

Chapter 4 Test

Name: _____ Date: _____

Directions: Write the correct letter on the blank before each question.

- _____ 1. Fires involve a heat-producing chemical reaction between fuel and:
(117) [4.3.11]
A. a catalyst.
B. an oxidizer.
C. free radicals.
D. a reducing agent.
- _____ 2. When a substance changes from one type of matter into another, such as two or more substances combining to form compounds, the substance undergoes a: (118) [4.3.11]
A. dissolution.
B. metamorphosis.
C. chemical reaction.
D. physiological change.
- _____ 3. Which statement about energy and combustion is accurate? (120) [4.3.11]
A. A fuel's chemical energy is the result of rapid vibrations in the molecules.
B. Chemical and physical changes almost never involve an exchange of energy.
C. A fuel's potential energy releases during combustion and converts to kinetic energy.
D. Chemical changes involve an exchange of energy; physical changes involve no energy exchange.
- _____ 4. Which element of the fire tetrahedron is included to explain flaming (gas-phase) combustion? (120) [4.3.11]
A. Fuel
B. Heat
C. Oxygen
D. Chemical chain reaction

-
- _____ 5. What occurs when a mixture of fuel and oxygen encounter an external heat source with sufficient heat or thermal energy to start the combustion reaction? (120) [4.3.11]
- A. Autoignition
 - B. Piloted ignition
 - C. Kinetic ignition
 - D. Sustained ignition
- _____ 6. The minimum temperature at which a fuel in the air must be heated in order to start self-sustained combustion is known as the: (122) [4.3.11]
- A. autoignition temperature (AIT).
 - B. piloted ignition temperature (PIT).
 - C. lower explosive (flammable) limit (LEL).
 - D. upper explosive (flammable) limit (UEL).
- _____ 7. What causes flaming combustion to occur? (123) [4.3.11]
- A. A solid fuel encounters an open flame and entrain enough air to ignite.
 - B. A gaseous fuel encounters an external heat source and experience piloted ignition.
 - C. A gaseous fuel mixes with an adequate amount of oxygen and heats to ignition temperature.
 - D. A solid fuel mixes with an adequate amount of liquid fuel to be able to sustain an open burning flame.
- _____ 8. What is the cause of most fire deaths? (124) [4.3.10, 4.3.11]
- A. Injuries caused by falling materials or structural collapse
 - B. Exposure to toxic gases found in smoke and/or lack of oxygen
 - C. Exposure to extreme heat and/or contact with flames and hot surfaces
 - D. Accidental injuries sustained during escape and/or evacuation procedures
- _____ 9. Which statement about the dangers of products of combustion is accurate? (124) [4.3.11]
- A. Visible smoke presents the greatest inhalation danger.
 - B. Low oxygen concentrations alone can result in hypoxia or death.
 - C. Toxic products of combustion are released only during the combustion reaction.
 - D. The toxic effects of smoke inhalation are the result of the interaction between carbon monoxide and heat.

- _____ 10. Which product of combustion acts as a chemical asphyxiant by excluding oxygen from the blood, leading to hypoxia of the brain and tissues? (124-125) [4.3.11]
- A. Carbon dioxide (CO₂)
 - B. Carbon monoxide (CO)
 - C. Aerosolized fuel particles
 - D. Hydrogen cyanide (HCN)
- _____ 11. Hydrogen cyanide (HCN) is a product of combustion that: (126) [4.3.11]
- A. is equally as toxic as carbon monoxide (CO).
 - B. is released when wood and other natural materials are burned.
 - C. targets the brain after being inhaled, ingested, or absorbed into the body.
 - D. acts as a respiratory stimulant, increasing respiratory rate and increasing oxygen to blood cells.
- _____ 12. How does a compartment fire affect pressure in and around gases in the compartment? (127) [4.3.11]
- A. Heat from a fire increases the pressure of the surrounding gases.
 - B. Gases move from areas of lower pressure to areas of higher pressure.
 - C. At standard temperature and atmospheric pressure, gases circulate at a steady, uniform rate.
 - D. Significant differences in pressure, typically 10 kPa or greater, are required to cause movement of gases in a compartment.
- _____ 13. What is the measurement of the average kinetic energy in the particles of a sample of matter? (127) [4.3.11]
- A. Heat
 - B. Wattage
 - C. Temperature
 - D. Candlepower
- _____ 14. Which measurement is often used to measure how long PPE will protect a firefighter in an interior fire environment? (127-128) [4.3.11]
- A. Heat flux to the PPE
 - B. Rate of rise in temperature
 - C. Pressure of convective flow
 - D. Temperature in the structure

