ m/\sec)$

(C) $1\ km/\sec$ (D) $1\,m/\sec$

66. $Erg - m^{-1}$ can be the unit of measure for

(A) Force (B) Momentum

(C) Power (D) Acceleration

67. The diameter and height of a cylinder are measured by a meter scale to be $12.6 \pm 0.1\,cm$ and $34.2 \pm 0.1\,cm$, respectively. What will be the value of its volume in appropriate significant figures?

(A) $4264 \pm 81\,cm^3$ (B) $4260 \pm 80\,cm^3$

(C) $4264 \pm 81.0\,cm^3$ (D) $4300 \pm 80\,cm^3$

68. The speed of light (c), gravitational constant (G) and Planck's constant (h) are taken as the fundamental units in a system. The dimension of time in this new system should be

(A) $G^{1/2}h^{1/2}c^{-5/2}$ (B) $G^{-1/2}h^{1/2}c^{1/2}$

(C) $G^{1/2}h^{1/2}c^{-3/2}$ (D) $G^{1/2}h^{1/2}c^{1/2}$

69. Which is different from others by units

(A) Phase difference (B) Mechanical equivalent

(C) Loudness of sound (D) Poisson's ratio

70. The decimal equivalent of $1/20$ upto three significant figures is

(A) 0.0500 (B) 0.05000

(C) 0.0050 (D) 5.0×10^{-2}

71. If the capacitance of a nanocapacitor is measured in terms of a unit $'u'$ made by combining the electric charge $'e'$, Bohr radius $'a_0'$, Planck's constant $'h'$ and speed of light $'c'$ then

(A) $u = \frac{e^2h}{a_0}$ (B) $u = \frac{hc}{e^2a_0}$

(C) $u = \frac{e^2c}{ha_0}$ (D) $u = \frac{e^2a_0}{hc}$

72. In $S = a + bt + ct^2$. S is measured in metres and t in seconds. The unit of c is

(A) None (B) m

(C) ms^{-1} (D) ms^{-2}

73. The characteristic distance at which quantum gravitational effects are significant, the Planck length, can be determined from a suitable combination of the fundamental physical constants G, h and c . Which of the following correctly gives the Planck length?

(A) G^2hc (B) $\left(\frac{Gh}{c^3}\right)^{\frac{1}{2}}$

(C) $G^{\frac{1}{2}}h^2c$ (D) Gh^2c^3

74. $Dyne/cm^2$ is not a unit of

(A) Pressure (B) Stress

(C) Strain (D) Young's modulus

75. In $SI\ units$, the dimensions of $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ is

(A) $AT^{-3}ML^{3/2}$ (B) $A^{-1}TML^3$

(C) $A^2T^3M^{-1}L^{-2}$ (D) $AT^2M^{-1}L^{-1}$

76. A body travels uniformly a distance of $(13.8 \pm 0.2)\,m$ in a time $(4.0 \pm 0.3)\,s$. The percentage error is .... $\%$

(A) 7 (B) 5.95

(C) 8.95 (D) 9.85

77. A beaker contains a fluid of density $\rho\, kg/m^3$, specific heat $S\, J/kg\,^oC$ and viscosity η. The beaker is filled upto height h. To estimate the rate of heat transfer per unit area (Q/A) by convection when beaker is put on a hot plate, a student proposes that it should depend on η, $\left(\frac{S\Delta\theta}{h}\right)$ and $\left(\frac{1}{\rho g}\right)$ when $\Delta\theta$ (in ^oC) is the difference in the temperature between the bottom and top of the fluid. In that situation the correct option for (Q/A) is

(A) $\eta\cdot\left(\frac{S\Delta\theta}{h}\right)\left(\frac{1}{\rho g}\right)$ (B) $\left(\frac{S\Delta\theta}{\eta h}\right)\left(\frac{1}{\rho g}\right)$

(C) $\frac{S\Delta\theta}{\eta h}$ (D) $\eta\frac{S\Delta\theta}{h}$

78. In a screw gauge, 5 complete rotations of the screw cause it to move a linear distance of $0.25\, cm$. There are 100 circular scale divisions. The thickness of a wire measured by this screw gauge gives a reading of 4 main scale divisions and 30 circular scale divisions . Assuming negligible zero error, the thickness of the wire is

(A) $0.0430\, cm$ (B) $0.3150\, cm$

(C) $0.4300\, cm$ (D) $0.2150\, cm$

79. The period ofoscillation ofa simple pendulum is $T=2\pi\sqrt{\frac{l}{g}}$. Measured value of L is $20.0\ cm$ known to $1\ mm$ accuracy and time for 100 oscillations of the pendulum is found to be $90\ s$ using a wrist watch of $1\ s$ resolution. The accuracy in the determination of g is .... $\%$

(A) 3 (B) 1

(C) 5 (D) 2

80. In an experiment the angles are required to be measured using an instrument, 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half- a degree $(=0.5^o)$, then the least count of the instrument is:

(A) 1° (B) $\frac{1}{2}^\circ$

(C) $1'$ (D) $(\frac{1}{2})'$

81. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to

(A) $\sqrt{\frac{hc^5}{G}}$ (B) $\sqrt{\frac{c^3}{Gh}}$

(C) $\sqrt{\frac{Gh}{c^5}}$ (D) $\sqrt{\frac{Gh}{c^3}}$

82. Candela is the unit of

(A) Electric intensity (B) Luminous intensity

(C) Sound intensity (D) None of these

83. The unit of L/R is (where L = inductance and R = resistance)

(A) $\sec$ (B) $\sec^{-1}$

(C) Volt (D) Ampere

84. The unit of the coefficient of viscosity in $S.I.$ system is

(A) $m/kg{-}s$ (B) $m{-}s/kg^2$

(C) $kg/m{-}s^2$ (D) $kg/m{-}s$

85. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then:

(A) $\varepsilon_0 = M^{-1}L^{-3}T^2A$ (B) $\varepsilon_0 = M^{-1}L^{-3}T^4A^2$

(C) $\varepsilon_0 = M^{-1}L^2T^{-1}A^{-2}$ (D) $\varepsilon_0 = M^{-1}L^2T^{-1}A$

86. The units of modulus of rigidity are

(A) $N-m$ (B) N/m

(C) $N-m^2$ (D) N/m^2

87. If the unit of length and force be increased four times, then the unit of energy is

(A) Increased 4 times (B) Increased 8 times

(C) Increased 16 times (D) Decreased 16 times

88. The correct value of 0^oC on the Kelvin scale is .... K

(A) 273.15 (B) 272.85

(C) 273 (D) 273.2

89. Which of the following is not represented in correct unit

(A) $\frac{\text{Stress}}{\text{Strain}}=N/m^2$ (B) Surface tension $=N/m$

(C) Energy $=kg{-}m/\sec$ (D) Pressure $=N/m^2$

90. Which of the following quantity is expressed as force per unit area

(A) Work (B) Pressure

(C) Volume (D) Area

91. The main scale of a vemler calliper has n divisions/ cm. n divisions of the vernler scale coincide with $(\text{n}-1)$ divisions of maln scale. The least count of the vernler calliper is,

(A) $\frac{1}{(n+1)(n-1)}\text{cm}$ (B) $\frac{1}{n}\text{ cm}$

(C) $\frac{1}{n^2}\text{ cm}$ (D) $\frac{1}{n(n+1)}\text{ cm}$

92. The surface tension of a liquid is $70\, dyne/cm$. In MKS system its value is

(A) $70N/m$ (B) $7\times10^{-2}\, N/m$

(C) $7\times10^3\, N/m$ (D) $7\times10^2\, N/m$

93. In the context of accuracy of measurement and significant figures in expressing results of experiment, which of the following is/are correct

(1) Out of the two measurements $50.14\, cm$ and 0.00025 ampere, the first one has greater accuracy

(2) If one travels $478\, km$ by rail and $397\, m.$ by road, the total distance travelled is $478\, km.$

(A) Only (1) is correct (B) Only (2) is correct

(C) Both are correct (D) None of them is correct.

94. The damping force on an oscillator is directly proportional to the velocity.The units of the constant of proportionality are

(A) $Kg\ ms^{-1}$ (B) $Kg\ ms^{-2}$

(C) $Kg\ s^{-1}$ (D) $Kg\ s$

95. If L, C and R represent inductance, capacitance and resistance respectively, then which of the following does not represent dimensions of frequency

(A) $\frac{1}{RC}$ (B) $\frac{R}{L}$

(C) $\frac{1}{\sqrt{LC}}$ (D) $\frac{C}{L}$

96. Density of wood is $0.5\, gm/cc$ in the CGS system of units. The corresponding value in MKS units is .... kg/m^3

(A) 500 (B) 5

(C) 0.5 (D) 5000

97. $Newton/metre^2$ is the unit of

(A) Energy (B) Momentum

(C) Force (D) Pressure

98. The value of Planck's constant is

(A) $6.63\times10^{-34}J{-}\sec$ (B) $6.63\times10^{34}J/\sec$

(C) $6.63\times10^{-34}kg{-}m^2$ (D) $6.63\times10^{34}kg/\sec$

99. In SI, Henry is the unit of

(A) Self inductance (B) Mutual inductance

(C) (a) and (b) both (D) None of the above

100. If radius of the sphere is $(5.3\pm0.1)cm$. Then percentage error in its volume will be

(A) $3+6.01\times\frac{100}{5.3}$ (B) $\frac{1}{3}\times0.01\times\frac{100}{5.3}$

(C) $\left(\frac{3\times0.1}{5.3}\right)\times100$ (D) $\frac{0.1}{5.3}\times100$

101. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length ?

(A) $\sqrt{\frac{hc}{G}}$ (B) $\sqrt{\frac{Gc}{h^{\frac{3}{2}}}}$

(C) $\frac{\sqrt{hG}}{c^{\frac{3}{2}}}$ (D) $\frac{\sqrt{hG}}{c^{\frac{5}{2}}}$

102. Number of particles is given by $n = -D\frac{n_2 - n_1}{x_2 - x_1}$ crossing a unit area perpendicular to X-axis in unit time, where n_1 and n_2 are number of particles per unit volume for the value of x meant to x_2 and x_1. Find dimensions of D called as diffusion constant

(A) M^0LT^2 (B) $M^0L^2T^{-4}$
(C) M^0LT^{-3} (D) $M^0L^2T^{-1}$

103. Unit of stress is

(A) N/m (B) $N-m$
(C) N/m^2 (D) $N-m^2$

104. If the time period t of the oscillation of a drop of liquid of density d, radius r, vibrating under surface tension s is given by the formula $t = \sqrt{r^{2b}\, s^c\, d^{a/2}}$. It is observed that the time period is directly proportional to $\sqrt{\frac{d}{s}}$. The value of b should therefore be

(A) $\frac{3}{4}$ (B) $\sqrt{3}$
(C) $\frac{3}{2}$ (D) $\frac{2}{3}$

105. A screw gauge with a pitch of $0.5\ mm$ and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that wen the two jaws of the screw gauge are brought in contact, the 45^{th}division coincides with the main scale line and the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is $0.5\ mm$ and the 25^{th} division coincides with the main scale line .... mm.

(A) 0.70 (B) 0.50
(C) 0.75 (D) 0.80

106. Volt/metre is the unit of

(A) Potential (B) Work
(C) Force (D) Electric intensity

107. $Kilowatt - hour$ is a unit of

(A) Electrical charge (B) Energy
(C) Power (D) Force

108. The period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$ where l is about $100\,cm$ and is known to have $1\,mm$ accuracy. The period is about $2\,s$. The time of 100 oscillations is measured by a stop watch of least count $0.1\,s$. The percentage error in g is .... $\%$

(A) 0.1 (B) 1
(C) 0.2 (D) 0.8

109. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value ofresistance of the wire is .... $\%$

(A) 3 (B) 6
(C) 0 (D) 1

110. In $C.G.S.$ system the magnitutde of the force is 100 dynes. In another system where the fundamental physical quantities are kilogram, metre and minute, the magnitude of the force is

(A) 0.036 (B) 0.36
(C) 3.6 (D) 36

111. Which of the following pairs is wrong

(A) Pressure-Baromter (B) Relative density-Pyrometer
(C) Temperature-Thermometer (D) Earthquake-SeismographDimensions

112. If e is the charge, V the potential difference, T the temperature, then the units of $\frac{eV}{T}$ are the same as that of

(A) Planck's constant (B) Stefan's constant
(C) Boltzmann constant (D) Gravitational constant

113. $Assertion$: The error in the measurement of radius of the sphere is 0.3%. The permissible error in its surface area is 0.6%
$Reason$: The permissible error is calculated by the formula $\frac{\Delta A}{A} = \frac{4\Delta r}{r}$

(A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(C) If the Assertion is correct but Reason is incorrect.
(D) If both the Assertion and Reason are incorrect.