-
- _____ 15. What is the MOST common source of heat in combustion reactions? (128) [4.3.11]
- A. Convective flow
 - B. Electrical energy
 - C. Chemical energy
 - D. Thermal equilibrium
- _____ 16. What may occur in an oxidation reaction when the heat generated exceeds the heat being lost? (129) [4.3.11]
- A. Piloted ignition
 - B. Arcing/sparking
 - C. Backdraft/flashover
 - D. Spontaneous ignition
- _____ 17. Which type of electrical heating occurs when the current flowing through a conductor exceeds its design limits? (130) [4.3.11]
- A. Arcing
 - B. Sparking
 - C. Friction heating
 - D. Overcurrent or overload
- _____ 18. What occurs when a gas is compressed? (130) [4.3.10, 4.3.11]
- A. Heat is absorbed
 - B. Heat is generated
 - C. Gas becomes more buoyant
 - D. Gas becomes less conductive
- _____ 19. The transfer of heat through and between solids is known as: (131) [4.3.10, 4.3.11, 4.3.12]
- A. radiation.
 - B. convection.
 - C. conduction.
 - D. self-heating.
- _____ 20. In the fire environment, convection usually involves the transfer of heat through: (132) [4.3.11, 4.3.12]
- A. electromagnetic energy waves.
 - B. direct contact with a heat source.
 - C. intermittent contact with a heat source.
 - D. the movement of hot smoke and fire gases.

- _____ 21. Which heat transfer mechanism is dependent on several factors including the turbulence and velocity of moving gases? (132) [4.3.11, 4.3.12]
- A. Radiation
 - B. Reflection
 - C. Convection
 - D. Conduction
- _____ 22. By which mechanism of heat transfer does heat travel in a straight line at the speed of light, allowing heat to travel through vacuums and air spaces? (134) [4.3.11, 4.3.12]
- A. Radiation
 - B. Reflection
 - C. Convection
 - D. Conduction
- _____ 23. Heat that is radiated to the insulating air layer between PPE and your body: (135) [4.3.11, 4.3.12]
- A. can cause heat stress and failure of the PPE.
 - B. may cause spontaneous ignition of the PPE materials.
 - C. dissipates at a much quicker rate than convected heat.
 - D. is less dangerous than heat conducted to the outside of the PPE.
- _____ 24. A fuel's chemical content influences its heat release rate and its: (136) [4.3.11]
- A. convective flow.
 - B. physical attributes.
 - C. organic compounds.
 - D. heat of combustion.
- _____ 25. Gaseous fuels can be the most dangerous of all fuel types because they: (137) [4.3.10, 4.3.11]
- A. will sink and collect in low areas.
 - B. can quickly change into a liquid or a solid fuel.
 - C. are the most commonly encountered form of fuel.
 - D. are already in the physical state required for ignition.

- _____ 26. What will a liquid with a specific gravity of less than one do when combined with water? (138) [4.3.10]
- A. Sink
 - B. Float
 - C. Vaporize
 - D. Easily mix
- _____ 27. The minimum temperature at which a liquid gives off sufficient vapors to ignite, but not sustain combustion is its: (139) [4.3.10, 4.3.11]
- A. flash point.
 - B. vapor pressure.
 - C. specific gravity.
 - D. degree of solubility.
- _____ 28. What may occur if water is added to a burning liquid that is less dense than water? (139) [4.3.10]
- A. The fuel's rate of vaporization will decrease due to the increased water pressure.
 - B. The water may disperse the burning liquid instead of extinguishing it.
 - C. The liquid fuel may vaporize much more rapidly as it draws thermal energy from the water.
 - D. The water will mix with the burning liquid and become less effective at extinguishing the fire.
- _____ 29. When solid fuels are heated, they begin to _____ and release fuel gases and vapors. (139) [4.3.10, 4.3.11]
- A. melt
 - B. pyrolize
 - C. hypoxilize
 - D. evaporate
- _____ 30. Sawdust ignites more easily than a log because the sawdust has a higher: (140) [4.3.11]
- A. pyrolysis point.
 - B. surface-to-mass ratio.
 - C. fuel thickness proportion.
 - D. flammable (explosive) range.