114. The unit of self inductance of a coil is

(A) Farad (B) Henry
(C) Weber (D) Tesla

115. Unit of Stefan's constant is

(A) $J\,s^{-1}$ (B) $J\,m^{-2}s^{-1}K^{-4}$
(C) $J\,m^{-2}$ (D) $J\,s$

116. Unit of moment of inertia in MKS system

(A) $kg \times cm^2$ (B) kg/cm^2
(C) $kg \times m^2$ (D) $Joule \times m$

117. Match List-I with List-II and select the correct answer by using the codes given below the lists

$a\ b\ c\ d$

List - I	List - II
(a) Distance between earth and stars	1. Microns
(b) Inter-atomic distance in a solid	2. Angstroms
(c) Size of the nucleus	3. Light years
(d) Wavelength of infrared laser	4. Fermi
	5. Kilometres

(A) $5\,4\,2\,1$ (B) $3\,2\,4\,1$
(C) $5\,2\,4\,3$ (D) $3\,4\,1\,2$

118. The SI unit of universal gas constant (R) is

(A) $Watt\,K^{-1}mol^{-1}$ (B) $Newton\,K^{-1}mol^{-1}$
(C) $Joule\,K^{-1}\,mol^{-1}$ (D) $Erg\,K^{-1}\,mol^{-1}$

119. The least count of a stop watch is $0.2\,second$. The time of $20\,oscillations$ of a pendulum is measured to be $25\,second$. The percentage error in the measurement of time will be .... $\%$

(A) 8 (B) 1.8
(C) 0.8 (D) 0.1

120. Temperature can be expressed as a derived quantity in terms of any of the following

(A) Length and mass (B) Mass and time
(C) Length, mass and time (D) None of these

121. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be

(A) $[EV^{-2}T^{-1}]$ (B) $[EV^{-1}T^{-2}]$
(C) $[EV^{-2}T^{-2}]$ (D) $[E^{-2}V^{-1}T^{-3}]$

122. The dimensional formula for torque is

(A) ML^2T^{-2} (B) $ML^{-1}T^{-1}$
(C) L^2T^{-1} (D) $M^2L^{-2}K^{-1}$

123. N divisions on the main scale of a vernier calliper coincide with $(N+1)$ divisions of the vernier scale. If each division of main scale is $'a'$ units , then the least count of the instrument is

(A) a (B) $\frac{a}{N}$
(C) $\frac{N}{N+1} \times a$ (D) $\frac{a}{N+1}$

124. If Surface tension (S), Moment of Inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be

(A) $S^{1/2}I^{1/2}h^0$ (B) $S^{1/2}I^{3/2}h^{-1}$
(C) $S^{3/2}I^{1/2}h^0$ (D) $S^{1/2}I^{1/2}h^{-1}$

125. $Par\sec$ is a unit of

(A) Distance (B) Velocity

(C) Time (D) Angle

126. A force F is applied onto a square plate of side L. If the percentage error in determining L is 2% and that in F is 4%, the permissible percentage error in determining the pressure is .... $\%$

(A) 2 (B) 4

(C) 6 (D) 8

127. The SI unit of momentum is

(A) $\frac{kg}{m}$ (B) $\frac{kg.m}{\sec}$

(C) $\frac{kg.m^2}{\sec}$ (D) $kg \times Newton$

128. The velocity v (in $cm/\sec$) of a particle is given in terms of time t (in sec) by the relation $v = at + \frac{b}{t+c}$; the dimensions of a, b and c are

(A) $a = L^2,\, b = T,\, c = LT^2$ (B) $a = LT^2,\, b = LT,\, c = L$

(C) $a = LT^{-2}, b = L,\, c = T$ (D) $a = L,\, b = LT,\, c = T^2$

129. Universal time is based on

(A) Rotation of the earth on its axis (B) Earth's orbital motion around the earth

(C) Vibrations of cesium atom (D) Oscillations of quartz crystal

130. The frequency of vibration of string is given by $\nu = \frac{p}{2l}\left[\frac{F}{m}\right]^{1/2}$. Here p is number of segments in the string and l is the length. The dimensional formula for m will be

(A) $[M^0LT^{-1}]$ (B) $[ML^0T^{-1}]$

(C) $[ML^{-1}T^0]$ (D) $[M^0L^0T^0]$

131. The dimension of $\frac{1}{2}\varepsilon_0 E^2$

(A) $M^1L^2T^{-2}$ (B) $M^1L^{-1}T^{-2}$

(C) $M^1L^2T^{-1}$ (D) MLT^{-1}

132. $Joule-second$ is the unit of

(A) Work (B) Momentum

(C) Pressure (D) Angular momentum

133. $Ampere-hour$ is a unit of

(A) Quantity of electricity (B) Strength of electric current

(C) Power (D) Energy

134. The formula $X = 5YZ^2$, X and Z have dimensions of capacitance and magnetic field respectively. What are the dimensions of Y in SI units?

(A) $[M^{-2}\,L^0\,T^{-4}\,A^{-2}]$ (B) $[M^{-3}\,L^{-2}\,T^8\,A^{-1}]$

(C) $[M^{-2}\,L^{-2}\,T^6\,A^3]$ (D) $[M^{-1}\,L^{-2}\,T^4\,A^2]$

135. The unit of percentage error is

(A) Same as that of physical quantity

(B) Different from that of physical quantity

(C) Percentage error is unit less

(D) Errors have got their own units which are different from that of physical quantity measured

136. Young's modulus of a material has the same units as

(A) Pressure (B) Strain

(C) Compressibility (D) Force

137. The relative density of material of a body is found by weighing it first in air and then in water. If the weight in air is (5.00 ± 0.05) Newton and weight in water is (4.00 ± 0.05) Newton. Then the relative density along with the maximum permissible percentage error is

(A) $5.0\ \pm 11\%$ (B) $5.0\ \pm 1\%$

(C) $5.0\ \pm 6\%$ (D) $1.25\ \pm\ 5\%$

138. In terms of resistance R and time T, the dimensions of ratio $\frac{\mu}{\varepsilon}$ of the permeability μ and permittivity ε is

(A) $[RT^{-2}]$ (B) $[R^2T^{-1}]$

(C) $[R^2]$ (D) $[R^2T^2]$

139. Which one of the following pairs of quantities and their units is a proper match

(A) Electric field - Coulomb/m (B) Magnetic flux - Weber

(C) Power - Farad (D) Capacitance - Henry

140. If the constant of gravitation (G), Planck's constant (h) and the velocity of light (c) be chosen as fundamental units. The dimension of the radius of gyration is

(A) $h^{1/2}c^{-3/2}G^{1/2}$ (B) $h^{1/2}c^{3/2}G^{1/2}$

(C) $h^{1/2}c^{-3/2}G^{-1/2}$ (D) $h^{-1/2}c^{-3/2}G^{1/2}$

141. The pair(s) of physical quantities that have the same dimensions, is (are)

(A) Reynolds number and coefficient of friction (B) Latent heat and gravitational potential

(C) Curie and frequency of a light wave (D) All of these

142. Newton-second is the unit of

(A) Velocity (B) Angular momentum

(C) Momentum (D) Energy

143. A body of mass $m = 3.513\ kg$ is moving along the $x-$axis with a speed of $5.00\ ms^{-1}$. The magnitude of its momentum is recorded as .... kgm/s

(A) 17.6 (B) 17.565

(C) 17.56 (D) 17.57

144. If dimensions of critical velocity v_c of a liquid flowing through a tube are expressed as$[^{x\,y}r^z]$ where , and r are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x, y and z are given by

(A) $1, 1, 1$ (B) $1, -1, -1$

(C) $-1, -1, 1$ (D) $-1, -1, -1$

145. Faraday is the unit of

(A) Charge (B) emf

(C) Mass (D) Energy

146. Match List-I with List-II and select the correct answer using the codes given below the lists

List-I	List -II
I Joule	A.Henry $\times$ Amp/sec
II Watt	B.Farad $\times$ Volt
III Volt	C.Coulomb $\times$ Volt
IV Coulomb	D. Oersted $\times$ cm
	E. Amp $\times$ Gauss
	F. Amp^2 $\times$ Ohm

(A) $I-A,\, II-F,\, III-E,\, IV-D$ (B) $I-C,\, II-F,\, III-A,\, IV-B$

(C) $I-C,\, II-F,\, III-A,\, IV-E$ (D) $I-B,\, II-F,\, III-A,\, IV-C$

147. Unit of energy is

(A) $J/\sec$ (B) $Watt-day$

(C) $Kilowatt$ (D) $gm{-}cm/\sec^2$

148. The mean time period of second's pendulum is $2.00s$ and mean absolute error in the time period is $0.05s$. To express maximum estimate of error, the time period should be written as

(A) $(2.00 \pm 0.01)s$ (B) $(2.00 \pm 0.025)s$

(C) $(2.00 \pm 0.05)s$ (D) $(2.00 \pm 0.10)s$

149. Which one of the following is not a unit of young's modulus

(A) Nm^{-1} (B) Nm^{-2}

(C) $Dyne\ cm^{-2}$ (D) Mega Pascal

150. The unit for nuclear dose given to a patient is

(A) Fermi (B) Rutherford

(C) Curie (D) Roentgen

ANSWER KEY

PHYSICS

1 - D	2 - D	3 - B	4 - C	5 - A	6 - C	7 - D	8 - D	9 - C	10 - A
11 - A	12 - C	13 - C	14 - D	15 - A	16 - A	17 - C	18 - D	19 - B	20 - C
21 - B	22 - B	23 - B	24 - D	25 - D	26 - C	27 - B	28 - C	29 - B	30 - A
31 - D	32 - B	33 - B	34 - B	35 - B	36 - B	37 - B	38 - D	39 - A	40 - A
41 - A	42 - B	43 - D	44 - A	45 - D	46 - D	47 - C	48 - A	49 - B	50 - D
51 - D	52 - C	53 - D	54 - D	55 - A	56 - A	57 - C	58 - C	59 - C	60 - C
61 - B	62 - D	63 - D	64 - D	65 - B	66 - A	67 - B	68 - A	69 - D	70 - A
71 - D	72 - D	73 - B	74 - C	75 - C	76 - C	77 - D	78 - D	79 - A	80 - C
81 - C	82 - B	83 - A	84 - D	85 - B	86 - D	87 - C	88 - A	89 - C	90 - B
91 - C	92 - B	93 - C	94 - C	95 - D	96 - A	97 - D	98 - A	99 - C	100 - C
101 - C	102 - D	103 - C	104 - C	105 - D	106 - D	107 - B	108 - C	109 - B	110 - C
111 - B	112 - C	113 - C	114 - B	115 - B	116 - C	117 - B	118 - C	119 - C	120 - D
121 - C	122 - A	123 - D	124 - A	125 - A	126 - D	127 - B	128 - C	129 - C	130 - C
131 - B	132 - D	133 - A	134 - B	135 - C	136 - A	137 - A	138 - C	139 - B	140 - A
141 - D	142 - C	143 - A	144 - B	145 - A	146 - B	147 - B	148 - C	149 - A	150 - D

SOLUTION

PHYSICS

1. The percentage errors in quantities P, Q, R and S are 0.5%, 1%, 3% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3Q^2}{\sqrt{RS}}$. the maximum percentage error in the value of A will be .... $\%$

(A) 8.5 (B) 6.0
(C) 7.5 (D) ✓6.5

Sol :
$$Maximum\,percentage\,error\,in\,A$$
$$= 3\,(\%\,error\,in\,p) + 2\,(\%\,error\,in\,Q)$$
$$+\frac{1}{2}(\%\,error\,in\,R) + 1\,(\%\,error\,in\,S)$$
$$= 3 \times 0.5 + 2 \times 1 = \frac{1}{2} \times 3 + 1 \times 1.5$$
$$= 1.5 + 2 + 1.5 + 1.5 = 6.5\%$$

2. A, B, C and D are four different physical quantities having different dimensions. None of them is dimensionless. But we know that the equation $AD = C\,ln\,(BD)$ holds true. Then which of the combination is not a meaningful quantity ?

(A) $\frac{C}{BD} - \frac{AD^2}{C}$ (B) $A^2 - B^2C^2$
(C) $\frac{A}{B} - C$ (D) ✓$\frac{(A-C)}{D}$

Sol : Dimension of $A \neq$ dimension of (C) Hence $A - C$ is not possible

3. According to Joule's law of heating, heat produced $H = I^2\,Rt$, where I is current, R is resistance and t is time. If the errors in the measurement of I, R and t are $3\%, 4\%$ and 6% respectively then error in the measurement of H is

(A) $\pm 17\%$ (B) ✓$\pm 16\%$
(C) $\pm 19\%$ (D) $\pm 25\%$

Sol : (b) $H = I^2Rt$

$$\therefore\ \frac{\Delta H}{H} \times 100 = \left(\frac{2\Delta I}{I} + \frac{\Delta R}{R} + \frac{\Delta t}{t}\right) \times 100$$
$$= (2 \times 3 + 4 + 6)\% = 16\%$$

4. The length of a cylinder is measured with a meter rod having least count $0.1\,cm$. Its diameter is measured with vernier calipers having least count $0.01\,cm$. Given that length is $5.0\,cm$. and radius is $2.0\,cm$. The percentage error in the calculated value of the volume will be .... $\%$

(A) 1 (B) 2
(C) ✓3 (D) 4

Sol : (c) Volume of cylinder $V = \pi r^2 l$

Percentage error in volume
$$\frac{\Delta V}{V} \times 100 = \frac{2\Delta r}{r} \times 100 + \frac{\Delta l}{l} \times 100$$
$$= \left(2 \times \frac{0.01}{2.0} \times 100 + \frac{0.1}{5.0} \times 100\right)$$
$= (1 + 2)\%$ =3%

5. The equation of state of some gases can be expressed as $\left(P + \frac{a}{V^2}\right) = \frac{R\theta}{V}$ Where P is the pressure, V the volume, θ the absolute temperature and a and b are constants. The dimensional formula of a is

(A) ✓$[ML^5T^{-2}]$ (B) $[M^{-1}L^5T^{-2}]$
(C) $[ML^{-1}T^{-2}]$ (D) $[ML^{-5}T^{-2}]$

Sol : (a) By the principle of dimensional homogenity
$$[P] = \left[\frac{a}{V^2}\right] \Rightarrow [a] = [P] \times [V^2] = [ML^{-1}T^{-2}]\,[L^6]$$
= $[ML^5T^{-2}]$

6. If the error in the measurement of radius of a sphere is 2% then the error in the determination of volume of the sphere will be .... $\%$

(A) 2 (B) 4
(C) ✓6 (D) 8

Sol :
$$V = \frac{4}{3}\Pi R^3\,;\ In\,V = In\left[\frac{4}{3}\Pi\right] + In\,R^3$$
$$Differentiating,\ \frac{dV}{V} = 3\frac{dR}{R}$$
$$Error\,in\,the\,deter\min ation\,of\,the\,volume$$
$$= 3 \times 2\% = 6\%$$

7. Which is the correct unit for measuring nuclear radii

(A) Micron (B) Millimetre
(C) Angstrom (D) ✓Fermi

Sol : (d)

8. Which of the following is not a unit of time

(A) Leap year (B) Micro second
(C) Lunar month (D) ✓Light year

Sol : (d) $1\,light\ year = 9.46 \times 10^{15}\,meter$

9. A suitable unit for gravitational constant is

(A) $kg - m\sec^{-1}$ (B) $N\ m^{-1}\,\sec$
(C) ✓$N\ m^2\ kg^{-2}$ (D) $kg\,m\,\sec^{-1}$

Sol : (c) $F = \frac{Gm_1m_2}{d^2}$;
$$\therefore G = \frac{Fd^2}{m_1m_2} = Nm^2/kg^2$$

10. The respective number of significant figures for the numbers $23.023, 0.0003$ and 2.1×10^3 are

(A) ✓$5, 1, 2$ (B) $5, 1, 5$
(C) $5, 5, 2$ (D) $4, 4, 2$

Sol : (i) All the non$-$zero digits are significant.

(ii) All the zeros between two non$-$zero digits are significant, no matter where the decimal point is, if at all.

(iii) If the number is less than 1, the $zero(s)$ on the right of decimal point but to the left of the first non$-$zero digit are not significant.

(iv) The power of 10 is irrelevant to the determination of significant Figures. According to the above rules, 23.023 has 5 significant figures.

0.0003 has 1 significant Figures. 2.1×10^{-3} has 2 significant figures.

11. A physical quantity is given by $X = M^aL^bT^c$. The percentage error in measurement of M, L and T are α, β and γ respectively. Then maximum percentage error in the quantity X is

(A) ✓$a\alpha + b\beta + c\gamma$ (B) $a\alpha + b\beta - c\gamma$
(C) $\frac{a}{\alpha} + \frac{b}{\beta} + \frac{c}{\gamma}$ (D) None of these

Sol : (a) Percentage error in X $= a\alpha + b\beta + c\gamma$

12. A physical quantity p is described by the relation $p = a^{1/2}\,b^2\,c^3\,d^{-4}$

If the relative errors in the measurement of a, b, c and d respectively, are $2\%, 1\%, 3\%$ and 5%, then the relative error in P will be .... $\%$

(A) 8 (B) 12
(C) ✓32 (D) 25

Sol :
$$Give,\ p = a^{1/2}b^2c^3d^{-4},$$
$$Maximum\,relative\,error,$$
$$\frac{\Delta p}{p} = \frac{1}{2}\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + 3\frac{\Delta c}{c} + 4\frac{\Delta d}{d}$$
$$= \frac{1}{2} \times 2 + 2 \times 1 + 3 \times 3 + 4 \times 5$$
$$= 32\%$$

13. Light year is a unit of

(A) Time (B) Mass
(C) ✓Distance (D) Energy

Sol : (c) Light year is a distance which light travels in one year.

14. Electron volt is a unit of
(A) Charge (B) Potential difference
(C) Momentum (D) ✓Energy

Sol : (d) The electron volt (symbol ev; also written electronvolt) is a unit of energy equal to approximately 1.602×10^{-19} joule (SI unit J)

By definition, it is the amount of energy gained by the charge of a single electron moved across an electric potential difference of one volt.

Hence, the correct option is d

15. In the relation $P = \frac{\alpha}{\beta} e^{-\frac{\alpha Z}{k\theta}}$ P is pressure, Z is the distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be
(A) ✓$[M^0L^2T^0]$ (B) $[M^1L^2T^1]$
(C) $[M^1L^0T^{-1}]$ (D) $[M^0L^2T^{-1}]$

Sol : (a) In given equation, $\frac{\alpha z}{k\theta}$ should be dimensionless

$\therefore \alpha = \frac{k\theta}{z} \Rightarrow [\alpha] = \frac{[ML^2T^{-2}K^{-1} \times K]}{[L]} = [MLT^{-2}]$

and $P = \frac{\alpha}{\beta} \Rightarrow [\beta] = \left[\frac{\alpha}{p}\right] = \frac{[MLT^{-2}]}{[ML^{-1}T^{-2}]} = [M^0L^2T^0]$.

16. The unit of reactance is
(A) ✓Ohm (B) Volt
(C) Mho (D) Newton

Sol : (a)

17. With the usual notations, the following equation $S_t = u + \frac{1}{2}a(2t-1)$ is
(A) Only numerically correct (B) Only dimensionally correct
(C) ✓Both numerically and dimensionally correct (D) Neither numerically nor dimensionally correct

Sol : (c) We can derive this equation from equations of motion so it is numerically correct.

S_t= distance travelled in t^{th} second $= \frac{\text{Distance}}{\text{time}} = [LT^{-1}]$

u = velocity = $[LT^{-1}]$ and $\frac{1}{2}a(2t-1) = [LT^{-1}]$

As dimensions of each term in the given equation are same, hence equation is dimensionally correct also.

18. What is the SI unit of permeability
(A) Henry per metre (B) Tesla metre per ampere
(C) Weber per ampere metre (D) ✓All the above units are correct

Sol : (d)

19. $1\,eV$ is
(A) Same as one joule (B) ✓$1.6 \times 10^{-19} J$
(C) $1V$ (D) $1.6 \times 10^{-19} C$

Sol : (b) $1\,eV = 1.6 \times 10^{-19} coulomb \times 1\,volt = 1.6 \times 10^{-19} J$.

20. One nanometre is equal to
(A) $10^9 mm$ (B) $10^{-6}\,cm$
(C) ✓$10^{-7} cm$ (D) $10^{-9} cm$

Sol : (c) $1\,nm = 10^{-9} m = 10^{-7} cm$

21. The dimensional formula of farad is
(A) $[M^{-1}L^{-2}TQ]$ (B) ✓$[M^{-1}L^{-2}T^2Q^2]$
(C) $[M^{-1}L^{-2}TQ^2]$ (D) $[M^{-1}L^{-2}T^2Q]$

Sol : $[C] = \left[\frac{Q}{V}\right] = \left[\frac{Q^2}{W}\right] - [M^{-1}L^{-2}T^{-2}Q^2]$

22. Length cannot be measured by
(A) Fermi (B) ✓Debye
(C) Micron (D) Light year

Sol : (b)

23. Number of base SI units is
(A) 4 (B) ✓7
(C) 3 (D) 5

Sol : (b)

24. The unit of Planck's constant is
(A) Joule (B) Joule/s
(C) Joule/m (D) ✓Joule-s

Sol : (d)

25. A physical parameter a can be determined by measuring the parameters b, c, d and e using the relation $a = b^\alpha c^\beta / d^\gamma e^\delta$. If the maximum errors in the measurement of b, c, d and e are $b_1\%$, $c_1\%$, $d_1\%$ and $e_1\%$, then the maximum error in the value of a determined by the experiment is
(A) $(b_1 + c_1 + d_1 + e_1)\%$ (B) $(b_1 + c_1 - d_1 - e_1)\%$
(C) $(\alpha b_1 + \beta c_1 - \gamma d_1 - \delta e_1)\%$ (D) ✓$(\alpha b_1 + \beta c_1 + \gamma d_1 + \delta e_1)\%$

Sol : (d) $a = b^\alpha\, c^\beta / d^\gamma\, e^\delta$

So maximum error in a is given by

$$\left(\frac{\Delta a}{a} \times 100\right)_{\max} = \alpha \,.\, \frac{\Delta b}{b} \times 100 + \beta \,.\, \frac{\Delta c}{c} \times 100$$

$$+\gamma \,.\, \frac{\Delta d}{d} \times 100 + \delta \,.\, \frac{\Delta e}{e} \times 100$$

$= (\alpha b_1 + \beta c_1 + \gamma d_1 + \delta e_1)\,\%$

26. One pico Farad is equal to
(A) $10^{-24} F$ (B) $10^{-18} F$
(C) ✓$10^{-12} F$ (D) $10^{-6} F$

Sol : (c) Pico prefix used for 10^{-12}

27. The unit of Young's modulus is
(A) Nm^2 (B) ✓Nm^{-2}
(C) Nm (D) Nm^{-1}

Sol : (b)

28. To determine the Young's modulus of a wire, the formula is $Y = \frac{F}{A} \times \frac{L}{\Delta L}$; where L = length, A =area of cross-section of the wire, ΔL =change in length of the wire when stretched with a force F. The conversion factor to change it from CGS to MKS system is .... $\mathrm{N/m^2}$
(A) 1 (B) 10
(C) ✓0.1 (D) 0.01

Sol : (c) $Y = \frac{F}{A} . \frac{L}{\Delta L} = \frac{dyne}{cm^2} = \frac{10^{-5} N}{10^{-4} m^2} = 0.1 N/m^2$

29. One million electron volt $(1\,MeV)$ is equal to
(A) $10^5 eV$ (B) ✓$10^6 eV$
(C) $10^4 eV$ (D) $10^7 eV$

Sol : (b) $1\;MeV = 10^6\;eV$

30. The speed of light (c), gravitational constant (G) and planck's constant (h) are taken as fundamental units in a system. The dimensions of time in this new system should be
(A) ✓$G^{1/2}h^{1/2}c^{-5/2}$ (B) $G^{-1/2}h^{1/2}c^{1/2}$
(C) $G^{1/2}h^{1/2}c^{-3/2}$ (D) $G^{1/2}h^{1/2}c^{1/2}$

Sol : Let time, $T \propto c^x G^y h^z$

$\Rightarrow T = kc^x G^y h^z$

Taking dimensions on both sides $[M^0L^0T^1] = [LT^{-1}]^x\,[M^{-1}L^3T^{-2}]^y\,[ML^2T^{-1}]^z$

$i.e$

$[M^0L^0T^1] = [M^{-y+z}L^{x+3y+2z}T^{-x-2y-z}]$

Equating power of $M, L,$ Ton both sides, we get

$-y + z = 0 \quad \ldots(1)$

$x + 3y + 2z = 0 \quad \ldots(2)$

$-x - 2y - z = 1 \quad \ldots.(3)$

From $(1) \Rightarrow z = y$

Adding (2) and $(3) \Rightarrow y + z = 1$

or $2y = 1$ [From]

i.e, $y = \frac{1}{2}$

$\therefore z = y = \frac{1}{2}$

Putting these values in (2) we get $x + \frac{3}{2} + 1 = 0$ or $x = \frac{-5}{2}$