- _____ 31. In most compartment fires, the energy release in fire is directly proportional to the: (140) [4.3.11]
- A. thermal conductivity of the fuel.
 - B. amount of fuel available for combustion.
 - C. ambient temperature of the environment.
 - D. amount of oxygen available for combustion.
- _____ 32. Materials that burn at normal oxygen levels will burn more intensely in _____ atmospheres. (143) [4.3.11]
- A. flaming
 - B. nonflaming
 - C. oxygen-enriched
 - D. oxygen-deficient
- _____ 33. Combustion can occur within a range of concentration of fuel vapor and air; this range is referred to as the: (143) [4.3.11]
- A. vapor pressure range.
 - B. surface to mass range.
 - C. flammable (explosive) range.
 - D. oxidation (combustion) range.
- _____ 34. How does the self-sustained chemical reaction influence the oxidation reaction in flaming combustion? (144) [4.3.11]
- A. Increases the speed of the oxidation reaction
 - B. Decreases the types of products of combustion released
 - C. Decreases the temperature required for the oxidation reaction
 - D. Increases the ratio of complete to incomplete combustion of fuel
- _____ 35. An extinguishing agent, such as dry chemical or Halon-replacement agent, terminates the combustion reaction by: (144) [4.3.11]
- A. cutting off the oxygen supply to the fuel.
 - B. interfering with the chemical chain reaction.
 - C. cooling the fuel below the ignition temperature.
 - D. reacting with the fuel to create a fire-resistant layer.
- _____ 36. Which statement describes the factor that MOST influences compartment fire development? (145) [4.3.11]
- A. Whether the fire is fuel-limited or ventilation-limited
 - B. Whether the fuel is cellulose-based or petroleum-based
 - C. Ratio of square footage to ceiling height of the compartment
 - D. Ambient temperature and wind speed outside the compartment

- _____ 37. Fires develop through four stages: Incipient, growth, _____, and decay. (146) [4.3.11]
- A. radiant
 - B. rollover
 - C. fully-developed
 - D. ventilation limited
- _____ 38. During the _____ stage of fire development, the three elements of the fire triangle come together and the combustion process begins. (146) [4.3.11]
- A. decay
 - B. growth
 - C. rollover
 - D. incipient
- _____ 39. Which statement describes a fire in the incipient stage? (146) [4.3.11]
- A. The fire consumes the available fuel and the heat release rate begins to decline.
 - B. The heat release rate of the fire has reached its peak because of lack of fuel or oxygen.
 - C. The temperature is only slightly above ambient in areas that the fire, plume, and ceiling jet directly affect.
 - D. The fire has grown large enough for compartment configuration and amount of ventilation to influence it.
- _____ 40. In a compartment fire, the interface between the hot gas layers and cooler layer of air is commonly referred to as the: (150) [4.3.11, 4.3.12]
- A. neutral plane.
 - B. no pressure zone.
 - C. zero balance plane.
 - D. neutral pressure interface.
- _____ 41. Which type of phenomenon occurs when the fire rapidly transitions from the growth stage to the fully developed stage? (153) [4.3.11]
- A. Flashover
 - B. Entrainment
 - C. Flame propagation
 - D. Spontaneous ignition