Hence, $[T] = \left[G^{1/2}h^{1/2}c^{-5/2}\right]$

31. The dimension of stopping potential V_0 in photoelectric effect in units of Planck's constant h, speed of light c and Gravitational constant G and ampere A is

(A) $h^2G^{3/2}C^{1/3}A^{-1}$
(B) $h^{-2/3}c^{-1/3}G^{4/3}A^{-1}$
(C) $h^{1/3}G^{2/3}c^{1/3}A^{-1}$
(D) ✓$h^0c^5G^{-1}A^{-1}$

Sol : $v_0 = h^x c^y G^z A^w$

$\frac{ML^2T^{-2}}{AT} = (ML^2T^{-1})^x (LT^{-1})^y (M^{-1}L^3T^{-2})^z A^w$

$\Rightarrow w = -1$

$(x - z = 1)$

$(x - z = 1)$

$-x - x = 1 - 2z = 2$

$-x - y - 2z = -3$

$x - \frac{1}{2}x = 0$

$x = 0$

$x = -1$

$2 \times 0 + y + 3x - 1 = 2$

$y = 5$

$\Rightarrow v_0 = h^0c^5G^{-1}A^{-1}$

32. Diameter of a steel ball is measured using a Vernier callipers which has divisions of $0.1\,cm$ on its main scale (MS) and 10 divisions of its vernier scale (VS) match 9 divisions on the main scale. Three such measurements for a ball are given as

If the zero error is $-0.03\,cm$, then mean corrected diameter is .... cm

S.No.	$MS(cm)$	VS divisions
(1)	0.5	8
(2)	0.5	4
(3)	0.5	6

(A) 0.52
(B) ✓0.59
(C) 0.56
(D) 0.53

Sol :
$$\begin{aligned} Lets\ count\ &= \frac{0.1}{10} = 0.01\ cm \\ d_1 &= 0.5 + 8 \times 0.01 + 0.03 = 0.61\,cm \\ d_2 &= 0.5 + 4 \times 0.01 + 0.03 = 0.57\,cm \\ d_3 &= 0.5 + 6 \times 0.01 + 0.03 = 0.59\,cm \\ Mean\,diameter\ &= \frac{0.61 + 0.57 + 0.59}{3} \\ &= 0.59\,cm \end{aligned}$$

33. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimation of the kinetic energy obtained by measuring mass and speed .... $\%$

(A) 11
(B) ✓8
(C) 5
(D) 1

Sol : (b) $E = \frac{1}{2}mv^2$

%$\%$ Error in $K.E.$ $=$ $\%$ error in mass $+2\times\%$ error in velocity $= 2 + 2 \times 3 = 8\%$

34. The $S.I.$ unit of gravitational potential is

(A) J
(B) ✓$J{-}kg^{-1}$
(C) $J{-}kg$
(D) $J{-}kg^{-2}$

Sol : (b) $V = \frac{W}{m}$

so, SI unit = $\frac{Joule}{kg}$

35. The equation $\left(P + \frac{a}{V^2}\right)(V - b)$ constant. The units of a are

(A) $Dyne \times cm^5$
(B) ✓$Dyne \times cm^4$
(C) $Dyne/cm^3$
(D) $Dyne/cm^2$

Sol : (b) Units of a and PV^2 are same and equal to dyne $\times$ cm^4.

36. Oersted is a unit of

(A) Dip
(B) ✓Magnetic intensity
(C) Magnetic moment
(D) Pole strength

Sol : (b) 1 Oerstead $= 1$ Gauss $= 10^{-4}Tesla$

37. What is the number of significant figures in 0.310×10^3

(A) 2
(B) ✓3
(C) 4
(D) 6

Sol : (b) Number of significant figures are 3, because 10^3 is decimal multiplier.

38. Which does not has the same unit as others

(A) Watt-sec
(B) Kilowatt-hour
(C) eV
(D) ✓J-sec

Sol : (d) Joule-sec is the unit of angular momentum where as other units are of energy.

39. Henry/ohm can be expressed in

(A) ✓Second
(B) Coulomb
(C) Mho
(D) Metre

Sol : (a) $\frac{L}{R}$ is a time constant of $L - R$ circuit so Henry/ohm can be expressed as second.

40. The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$, where P is pressure, x is distance and t is time, are

(A) ✓MT^{-2}
(B) M^2LT^{-3}
(C) ML^3T^{-1}
(D) LT^{-3}

Sol : (a) $[a] = [T^2]$ and $[b] = \frac{[a - t^2]}{[P]\,[x]} = \frac{T^2}{[ML^{-1}T^{-2}]\,[L]}$

==>$[b] = [M^{-1}T^4]$

So $\left[\frac{a}{b}\right] = \frac{[T^2]}{[M^{-1}T^4]} = [MT^{-2}]$

41. The density of a material in $SI\,units$ is $128\,kg\,m^{-3}$. In certain units in which the unit of length is $25\,cm$ and the unit of mass $50\,g$, the numerical value of density of the material is

(A) ✓40
(B) 16
(C) 640
(D) 410

Sol :
$$\begin{aligned} &\frac{128kg}{m^3} = \frac{125\,(50g)\,(20)}{(25cm)^3 (4)^3} \\ &= \frac{128}{64}(20)\,units \\ &= 40units \end{aligned}$$

42. $1kWh =$

(A) $1000W$
(B) ✓$36 \times 10^5 J$
(C) $1000J$
(D) $3600\,J$

Sol : (b) $1\,kWh = 1 \times 10^3 \times 3600\,W \times \sec = 36 \times 10^5 J$

43. A wire has a mass $0.3 \pm 0.003\,g$, radius $0.5 \pm 0.005\,mm$ and length $6 \pm 0.06\,cm$. The maximum percentage error in the measurement of its density is .... $\%$

(A) 1
(B) 2
(C) 3
(D) ✓4

Sol : (d) Density, $\rho = \frac{M}{V} = \frac{M}{\pi r^2 L}$

$\Rightarrow \frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + 2\frac{\Delta r}{r} + \frac{\Delta L}{L}$

$= \frac{0.003}{0.3} + 2 \times \frac{0.005}{0.5} + \frac{0.06}{6}$

$= 0.01 + 0.02 + 0.01 = 0.04$

$\therefore$ Percentage error $= \frac{\Delta\rho}{\rho} \times 100 = 0.04 \times 100 = 4\%$

44. The dimension of $\frac{B^2}{2\mu_0}$, where B is magnetic field and μ_0 is the magnetic permeability of vacuum, is

(A) ✓$ML^{-1}T^{-2}$
(B) ML^2T^{-1}
(C) MIT^{-2}
(D) MI^2T^{-2}

Sol : Magnetic energy stored per unit volume is $\frac{B^2}{2\mu_0}$

Dimension is $ML^{-1}T^{-2}$

45. A student measured the diameter of a wire using a screw gauge with the least count $0.001\,cm$ and listed the measurements. The measured value should be recorded as

(A) $5.3200\,cm$ (B) $5.3\,cm$
(C) $5.32\,cm$ (D) $\checkmark 5.320\,cm$

Sol : The least count $(L.C.)$ of a screw guage is the smallest length which can be measured accurately with it.

As least count is $0.001\,cm = \frac{1}{1000}cm$

Hence measured value should be recorded upto 3 decimal places i.e., $5.320\,cm$

46. Dimensions of $\frac{1}{\mu_0\varepsilon_0}$, where symbols have their usual meaning, are

(A) $[LT^{-1}]$ (B) $[L^{-1}T]$
(C) $[L^{-2}T^2]$ (D) $\checkmark [L^2T^{-2}]$

Sol : (d) $C = \frac{1}{\sqrt{\mu_0\varepsilon_0}} \Rightarrow \frac{1}{\mu_0\varepsilon_0} = c^2 = [L^2T^{-2}]$

47. Curie is a unit of

(A) Energy of $\gamma -\ rays$ (B) Half life
(C) ✓Radioactivity (D) Intensity of $\gamma - rays$

Sol : (c) Curie = disintegration/second

48. $Assertion$: In the measurement of physical quantities direct and indirect methods are used.
$Reason$: The accuracy and precision of measuring instruments along with errors in measurements should be taken into account, while expressing the result.

(A) ✓If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(C) If the Assertion is correct but Reason is incorrect.

(D) If both the Assertion and Reason are incorrect.

49. Which of the following physical quantities do not have same dimensions?

(A) pressure and stress (B) ✓tension and surface tension
(C) strain and angle (D) energy and work.

Sol : Tension is a force and surface tension is force per unit area hence their dimensions are not same.

50. If force (F), velocity (V) and time (T) are taken as fundamental units, then the dimensions of mass are

(A) $[FVT^{-1}]$ (B) $[FVT^{-2}]$
(C) $[FV^{-1}T^{-1}]$ (D) $\checkmark\ [FV^{-1}T]$

Sol :
$Let\,mass\,m\ \propto\ F^aV^bT^e$
$or\qquad m = kF^aV^bT^c \qquad\qquad ...(i)$
$Where\,k\,is\,a$ dimensionless constant $and\,a,\ b\ and\ c$ $are\,the$ exponents.
$Writing$ dimension $on\,both\,sides,\ we\,get$

$$[ML^0T^0] = [MLT^{-2}]^a[LT^{-1}]^b[T]^c$$
$$[ML^0T^0] = [M^aL^{a+b}T^{-2ab+c}]$$

$Applying\,the\,principle\,of$ homogeneity of dimension, $we\,get$

$a = 1 \qquad ...(ii)$
$a + b = 0 \qquad ...(iii)$
$-2a - b + c = 0 \qquad ...(iv)$

$Solving\,eqns.\ (ii)\,,(iii)\ and\ (iv)\,,\ we\,get$
$a = 1, b = \ -1, c = 1$
$From\,eqn.\,(i),\ [m] = [FV^{-1}T]$

51. If the capacitance of a nanocapacitor is measured in terms of a unit $'u'$ made by combining the electric charge $'e'$, Bohr radius $'a_0'$, Planck's constant $'h'$ and speed of light $'c'$ then

(A) $u = \frac{e^2h}{a_0}$ (B) $u = \frac{hc}{e^2a_0}$
(C) $u = \frac{e^2c}{ha_0}$ (D) $\checkmark u = \frac{e^2a_0}{hc}$

Sol :
$Let\,unit\,'u'\,releted\,with\,e,\ a_0,\ h\,and\,c\,as\,follows:$
$$[u] = [e]^a[a_0]^b[h]^c[c]^d$$
Using dimensional $method,$
$[M^{-1}L^{-2}T^{+4}A^{+2}]$
$= [A^1T^1]^a[L]^2[ML2T^{-1}]^c[LT^{-1}]^d$
$[M^{-1}L^{-2}T^{+4}A^{+2}] = [M^cL^{b+2c+d}T^{a-c-d}A^a]$
$a = 2, b = 1, c = \ -1, d = \ -1$
$\therefore \qquad u = \frac{e^2a_0}{hc}$

52. Which is not a unit of electric field

(A) NC^{-1} (B) Vm^{-1}
(C) $\checkmark JC^{-1}$ (D) $JC^{-1}m^{-1}$

Sol : (c)

53. The unit of permittivity of free space ε_0 is

(A) $Coulomb/Newton-metre$ (B) $Newton\ -\ metre^2/Coulomb^2$
(C) $\mathrm{Coulomb}^2/(Newton{-}metre)^2$ (D) $\checkmark Coulomb^2/Newton{-}metre^2$

Sol : (d) $F = \frac{1}{4\pi\varepsilon_0}.\frac{Q_1Q_2}{r^2}$

==>$\varepsilon_0 \propto \frac{Q^2}{F\times r^2}$

Soε_0 has units of $Coulomb^2/Newton{-}m^2$

54. $X\ =\ 3YZ^2$ find dimension of Y in $(MKSA)$ system, if X and Z are the dimension of capacity and magnetic field respectively

(A) $M^{-3}L^{-2}T^{-4}A^{-1}$ (B) ML^{-2}
(C) $M^{-3}L^{-2}T^4A^4$ (D) $\checkmark M^{-3}L^{-2}T^8A^4$

Sol : (d) $Y = \frac{X}{3Z^2} = \frac{M^{-1}L^{-2}T^4A^2}{[MT^{-2}A^{-1}]^2} = [M^{-3}L^{-2}T^8A^4]$

55. The dimensions of $e^2/4\pi\varepsilon_0hc$, where $e,\ \varepsilon_0,\ h$ and c are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively

(A) $\checkmark [M^0L^0T^0]$ (B) $[M^1L^0T^0]$
(C) $[M^0L^1T^0]$ (D) $[M^0L^0T^1]$

Sol : (a) $[e] = [AT], \in_0 = [M^{-1}L^{-3}T^4A^2]$, $[h] = [ML^2T^{-1}]$ and $[c] = [LT^{-1}]$

$\therefore \left[\frac{e^2}{4\pi\in_0hc}\right] = \left[\frac{A^2T^2}{M^{-1}L^{-3}T^4A^2\times ML^2T^{-1}\times LT^{-1}}\right]$
$= [M^0L^0T^0]$

56. A thin copper wire of length l metre increases in length by 2% when heated through $10^o\ C$. .... $\%$ is the percentage increase in area when a square copper sheet of length l metre is heated through $10^o\ C$

(A) $\checkmark 4$ (B) 8
(C) 16 (D) None of the above

Sol : (a) Since percentage increase in length $= 2\%$

Hence, percentage increase in area of square sheet $= 2\times 2\% = 4\%$

57. If electronic charge e, electron mass m, speed of light in vacuum c and Planck 's constant h are taken as fundamental quantities, the permeability of vacuum μ_0 can be expressed in units of

(A) $\left(\frac{h}{me^2}\right)$ (B) $\left(\frac{hc}{me^2}\right)$
(C) $\checkmark \left(\frac{h}{ce^2}\right)$ (D) $\left(\frac{mc^2}{he^2}\right)$

Sol :
$Let\,\mu_0\,related\,with\ e,\ m,\ c\ and\ h\ as\,follows.$
$\mu_0 = ke^am^bc^ch^d$
$[MLT^{-2}A^{-2}] = [AT]^a[M]^b[LT^{-1}]^c[ML^2T^{-1}]^d$
$= [M^{b+d}L^{c+2d}T^{a-c-d}A^a]$
$On\,comparing\,both\,sides\,we\,get$
$a = \ -2 \qquad ...(i)$

$b + d = 1 \qquad ...(ii)$
$c + 2d = 1 \qquad ...(iii)$
$a - c - d = \ -2 \qquad ...(iv)$
$By\,equations\ (i)\,,(ii)\,,\ (iii)\,\&\,(iv)\ we\,get,$
$a = \ -2, b = 0, c = \ -1, d = 1$
$\therefore [\mu_0] = \left[\frac{h}{ce^2}\right]$

58. A student measured the diameter of a small steel ball using a screw gauge of least count $0.001\,cm$. The main scale reading is $5\,mm$ and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of $-0.004\,cm$, the correct diameter of the ball is

(A) $0.521\,cm$ (B) $0.525\,cm$
(C) ✓$0.529\,cm$ (D) $0.053\,cm$

Sol : Diameter of the ball
$= MSR + CSR\times$ (Least count) $- Zero\,error$
$= 5\ mm + 25 \times 0.001\ cm - (-0.004)\ cm$
$= 0.5\ cm + \ 25 \times 0.001\ cm - (-0.004)\ cm = 0.529\ cm.$

59. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measured by using a watch of $1\,second$ least count. The mean value of time taken comes out to be $30\,s$. The length of pendulum is measured by using a meter scale of least count $1\,mm$ and the value obtained is $55.0\,cm$. The percentage error in the determination of g is close to .... $\%$

(A) 0.7 (B) 3.5
(C) ✓6.8 (D) 0.2

Sol :
$$T = \frac{30 \text{ sec}}{20} \qquad \Delta T = \frac{1}{20}\text{sec},$$
$$L = 55\,cm \qquad \Delta L = 1\,mm = 0.1\,cm$$
$$g = \frac{4\pi^2 L}{T^2}$$
$percentage\,error\,in\,g\,is$
$$\frac{\Delta g}{g} \times 100 = \left(\frac{\Delta L}{L} + \frac{2\Delta T}{T}\right) 100\%$$
$$= \left(\frac{0.1}{5.5} + 2\frac{\left(\frac{1}{20}\right)}{\frac{30}{20}}\right) 100\% \ \simeq 6.8\%.$$

60. The SI unit of surface tension is

(A) Dyne/cm (B) Newton/cm
(C) ✓Newton/metre (D) Newton-metre

Sol : (c) The tension of the surface film of a liquid caused by the attraction of the particles in the surface layer by the bulk of the liquid, which tends to minimize surface area.
OR
It is the tangential force acting on unit surface length.Hence, SI unit for surface tension is N/m

61. One femtometer is equivalent to

(A) $10^{15}\,m$ (B) ✓$10^{-15}\,m$
(C) $10^{-12}\,m$ (D) $10^{12}\,m$

Sol : (b)

62. The number of significant figures in all the given numbers $25, 12, 2009, 4.156$ and 1.217×10^{-4} is

(A) 1 (B) 2
(C) 3 (D) ✓4

Sol : (d) The number of significant figures in all of the given number is 4.

63. SI unit of permittivity is

(A) $C^2m^2N^{-1}$ (B) $C^{-1}m^2N^{-2}$
(C) $C^2m^2N^2$ (D) ✓$C^2m^{-2}N^{-1}$

Sol : (d) $F = \dfrac{1}{4\pi \in} \dfrac{q_1q_2}{r^2}$
$$\Rightarrow \in = \frac{1}{4\pi}\frac{q_1q_2}{Fr^2} = C^2m^{-2}N^{-1}$$

64. In the density measurement of a cube, the mass and edge length are measured as $(10.00 \pm 0.10)\ kg$ and $(0.10 \pm 0.01)\ m$ respectively. The error in the measurement of density is

(A) $0.10\ kg/m^3$ (B) $0.31\ kg/m^3$
(C) $0.07\ kg/m^3$ (D) ✓None of these

Sol :
$$\rho\ = \frac{m}{v}$$
$Maximum\,\%\,error\,in\,\rho\,will\,be\,given\,by$
$$\frac{\Delta p}{p} \times 100\% \ = \left(\frac{\Delta m}{m}\right) \times 100\% \ + 3\left(\frac{\Delta L}{L}\right) \times 100\% \ \dots (i)$$
$This\,is\,not\,applicable\,as\,error\,is\,big.$
$$\rho_{\min} = \frac{m_{\min}}{v_{\max}} = \frac{9.9}{(0.11)^3} = 7438kg/m^3$$
$$\&\,\rho_{\max} = \frac{m_{\max}}{v_{\min}} = \frac{10.1}{(0.09)^3} = 13854.6kg/m^3$$
$$\Delta\rho\ = 6416.6\ kg/m^3$$

65. One Mach number is equal to

(A) Velocity of light (B) ✓Velocity of sound $(332\ m/\sec)$
(C) $1\ km/\sec$ (D) $1\,m/\sec$

Sol : (b) Mach number $= \dfrac{\text{Velocity of object}}{\text{Velocity of sound}}$.

66. $Erg - m^{-1}$ can be the unit of measure for

(A) ✓Force (B) Momentum
(C) Power (D) Acceleration

Sol : (a) Energy $(E) = F \times d$
$$\Rightarrow F = \frac{E}{d}$$
so Erg/metre can be the unit of force.

67. The diameter and height of a cylinder are measured by a meter scale to be $12.6 \pm 0.1\,cm$ and $34.2\ \ \pm\ 0.1\,cm$, respectively. What will be the value of its volume in appropriate significant figures?

(A) $4264 \pm 81\,cm^3$ (B) ✓$4260 \pm 80\,cm^3$
(C) $4264 \pm 81.0\,cm^3$ (D) $4300 \pm 80\,cm^3$

Sol :
$$V = \pi R^2 h = \frac{\pi}{4} D^2 h$$
$$= 4260\,cm^2$$
$$\frac{\Delta V}{V} = 2\frac{\Delta D}{D} + \frac{\Delta h}{h}$$
$$= \left(2 \times \frac{0.1}{12.6} + \frac{0.1}{34.2}\right) V$$
$$= \frac{2 \times 426}{12.6} + \frac{426}{34.2}$$
$$= 67.61 + 12.459 = 80.075$$
$$\therefore \qquad V = 4260 \pm 80\,cm^3$$

68. The speed of light (c), gravitational constant (G) and Planck's constant (h) are taken as the fundamental units in a system. The dimension of time in this new system should be

(A) ✓$G^{1/2}h^{1/2}c^{-5/2}$ (B) $G^{-1/2}h^{1/2}c^{1/2}$
(C) $G^{1/2}h^{1/2}c^{-3/2}$ (D) $G^{1/2}h^{1/2}c^{1/2}$

Sol : (a) Time $\propto c^xG^yh^z \Rightarrow T = kc^xG^yh^z$

Putting the dimensions in the above relation
$$\Rightarrow [M^0L^0T^1] = [LT^{-1}]^x[M^{-1}L^3T^{-2}]^y[ML^2T^{-1}]^z$$
$$\Rightarrow [M^0L^0T^1] = [M^{-y+z}L^{x+3y+2z}T^{-x-2y-z}]$$
Comparing the powers of M, L and T
$$-y + z = 0\ .\ .\ .\ (i)$$
$$x + 3y + 2z = 0\ .\ .\ .\ (ii)$$
$$-x - 2y - z = 1\ .\ .\ .\ (iii)$$
On solving equations (i) and (ii) and (iii)
$$x = \frac{-5}{2},\ y = z = \frac{1}{2}$$
Hence dimension of time are $[G^{1/2}h^{1/2}c^{-5/2}]$

69. Which is different from others by units

(A) Phase difference (B) Mechanical equivalent
(C) Loudness of sound (D) ✓Poisson's ratio

Sol : (d) Poission ratio is a unitless quantity.

70. The decimal equivalent of $1/20$ upto three significant figures is

(A) ✓0.0500 (B) 0.05000
(C) 0.0050 (D) 5.0×10^{-2}

Sol : (a) $\dfrac{1}{20} = 0.05$

Decimal equivalent upto 3 significant figures is 0.0500

71. If the capacitance of a nanocapacitor is measured in terms of a unit $'u'$ made by combining the electric charge $'e'$, Bohr radius $'a_0'$, Planck's constant $'h'$ and speed of light $'c'$ then

(A) $u = \frac{e^2h}{a_0}$ (B) $u = \frac{hc}{e^2a_0}$

(C) $u = \frac{e^2c}{ha_0}$ (D) $\checkmark u = \frac{e^2a_0}{hc}$

Sol :
$Let\,unite\,'u'\,related\,with\,e,\,a_0,h\,and\,c\,as\,follows.$
$[u]=[e]^a[a_0]^b[h]^c[c]^d$
$\text{Using dimensional } method,\,[LT^{-1}]^d$
$[M^{-1}L^{-2}T^{+4}A^{+2}]=[M^cL^{b+2c+d}T^{a-c-d}A^a]$
$a=2,b=1,c=\;-1,d=1$
$\therefore u=\frac{e^2a_0}{hc}$

72. In $S=a+bt+ct^2$. S is measured in metres and t in seconds. The unit of c is

(A) None (B) m

(C) ms^{-1} (D) $\checkmark ms^{-2}$

Sol : (d) ct^2 must have dimensions of L

$\Rightarrow c$ must have dimensions of L/T^2 i.e. LT^{-2}.

73. The characteristic distance at which quantum gravitational effects are significant, the Planck length, can be determined from a suitable combination of the fundamental physical constants G, h and c . Which of the following correctly gives the Planck length?