- _____ 42. What occurs during flashover? (154) [4.3.11]
- A. The heat release rate of the fire will reach its peak.
 - B. Flames propagate through the hot gas layer or across the ceiling.
 - C. The volume of burning gases can increase to fill the room's entire volume and extend out of any openings from the room.
 - D. The compartment will fill with black smoke and slowly cooling fuel gases; the compartment will show no visible flames.
- _____ 43. In a compartment fire, smoke flashover indicators include rapidly increasing volume, turbulence, optical density and: (155) [4.3.11]
- A. fuel load.
 - B. ventilation.
 - C. darkening color.
 - D. thermal properties.
- _____ 44. Observed from the exterior, a high neutral plane may indicate that the fire is in the early stages of development, or could indicate: (155) [4.3.11, 4.3.12]
- A. a fire in decay stage.
 - B. a fire above your level.
 - C. that the fire is reaching backdraft conditions.
 - D. that the compartment has not yet ventilated.
- _____ 45. In a ventilation-limited compartment fire that has a large volume of flammable gases, opening a door or window could result in: (156) [4.3.11]
- A. flashover.
 - B. backdraft.
 - C. piloted ignition.
 - D. spontaneous ignition.
- _____ 46. Which is an indicator for potential backdraft? (157) [4.3.11]
- A. Light, white smoke rising from the roof
 - B. Heavy black smoke from numerous open windows
 - C. Turbulent, dark smoke coming from the open front door
 - D. Pulsing smoke movement around small openings in the building

- _____ 47. The _____ stage of fire development occurs when the heat release rate of the fire has reached its peak. (157) [4.3.11]
- A. decay
 - B. growth
 - C. incipient
 - D. fully-developed
- _____ 48. A collapsed storage shed that is fully involved in flames would be an example of a: (157-158) [4.3.11]
- A. fire in the decay stage.
 - B. fire in the growth stage.
 - C. fully-developed fuel-limited fire.
 - D. fully-developed ventilation-limited fire.
- _____ 49. What is the likely result if additional air is allowed into an already-ventilated compartment fire? (158) [4.3.11]
- A. Lower neutral plane
 - B. Higher peak heat release rate
 - C. Reduced vapor pressure at the seat of the fire
 - D. Higher ratio of complete to incomplete combustion
- _____ 50. Which action will transition a compartment fire in a modern structure from ventilation-limited to fuel-limited? (158) [4.3.11]
- A. Extinguishing some of the fuel
 - B. Cooling the exterior of the compartment
 - C. Altering the flow paths within the structure
 - D. Making additional openings in the compartment
- _____ 51. A fire is said to be in the _____ stage when it runs out of either available fuel or available oxygen. (159) [4.3.11]
- A. decay
 - B. growth
 - C. incipient
 - D. fully-developed

- _____ 52. To ensure that the decay stage of a ventilation-limited fire is the fire's final stage, firefighters must provide a controlled transition of a fire in the decay stage from ventilation-limited to fuel-limited, by: (160) [4.3.11]
- A. carrying unburned fuel away from the compartment.
 - B. cooling the hot fire gases before further ventilation occurs.
 - C. protecting exposures until the fire consumes all available fuel.
 - D. restricting ventilation until the heat transfers out of the compartment.
- _____ 53. The flow path of a structure fire is comprised of two regions: the ambient air flow in and the: (161) [4.3.11]
- A. ceiling jet.
 - B. cool air subsidence.
 - C. ambient air flow out.
 - D. hot exhaust flow out.
- _____ 54. What factor helps determine the flow path in a structure fire? (161) [4.3.11]
- A. The stage of development of the fire
 - B. The nature and arrangement of the fuel
 - C. The floor plan and openings within the structure
 - D. The temperature reactions of the structure and its contents
- _____ 55. What will establish new flow paths between the fire compartment and exterior vents of the building? (162) [4.3.11]
- A. Fire gases pushing into compartments adjacent to the burning compartment
 - B. Rapid fire development from the growth stage into the fully developed stage
 - C. Firefighters applying water from the exterior through an existing opening in the structure
 - D. Firefighters advancing a hoseline through an open door or ventilating windows to make entry into a building