(A) G^2hc (B) $\checkmark \left(\frac{Gh}{c^3}\right)^{\frac{1}{2}}$

(C) $G^{\frac{1}{2}}h^2c$ (D) Gh^2c^3

Sol : Plank length is a unit of length

$I_p\;=1.616229\times10^{-35}\,m$

$l_p=\sqrt{\frac{hG}{c^3}}$

74. $Dyne/cm^2$ is not a unit of

(A) Pressure (B) Stress

(C) ✓Strain (D) Young's modulus

Sol : (c)

75. In $SI\,units$, the dimensions of $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ is

(A) $AT^{-3}ML^{3/2}$ (B) $A^{-1}TML^3$

(C) $\checkmark A^2T^3M^{-1}L^{-2}$ (D) $AT^2M^{-1}L^{-1}$

Sol :
$Dimension\,of\,\sqrt{\frac{\varepsilon_0}{\mu_0}}$
$[\varepsilon_0]=[M^{-1}L^{-3}T^4A^2]$
$[\mu_0]=[MLT^{-2}A^{-2}]$
$Dimension\,of\,\sqrt{\frac{\varepsilon_0}{\mu_0}}=\left[\frac{M^{-1}L^{-3}T^4A^2}{MLT^{-2}A^{-2}}\right]^{\frac{1}{2}}$
$=[M^{-2}L^{-4}T^6A^4]^{1/2}$
$=[M^{-1}L^{-2}T^3A^2]$

76. A body travels uniformly a distance of $(13.8\pm0.2)\,m$ in a time $(4.0\pm0.3)\,s$. The percentage error is .... %

(A) 7 (B) 5.95

(C) $\checkmark 8.95$ (D) 9.85

Sol : (c) % error in velocity$=$ % error in $L+$% error in t

$=\frac{0.2}{13.8}\times100+\frac{0.3}{4}\times100$

$=1.44+7.5=8.94\%$

77. A beaker contains a fluid of density $\rho\,kg/m^3$, specific heat $S\,J/kg\,^oC$ and viscosity η. The beaker is filled upto height h. To estimate the rate of heat transfer per unit area (Q/A) by convection when beaker is put on a hot plate, a student proposes that it should depend on η, $\left(\frac{S\Delta\theta}{h}\right)$ and $\left(\frac{1}{\rho g}\right)$ when $\Delta\theta$ (in ^oC) is the difference in the temperature between the bottom and top of the fluid. In that situation the correct option for (Q/A) is

(A) $\eta\cdot\left(\frac{S\Delta\theta}{h}\right)\left(\frac{1}{\rho g}\right)$ (B) $\left(\frac{S\Delta\theta}{\eta h}\right)\left(\frac{1}{\rho g}\right)$

(C) $\frac{S\Delta\theta}{\eta h}$ (D) $\checkmark \eta\frac{S\Delta\theta}{h}$

Sol :
$Let\;\frac{Q}{A}=\eta^a\left(\frac{S\Delta\theta}{h}\right)^b\left(\frac{1}{\rho g}\right)^c$
$\text{Using dimensional } method$
$MT^{-3}=[ML^{-1}T^{-1}]^a[LT^{-2}]^b[M^{-1}L^2T^2]^c$
$or,\;MT^{-3}=[M^{a-c}L^{-a+b+2c}T^{-a-2b+2c}]$
$Equating\,powers\,and\,solving$
$we\,get,a=1,b=1,c=0$
$\therefore\frac{Q}{A}=\eta\frac{S\Delta\theta}{h}$

78. In a screw gauge, 5 complete rotations of the screw cause it to move a linear distance of $0.25\,cm$. There are 100 circular scale divisions. The thickness of a wire measured by this screw gauge gives a reading of 4 main scale divisions and 30 circular scale divisions . Assuming negligible zero error, the thickness of the wire is

(A) $0.0430\,cm$ (B) $0.3150\,cm$

(C) $0.4300\,cm$ (D) $\checkmark 0.2150\,cm$

Sol :
$Least\,count$
$\frac{Value\,of\,1\,part\,on\,main\,scale}{Number\,of\,parts\,on\,venier\,scale}$
$=\frac{0.25}{5\times100}cm=5\times10^{-4}cm$
$\text{Reading}=4\times0.005\,cm+30\times10^4cm$
$=(0.2+0.0150)\,cm=0.2150cm\,(Thickness\,of\,wire)$

79. The period ofoscillation ofa simple pendulum is $T=2\pi\sqrt{\frac{l}{g}}$. Measured value of L is $20.0\;cm$ known to $1\;mm$ accuracy and time for 100 oscillations of the pendulum is found to be $90\;s$ using a wrist watch of $1\;s$ resolution. The accuracy in the determination of g is .... %

(A) $\checkmark 3$ (B) 1

(C) 5 (D) 2

Sol :
$AS,\,g=4\pi^2\frac{l}{T^2}$
$So,\;\frac{\Delta g}{g}\times100=\frac{\Delta l}{L}\times100+2\frac{\Delta T}{T}\times100$
$=\frac{0.1}{20}\times100+2\times\frac{1}{90}\times100=2.72\simeq3\%$

80. In an experiment the angles are required to be measured using an instrument, 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half- a degree $(=0.5^o)$, then the least count of the instrument is:

(A) 1° (B) $\frac{1}{2}^\circ$

(C) $\checkmark 1'$ (D) $(\frac{1}{2})'$

Sol :
$30\,Divisions\,of\,vernier\,scale\,coincide\,with\,29$
$divisions\,of\,main\,scales$
$Therefore\,1\,V.S.D=\frac{29}{30}MSD$
$Least\,count\;=1\,MSD-1VSD=1MSD-\frac{29}{30}MSD$
$=\frac{1}{30}MSD=\frac{1}{30}\times0.5^\circ=1\text{minute}.$

81. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to

(A) $\sqrt{\frac{hc^5}{G}}$ (B) $\sqrt{\frac{c^3}{Gh}}$

(C) ✓$\sqrt{\frac{Gh}{c^5}}$ (D) $\sqrt{\frac{Gh}{c^3}}$

Sol :
$$t = G^a h^b c^c$$
$$\Rightarrow M^0L^0T^1 = (M^{-1}L^3T^{-2})^a (ML^2T^{-1})^b (LT^{-1})^c$$
$$\Rightarrow -a+b=0 \Rightarrow a=b$$
$$\Rightarrow 3a+2b+c=0$$
$$\Rightarrow c=-5a$$
$$\Rightarrow -2a-b-c=1$$
$$\Rightarrow a=\frac{1}{2}; b=\frac{1}{2}; c=-\frac{5}{2}$$

82. Candela is the unit of

(A) Electric intensity (B) ✓Luminous intensity

(C) Sound intensity (D) None of these

Sol : (b)

83. The unit of L/R is (where L = inductance and R = resistance)

(A) ✓sec (B) $\sec^{-1}$

(C) Volt (D) Ampere

Sol : (a) $[L/R]$ is a time constant so its unit is Second.

84. The unit of the coefficient of viscosity in $S.I.$ system is

(A) $m/kg-s$ (B) $m-s/kg^2$

(C) $kg/m-s^2$ (D) ✓$kg/m-s$

Sol : (d) $[\eta] = ML^{-1}T^{-1}$ so its unit will be $kg/m-sec$.

85. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then:

(A) $\varepsilon_0 = M^{-1}L^{-3}T^2A$ (B) ✓ $\varepsilon_0 = M^{-1}L^{-3}T^4A^2$

(C) $\varepsilon_0 = M^{-1}L^2T^{-1}A^{-2}$ (D) $\varepsilon_0 = M^{-1}L^2T^{-1}A$

Sol :
$$As\, we\, know,\, F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{R^2} \Rightarrow \varepsilon_0 = \frac{q_1q_2}{4\pi FR^2}$$
$$Hence,\, \varepsilon_0 = \frac{[AT]^2}{MLT^{-2}L^2} = [M^{-1}L^{-3}T^4A^2]$$

86. The units of modulus of rigidity are

(A) $N-m$ (B) N/m

(C) $N-m^2$ (D) ✓N/m^2

Sol : (d)

87. If the unit of length and force be increased four times, then the unit of energy is

(A) Increased 4 times (B) Increased 8 times

(C) ✓Increased 16 times (D) Decreased 16 times

Sol : (c) Energy = force $\times$ distance, so if both are increased by 4 times then energy will increase by 16 times.

88. The correct value of 0^oC on the Kelvin scale is .... K

(A) ✓273.15 (B) 272.85

(C) 273 (D) 273.2

Sol : (a) $K = C + 273.15$

89. Which of the following is not represented in correct unit

(A) $\frac{\text{Stress}}{\text{Strain}} = N/m^2$ (B) Surface tension $=N/m$

(C) ✓Energy $= kg-m/\sec$ (D) Pressure $= N/m^2$

Sol : (c) Unit of energy will be $kg-m^2/\sec^2$

90. Which of the following quantity is expressed as force per unit area

(A) Work (B) ✓Pressure

(C) Volume (D) Area

Sol : (b)

91. The main scale of a vemler calliper has n divisions/ cm. n divisions of the vernler scale coincide with $(n-1)$ divisions of maln scale. The least count of the vernler calliper is,

(A) $\frac{1}{(n+1)(n-1)}$cm (B) $\frac{1}{n}$ cm

(C) ✓ $\frac{1}{n^2}$ cm (D) $\frac{1}{n(n+1)}$ cm

Sol : $\mathrm{n(USD) = (n-1)MSD \Rightarrow 1VSD = \frac{(n-1)}{n}MSD}$

Least count $= \mathrm{1MSD - 1VSD} = \left[1 - \frac{(n-1)}{n}\right]\mathrm{MSD} = \frac{1}{n}\mathrm{MSD} = \frac{1}{n}\left(\frac{1}{n}\right)\mathrm{cm} = \frac{1}{n^2}\mathrm{cm}$

92. The surface tension of a liquid is $70\, dyne/cm$. In MKS system its value is

(A) $70N/m$ (B) ✓$7\times10^{-2}\, N/m$

(C) $7\times10^3\, N/m$ (D) $7\times10^2\, N/m$

Sol : (b) 1 dyne $= 10^{-5}$ Newton, $1\, cm = 10^{-2}m$

$70\, \frac{dyne}{cm} = \frac{70\times10^{-5}}{10^{-2}}\, \frac{N}{m}$

$= 7\times10^{-2}N/m.$

93. In the context of accuracy of measurement and significant figures in expressing results of experiment, which of the following is/are correct

(1) Out of the two measurements $50.14\, cm$ and 0.00025 ampere, the first one has greater accuracy

(2) If one travels $478\, km$ by rail and $397\, m.$ by road, the total distance travelled is $478\, km.$

(A) Only (1) is correct (B) Only (2) is correct

(C) ✓Both are correct (D) None of them is correct.

Sol : (c) Since for $50.14\, cm$, significant number $= 4$ and for 0.00025, significant numbers $= 2$

94. The damping force on an oscillator is directly proportional to the velocity.The units of the constant of proportionality are

(A) $Kg\ ms^{-1}$ (B) $Kg\ ms^{-2}$

(C) ✓$Kg\ s^{-1}$ (D) $Kg\ s$

Sol :
$$Damping\, force,\, F \propto v\, or\, F = kv$$
$$Where\, k\, is\, the\, constant\, of\, proportionality$$
$$\therefore\, k = \frac{F}{v} = \frac{N}{m\,s^{-1}} = \frac{kg\,m\,s^{-2}}{m\,s^{-1}} = kg\,s^{-1}$$

95. If L, C and R represent inductance, capacitance and resistance respectively, then which of the following does not represent dimensions of frequency

(A) $\frac{1}{RC}$ (B) $\frac{R}{L}$

(C) $\frac{1}{\sqrt{LC}}$ (D) ✓$\frac{C}{L}$

Sol : (d) $f = \frac{1}{2\pi\sqrt{LC}}$ $\left(\frac{C}{L}\right)$ does not represent the dimension of frequency

96. Density of wood is $0.5\, gm/cc$ in the CGS system of units. The corresponding value in MKS units is .... kg/m^3

(A) ✓500 (B) 5

(C) 0.5 (D) 5000

Sol : (a) $1\, C.G.S$ unit of density $= 1000\, M.K.S.$ unit of density

$\Rightarrow 0.5\ gm/cc = 500\, kg/m^3$

97. $Newton/metre^2$ is the unit of

(A) Energy (B) Momentum

(C) Force (D) ✓Pressure

Sol : (d)

98. The value of Planck's constant is

(A) ✓$6.63\times10^{-34}J-\sec$ (B) $6.63\times10^{34}J/\sec$

(C) $6.63\times10^{-34}kg-m^2$ (D) $6.63\times10^{34}kg/\sec$

Sol : (a)

99. In SI, Henry is the unit of

(A) Self inductance (B) Mutual inductance

(C) ✓(a) and (b) both (D) None of the above

Sol : (c)

100. If radius of the sphere is $(5.3 \pm 0.1)cm$. Then percentage error in its volume will be

(A) $3 + 6.01 \times \frac{100}{5.3}$
(B) $\frac{1}{3} \times 0.01 \times \frac{100}{5.3}$
(C) ✓ $\left(\frac{3 \times 0.1}{5.3}\right) \times 100$
(D) $\frac{0.1}{5.3} \times 100$

Sol : (c) Volume of sphere $(V) = \frac{4}{3}\pi r^3$

% error in volume $= 3 \times \frac{\Delta r}{r} \times 100 = \left(3 \times \frac{0.1}{5.3}\right) \times 100$

101. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length ?

(A) $\sqrt{\frac{hc}{G}}$
(B) $\sqrt{\frac{Gc}{h^{\frac{3}{2}}}}$
(C) ✓ $\frac{\sqrt{hG}}{c^{\frac{3}{2}}}$
(D) $\frac{\sqrt{hG}}{c^{\frac{5}{2}}}$

Sol :
$$\begin{aligned}&According\,to\,questions,\\&l \propto h^p c^q G^r\\&l = k\, h^p c^q G^r \qquad \ldots (i)\\&Writting\text{ dimensions } of\; physical\; quantities\; on\; both\; sides,\\&[M^0LT^0] = [ML^2T^{-1}]^p [LT^{-1}]^q [M^{-1}L^3T^{-2}]^r\\&Applying\; the\; principle\; of \text{ homogeneity } of \text{ dimensions, we get}\end{aligned}$$

$P - r = 0 \qquad \ldots (i)$

$2_p + q + 3r = 1 \qquad \ldots (iii)$

$-P - q - 2r = 0 \qquad \ldots (iv)$

$Solving\; eqns.\; (ii), (iii)\; and\; (iv), \;we\; get$

$P = r = \frac{1}{2}, q = -\frac{3}{2}$

$From\; eqn.\; (i)\; l = \frac{\sqrt{hG}}{c^{3/2}}$

102. Number of particles is given by $n = -D\frac{n_2 - n_1}{x_2 - x_1}$ crossing a unit area perpendicular to X-axis in unit time, where n_1 and n_2 are number of particles per unit volume for the value of x meant to x_2 and x_1. Find dimensions of D called as diffusion constant

(A) M^0LT^2
(B) $M^0L^2T^{-4}$
(C) M^0LT^{-3}
(D) ✓ $M^0L^2T^{-1}$

Sol : (d) $[n]$ = Number of particles crossing a unit area in unit time = $[L^{-2}T^{-1}]$

$[n_2] = [n_1]$= number of particles per unit volume $= [L-3]$

$[x_2] = [x_1]$= positions

$$D = \frac{[n]\;[x_2 - x_1]}{[n_2 - n_1]} = \frac{[L^{-2}T^{-1}] \times [L]}{[L^{-3}]} = [L^2T^{-1}]$$

103. Unit of stress is

(A) N/m
(B) $N - m$
(C) ✓ N/m^2
(D) $N - m^2$

Sol : (c) Stress $= \frac{\text{Force}}{\text{Area}} = \frac{N}{m^2}$

104. If the time period t of the oscillation of a drop of liquid of density d, radius r, vibrating under surface tension s is given by the formula $t = \sqrt{r^{2b}\, s^c\, d^{a/2}}$. It is observed that the time period is directly proportional to $\sqrt{\frac{d}{s}}$. The value of b should therefore be

(A) $\frac{3}{4}$
(B) $\sqrt{3}$
(C) ✓ $\frac{3}{2}$
(D) $\frac{2}{3}$

105. A screw gauge with a pitch of $0.5\; mm$ and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that wen the two jaws of the screw gauge are brought in contact, the 45^{th} division coincides with the main scale line and the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is $0.5\; mm$ and the 25^{th} division coincides with the main scale line .... mm.

(A) 0.70
(B) 0.50
(C) 0.75
(D) ✓ 0.80

Sol :
$$\begin{aligned}&L.C = \frac{0.5}{50} = 0.001\, mm\\&zero\, error = 5 \times 0.001 = 0.05\, mm\, (negative)\\&\text{Reading} = (0.5 + 25 \times 0.01) + 0.05 = 0.80\, mm\end{aligned}$$

106. Volt/metre is the unit of

(A) Potential
(B) Work
(C) Force
(D) ✓Electric intensity

Sol : (d) $E = -\frac{dV}{dx}$

107. $Kilowatt - hour$ is a unit of

(A) Electrical charge
(B) ✓Energy
(C) Power
(D) Force

Sol : (b)

108. The period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$ where l is about $100\, cm$ and is known to have $1\, mm$ accuracy. The period is about $2\, s$. The time of 100 oscillations is measured by a stop watch of least count $0.1\, s$. The percentage error in g is .... %

(A) 0.1
(B) 1
(C) ✓0.2
(D) 0.8

Sol : (c) $T = 2\pi\sqrt{l/g} \Rightarrow T^2 = 4\pi^2 l/g$

$\Rightarrow g = \frac{4\pi^2 l}{T^2}$

$Here\, \%\, error\, in\, l = \frac{1mm}{100cm} \times 100 = \frac{0.1}{100} \times 100 = 0.1\%\;\; and\, \%\, error\, in\, T = \frac{0.1}{2 \times 100} \times 100 = 0.05\%$

$\%\, error\, in\, g = \%\, error\, in\, l + 2(\%\, error\, in\, T)$

$= 0.1 + 2 \times 0.05 = 0.2\%$

109. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value ofresistance of the wire is .... %

(A) 3
(B) ✓6
(C) 0
(D) 1

Sol :
$$\begin{aligned}&R = \frac{V}{I}\\&\frac{\Delta R}{R} \times 100 = \frac{\Delta V}{V} \times 100 + \frac{\Delta I}{I} \times 100 = 3 + 3 = 6\%\end{aligned}$$

110. In $C.G.S.$ system the magnitutde of the force is 100 dynes. In another system where the fundamental physical quantities are kilogram, metre and minute, the magnitude of the force is

(A) 0.036
(B) 0.36
(C) ✓3.6
(D) 36

Sol : (c) $n_2 = n_1\left(\frac{M_1}{M_2}\right)^1\left(\frac{L_1}{L_2}\right)^1\left(\frac{T}{T_2}\right)^{-2}$

= $100\left(\frac{gm}{kg}\right)^1\left(\frac{cm}{m}\right)^1\left(\frac{\sec}{min}\right)^{-2}$

= $100\left(\frac{gm}{10^3 gm}\right)^1\left(\frac{cm}{10^2 cm}\right)^1\left(\frac{\sec}{60\sec}\right)^{-2}$

$n_2 = \frac{3600}{10^3} = 3.6$

111. Which of the following pairs is wrong

(A) Pressure-Baromter
(B) ✓Relative density-Pyrometer
(C) Temperature-Thermometer
(D) Earthquake-SeismographDimensions

Sol : (b) Pyrometer is used for measurement of temperature.

112. If e is the charge, V the potential difference, T the temperature, then the units of $\frac{eV}{T}$ are the same as that of

(A) Planck's constant (B) Stefan's constant

(C) ✓Boltzmann constant (D) Gravitational constant

Sol : $\frac{eV}{T} = \frac{W}{T} = \frac{PV}{T} = R$

$and\ \frac{R}{N} = Boltzmann\,\text{constant}.$

113. $Assertion$: The error in the measurement of radius of the sphere is 0.3%. The permissible error in its surface area is 0.6%

$Reason$: The permissible error is calculated by the formula $\frac{\Delta A}{A} = \frac{4\Delta r}{r}$

(A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(C) ✓If the Assertion is correct but Reason is incorrect.

(D) If both the Assertion and Reason are incorrect.

Sol :
$$Area\,of\,the\,sphere,\ A = 4\pi r^2$$
$$\%\,error\,in\,area\ = 2 \times \%\,error\,in\,radius$$
$$i.e,\ \frac{\Delta A}{A} \times 100 = 2 \times \frac{\Delta r}{r} \times 100$$
$$= 2 \times 0.3\%\ = 0.6\%$$
$$But\,\frac{\Delta A}{A} = 4\frac{\Delta r}{r}\,is\,false.$$

114. The unit of self inductance of a coil is

(A) Farad (B) ✓Henry

(C) Weber (D) Tesla

Sol : (b) $L = \frac{\phi}{I} = \frac{Wb}{A} = Henry.$

115. Unit of Stefan's constant is

(A) $J\,s^{-1}$ (B) ✓$J\,m^{-2}s^{-1}K^{-4}$

(C) $J\,m^{-2}$ (D) $J\,s$

Sol : (b) $\frac{Q}{t} = \sigma AT^4$

$\Rightarrow \sigma = Jm^{-2}s^{-1}K^{-4}$

116. Unit of moment of inertia in MKS system

(A) $kg \times cm^2$ (B) kg/cm^2

(C) ✓$kg \times m^2$ (D) $Joule \times m$

Sol : (c) As $I\ = MR^2 = kg - m^2$

117. Match List-I with List-II and select the correct answer by using the codes given below the lists

$a\ b\ c\ d$

List - I	List - II
(a) Distance between earth and stars	1. Microns
(b) Inter-atomic distance in a solid	2. Angstroms
(c) Size of the nucleus	3. Light years
(d) Wavelength of infrared laser	4. Fermi
	5. Kilometres

(A) $5\,4\,2\,1$ (B) ✓$3\,2\,4\,1$

(C) $5\,2\,4\,3$ (D) $3\,4\,1\,2$

Sol : (b)

118. The SI unit of universal gas constant (R) is

(A) $Watt\,K^{-1}mol^{-1}$ (B) $Newton\,K^{-1}mol^{-1}$

(C) ✓$Joule\,K^{-1}\,mol^{-1}$ (D) $Erg\,K^{-1}\,mol^{-1}$

Sol : (c) $PV\ = nRT\ \Rightarrow\ R\ = \frac{PV}{nT} = \frac{Joule}{mole \times Kelvin} = JK^{-1}mol^{-1}$

119. The least count of a stop watch is $0.2\,second$. The time of $20\,oscillations$ of a pendulum is measured to be $25\,second$. The percentage error in the measurement of time will be .... %

(A) 8 (B) 1.8

(C) ✓0.8 (D) 0.1

Sol : $\frac{0.2}{25} \times 100 = 0.8$

120. Temperature can be expressed as a derived quantity in terms of any of the following

(A) Length and mass (B) Mass and time

(C) Length, mass and time (D) ✓None of these

Sol : (d) Because temperature is a fundamental quantity.

121. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be

(A) $[EV^{-2}T^{-1}]$ (B) $[EV^{-1}T^{-2}]$

(C) ✓$[EV^{-2}T^{-2}]$ (D) $[E^{-2}V^{-1}T^{-3}]$

Sol :
$$Let\,S = kE^aV^bT^c$$
$$Where\,k\,is\,a\,\text{dimensionless constant}.$$
$$\text{Writing}\,the\,\text{dimensions}\,on\,both\,sides,\ we\,get$$
$$\left[M^1L^0T^{-2}\right] = \left[ML^2T^{-2}\right]^a\left[LT^{-1}\right]^b[T]^c$$
$$= \left[M^aL^{2a+b}T^{-2a\,-\,b+c}\right]$$

$$Applying\,principle\,of\,\text{homogeneity}\,of\,\text{dimensions},$$
$$we\,get,\ a = 1 \qquad ...(i)$$
$$2a + b = 0 \qquad ...(ii)$$
$$-2 - b + c =\ -2 \qquad ...(iii)$$
$$Adding\ (ii)\ and\ (iii),\ we\,get$$
$$c =\ -2$$
$$from\ (ii),\ b =\ -2a =\ -2$$
$$\therefore\quad S = kEV^{-2}T^{-2}\,or\ [S] = \left[EV^{-2}T^{-2}\right]$$

122. The dimensional formula for torque is

(A) ✓ML^2T^{-2} (B) $ML^{-1}T^{-1}$

(C) L^2T^{-1} (D) $M^2L^{-2}K^{-1}$

Sol : $\tau\ = Fr = MLT^{-2}L = ML^2T^{-2}$

123. N divisions on the main scale of a vernier calliper coincide with $(N+1)$ divisions of the vernier scale. If each division of main scale is $'a'$ units , then the least count of the instrument is

(A) a (B) $\frac{a}{N}$

(C) $\frac{N}{N+1} \times a$ (D) ✓$\frac{a}{N+1}$

Sol :
$$No\,of\,divisions\,on\,main\,scale\ = N$$
$$No\,of\,divisions\,on\,vernier\,scale\ = N+1$$
$$Size\,of\,main\,scale\,divisions\ = a$$
$$Let\,size\,of\,vernier\,scale\,division\,be\,b\,then\,we\,have$$
$$aN = b\ (N+1) \Rightarrow b = \frac{aN}{N+1}$$
$$Least\,count\,is\,a - b = a - \frac{aN}{N+1}$$
$$= a\left[\frac{N+1-N}{N+1}\right] = \frac{a}{N+1}$$

124. If Surface tension (S), Moment of Inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be

(A) ✓$S^{1/2}I^{1/2}h^0$ (B) $S^{1/2}I^{3/2}h^{-1}$

(C) $S^{3/2}I^{1/2}h^0$ (D) $S^{1/2}I^{1/2}h^{-1}$

Sol :
$$P = k\,s^ai^bh^c$$
$$Where\,k\,is\,\text{dimensionless constant}$$
$$MLT^{-1} = \left(MT^{-2}\right)^a\left(ML^2\right)\left(ML^2T^{-1}\right)^c$$
$$a + b + c = 1$$
$$2b + 2c =\ -1$$
$$-2a - c =\ -1$$
$$a = \frac{1}{2}\quad b = \frac{1}{2}\quad c = 0$$
$$S^{1/2}i^{1/2}h^0$$

125. $Par\,\text{sec}$ is a unit of

(A) ✓Distance (B) Velocity

(C) Time (D) Angle

Sol : (a) Astronomical unit of distance.

126. A force F is applied onto a square plate of side L. If the percentage error in determining L is 2% and that in F is 4%, the permissible percentage error in determining the pressure is .... $\%$

(A) 2 (B) 4

(C) 6 (D) ✓8

Sol :
$$As,\, pressure\, p = \frac{F}{A} = \frac{F}{L^2}$$
$$\%\, Error\ = \frac{\Delta F}{F} \times 100 + 2\frac{\Delta L}{L} \times 100$$
$$= 4 + 2 \times 2 = 8\%$$

127. The SI unit of momentum is

(A) $\frac{kg}{m}$ (B) ✓$\frac{kg.m}{\sec}$

(C) $\frac{kg.m^2}{\sec}$ (D) $kg \times Newton$

Sol : (b) $mv = kg\left(\frac{m}{\sec}\right)$

128. The velocity v (in $cm/\sec$) of a particle is given in terms of time t (in sec) by the relation $v = at + \frac{b}{t+c}$; the dimensions of a, b and c are

(A) $a = L^2,\, b = T,\, c = LT^2$ (B) $a = LT^2,\, b = LT,\, c = L$

(C) ✓$a = LT^{-2}, b = L,\, c = T$ (D) $a = L,\, b = LT,\, c = T^2$

Sol : (c) From the principle of dimensional homogenity $[v] = [at] \Rightarrow [a] = [LT^{-2}]$.

Similarly $[b] = [L]$and $[c] = [T]$

129. Universal time is based on

(A) Rotation of the earth on its axis (B) Earth's orbital motion around the earth

(C) ✓Vibrations of cesium atom (D) Oscillations of quartz crystal

Sol : (c) According to the definition.

130. The frequency of vibration of string is given by $\nu\ = \frac{p}{2l}\left[\frac{F}{m}\right]^{1/2}$. Here p is number of segments in the string and l is the length. The dimensional formula for m will be

(A) $[M^0LT^{-1}]$ (B) $[ML^0T^{-1}]$

(C) ✓$[ML^{-1}T^0]$ (D) $[M^0L^0T^0]$

Sol : (c) $\nu = \frac{P}{2l}\left[\frac{F}{m}\right]^{1/2}$

$$\Rightarrow \nu^2 = \frac{P^2}{4l^2}\left[\frac{F}{m}\right]$$

$$\therefore m \propto \frac{F}{l^2\nu^2}$$

$$\Rightarrow [m] = \left[\frac{MLT^{-2}}{L^2T^{-2}}\right] = [ML^{-1}T^0]$$

131. The dimension of $\frac{1}{2}\varepsilon_0 E^2$

(A) $M^1L^2T^{-2}$ (B) ✓$M^1L^{-1}T^{-2}$

(C) $M^1L^2T^{-1}$ (D) MLT^{-1}

Sol :
$$Energy\, density\, of\, an\, electric\, filed\, E\, is$$
$$u_E = \frac{1}{2}\varepsilon_o E^2$$
$$Where\ \varepsilon_o\, is\, permittivity\, of\, free\, space$$
$$u_E = \frac{Energy}{Volume} = \frac{ML^2T^{-2}}{L^3} = ML^{-1}T^{-2}$$
$$Hence,\, the\, \dim ension\, of\, \frac{1}{2}\varepsilon_o E^2\, is\, ML^{-1}T^{-2}$$

132. $Joule - second$ is the unit of

(A) Work (B) Momentum

(C) Pressure (D) ✓Angular momentum

Sol : (d) $\tau = \frac{dL}{dt}$

$\Rightarrow dL = \tau \times dt = r \times F \times dt$

i.e. the unit of angular momentum is joule-second.

133. $Ampere - hour$ is a unit of

(A) ✓Quantity of electricity (B) Strength of electric current

(C) Power (D) Energy

Sol : (a) Charge = current $\times$ time

134. The formula $X = 5YZ^2$, X and Z have dimensions of capacitance and magnetic field respectively. What are the dimensions of Y in SI units?

(A) $[M^{-2}\, L^0\, T^{-4}\, A^{-2}]$ (B) ✓$[M^{-3}\, L^{-2}\, T^8\, A^{-1}]$

(C) $[M^{-2}\, L^{-2}\, T^6\, A^3]$ (D) $[M^{-1}\, L^{-2}\, T^4\, A^2]$

Sol : $X\ = 5YZ^2$

$$Y\ = \frac{X}{5Z^2} = M^{-3}L^{-2}T^8A^4$$

135. The unit of percentage error is

(A) Same as that of physical quantity

(B) Different from that of physical quantity

(C) ✓Percentage error is unit less

(D) Errors have got their own units which are different from that of physical quantity measured

Sol : (c)

136. Young's modulus of a material has the same units as

(A) ✓Pressure (B) Strain

(C) Compressibility (D) Force

Sol : (a) $Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\text{Force/Area}}{\text{Dimensionless}} \Rightarrow Y \equiv \text{Pressure.}$

137. The relative density of material of a body is found by weighing it first in air and then in water. If the weight in air is (5.00 ± 0.05) Newton and weight in water is (4.00 ± 0.05) Newton. Then the relative density along with the maximum permissible percentage error is

(A) ✓$5.0\ \pm 11\%$ (B) $5.0\ \pm 1\%$

(C) $5.0\ \pm 6\%$ (D) $1.25\ \pm\ 5\%$

Sol : (a) Weight in air $= (5.00 \pm 0.05)\, N$

Weight in water$= (4.00 \pm 0.05)\, N$

Loss of weight in water $= (1.00 \pm 0.1)\, N$

Now relative density $= \frac{\text{weight in air}}{\text{weight loss in, water}}$

i.e. R . D$= \frac{5.00 \pm 0.05}{1.00 \pm 0.1}$

Now relative density with max permissible error

$$= \frac{5.00}{1.00} \pm \left(\frac{0.05}{5.00} + \frac{0.1}{1.00}\right) \times 100$$
$$= 5.0 \pm (1 + 10)\% = 5.0 \pm 11\%$$

138. In terms of resistance R and time T, the dimensions of ratio $\frac{\mu}{\varepsilon}$ of the permeability μ and permittivity ε is

(A) $[RT^{-2}]$ (B) $[R^2T^{-1}]$

(C) ✓$[R^2]$ (D) $[R^2T^2]$

Sol :
$$\text{Dimensionsof}\ \mu\ = [MLT^{-2}A^{-2}]$$
$$\text{Dimensionsof}\ \in = [M^{-1}L^{-3}T^4A^2]$$
$$\text{Dimensionsof}\ R\ = [ML^2T^{-3}A^{-2}]$$
$$\therefore \frac{\text{Dimensionsof}\ \mu}{\text{Dimensionsof}\ \in} = \left[\frac{MLT^{-2}A^{-2}}{M^{-1}L^{-3}T^4A^2}\right]$$
$$= [M^2L^4T^6A^{-4}] = [R^2]$$

139. Which one of the following pairs of quantities and their units is a proper match

(A) Electric field - Coulomb/m (B) ✓Magnetic flux - Weber

(C) Power - Farad (D) Capacitance - Henry

Sol : (b)

140. If the constant of gravitation (G), Planck's constant (h) and the velocity of light (c) be chosen as fundamental units. The dimension of the radius of gyration is

(A) ✓$h^{1/2}c^{-3/2}G^{1/2}$ (B) $h^{1/2}c^{3/2}G^{1/2}$

(C) $h^{1/2}c^{-3/2}G^{-1/2}$ (D) $h^{-1/2}c^{-3/2}G^{1/2}$

Sol : (a) Let radius of gyration $[k] \propto [h]^x [c]^y [G]^z$

By substituting the dimension of $[k] = [L]$

$[h] = [ML^2T^{-1}]$, $[c] = [LT^{-1}]$, $[G] = [M^{-1}L^3T^{-2}]$

and by comparing the power of both sides

we can get $x = 1/2$, $y = -3/2$, $z = 1/2$

So dimension of radius of gyration are $[h]^{1/2}[c]^{-3/2}[G]^{1/2}$

141. The pair(s) of physical quantities that have the same dimensions, is (are)

(A) Reynolds number and coefficient of friction
(B) Latent heat and gravitational potential
(C) Curie and frequency of a light wave
(D) ✓All of these

Sol : (d) Reynolds number and coefficient of friction are dimensionless.

Latent heat and gravitational potential both have dimension $[L^2T^{-2}]$.

Curie and frequency of a light wave both have dimension $[T^{-1}]$. But dimensions of Planck's constant is $[T^{-1}]$ and torque is $[ML^2T^{-2}]$.

142. Newton-second is the unit of

(A) Velocity
(B) Angular momentum
(C) ✓Momentum
(D) Energy

Sol : (c) Impulse $=$ change in momentum $= F \times t$

So the unit of momentum will be equal to Newton-sec.

143. A body of mass $m = 3.513\ kg$ is moving along the $x-$axis with a speed of $5.00\ ms^{-1}$. The magnitude of its momentum is recorded as .... kgm/s

(A) ✓17.6
(B) 17.565
(C) 17.56
(D) 17.57

Sol :
$$Momentum,\ P = m \times v$$
$$= (3.513) \times (5.00) = 17.565\,kg\,\mathrm{m/s}$$
$$= 17.6\ (Rounding\,off\,to\,get\,three\,significant\,figures)$$

144. If dimensions of critical velocity v_c of a liquid flowing through a tube are expressed as$[^{x\,y}r^z]$ where , and r are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x, y and z are given by

(A) $1, 1, 1$
(B) ✓$1, -1, -1$
(C) $-1, -1, 1$
(D) $-1, -1, -1$

Sol :
$$[v_c] = [\eta^x \rho^y r^z] \quad (given) \qquad \ldots (i)$$
$$\text{Writing the dimensions } of \text{ various } quantities\ in$$
$$eqn.\ (i)\ ,\ we\ get$$
$$\left[M^0LT^{-1}\right] = \left[ML^{-1}T^{-1}\right]^x \left[ML^{-3}T^0\right]^y \left[M^0LT^0\right]^z$$
$$= \left[M^{x+y}L^{-x-3y+z}T^{-x}\right]$$

$Applying\ the\ principle\ of$ homogeneity of dimensions, $we\ get$
$$x + y = 0; -x - 3y + z = 1; -x = \ -1$$
$On\ solving,\ we\ get$
$$x = 1, y = \ -1, z = \ -1$$

145. Faraday is the unit of

(A) ✓Charge
(B) emf
(C) Mass
(D) Energy

Sol : (a) 1 Faraday $= 96500$ coulomb.

146. Match List-I with List-II and select the correct answer using the codes given below the lists

List-I	List -II
I Joule	A.Henry $\times$ Amp/sec
II Watt	B.Farad $\times$ Volt
III Volt	C.Coulomb $\times$ Volt
IV Coulomb	D. Oersted $\times$ cm
	E. Amp $\times$ Gauss
	F. Amp^2 $\times$ Ohm

(A) $I - A,\ II - F,\ III - E,\ IV - D$
(B) ✓$I - C,\ II - F,\ III - A,\ IV - B$
(C) $I - C,\ II - F,\ III - A,\ IV - E$
(D) $I - B,\ II - F,\ III - A,\ IV - C$

Sol : (b)

147. Unit of energy is

(A) $J/\sec$
(B) ✓$Watt - day$
(C) $Kilowatt$
(D) $gm{-}cm/\sec^2$

Sol : (b)

148. The mean time period of second's pendulum is $2.00s$ and mean absolute error in the time period is $0.05s$. To express maximum estimate of error, the time period should be written as

(A) $(2.00 \pm 0.01)s$
(B) $(2.00 \pm 0.025)s$
(C) ✓$(2.00 \pm 0.05)s$
(D) $(2.00 \pm 0.10)s$

Sol : (c) Mean time period $T = 2.00\,sec$

& Mean absolute error $= \Delta T = 0.05\,sec$.

To express maximum estimate of error, the time period should be written as $(2.00 \pm 0.05)\,sec$

149. Which one of the following is not a unit of young's modulus

(A) ✓Nm^{-1}
(B) Nm^{-2}
(C) $Dyne\ cm^{-2}$
(D) Mega Pascal

Sol : (a)

150. The unit for nuclear dose given to a patient is

(A) Fermi
(B) Rutherford
(C) Curie
(D) ✓Roentgen

Sol : (d)