- _____ 56. Why must firefighters use tactics that control the oxygen available to the fire when they advance a hoseline through a door or ventilate windows? (162) [4.3.11]
- A. To maintain structural integrity
 - B. To prevent unwanted fire spread
 - C. To increase the pressure inside the compartment
 - D. To transition the fire to a ventilation-limited environment
- _____ 57. Firefighters working in the exhaust portion of the flow path will: (163) [4.3.11]
- A. see visibility improve as turbidity and airflow increases.
 - B. feel a decrease in temperature as air is entrained by the fire.
 - C. see waves of radiant heat emitting from the walls and ceiling.
 - D. feel the increase in temperature as the velocity and/or turbulence increases.
- _____ 58. What will occur if firefighters begin an attack on a ventilation-limited structure fire with ventilation alone? (163) [4.3.11]
- A. Hot gases will be pushed inward, toward the seat of the fire.
 - B. Visibility will improve, clearing path to the seat of the fire.
 - C. The fire's heat release rate and spread will progressively increase as additional vents are made.
 - D. The fire's heat release rate will decrease temporarily until the introduced air is heated to the fuel's ignition temperature.
- _____ 59. When a structural member such as a window, roof or doorway fails, introducing a new source of oxygen to a fire, _____ ventilation has occurred. (164) [4.3.11]
- A. natural
 - B. passive
 - C. elemental
 - D. unplanned

- _____ 60. Which statement about ventilation and wind considerations is MOST accurate? (164) [4.3.11]
- A. The source of new oxygen always originates from outside the building.
 - B. Unplanned ventilation is most likely to occur in structures undergoing construction or renovation.
 - C. Wind can increase the pressure inside the structure, driving smoke and flames into unburned portions of the structure and onto advancing firefighters.
 - D. Unplanned ventilation occurs when an occupant or bystander interferes with coordinated fireground activities and introduces a new source of oxygen to the fire.
- _____ 61. What occurs when a mixture of unburned fuel gases and oxygen come in contact with an ignition source? (165) [4.3.11]
- A. Flashover
 - B. Smoke explosion
 - C. Radiant combustion
 - D. Spontaneous ignition
- _____ 62. Which means of influencing fire dynamics is typically a tactic in wildland fires or liquid and gas fires? (165) [4.3.11]
- A. Fuel removal
 - B. Oxygen exclusion
 - C. Temperature reduction
 - D. Chemical flame inhibition
- _____ 63. Using extinguishing agents other than water and foam to interrupt the combustion reaction is referred to as: (165) [4.3.11]
- A. fuel removal.
 - B. oxygen exclusion.
 - C. temperature reduction.
 - D. chemical flame inhibition.

- _____ 64. Most building codes rate construction types according to: (165) [4.3.11]
- A. the size, type, and capability of fire suppression systems.
 - B. the ratio of the typical number of occupants to the number of egress points.
 - C. the size of each compartment relative to the total square footage of the structure.
 - D. how long each construction type maintains its structural integrity over a certain period of time.
- _____ 65. What provides the best indicators of structural integrity? (167) [4.3.11]
- A. Occupancy classification
 - B. Year and method of construction
 - C. Information gathered at the scene
 - D. Occupant interview during the preincident survey
- _____ 66. What is often the most readily available fuel source and significantly influences fire development in a compartment fire? (167) [4.3.11]
- A. Exterior wall coverings
 - B. Combustible roof materials
 - C. Contents within the structure
 - D. Window, wall, and floor coverings
- _____ 67. What is the most effective means of establishing awareness of hazards in commercial, industrial, and storage facilities with large fuel loads? (168) [4.3.10, 4.3.11]
- A. Studying plat maps and building plans
 - B. Accessing code enforcement databases
 - C. Performing and updating preincident surveys
 - D. Contacting the facilities manager during the incident
- _____ 68. In addition to structural members, what can be a significant factor influencing fire spread and loss of lives in fires? (169) [4.3.11]
- A. Combustible exterior wall coverings
 - B. Free radicals released during combustion
 - C. Combustible interior finishes and furnishings
 - D. Gases heavier than air that collect in the lower levels

- _____ 69. A compartment is any: (170)
- A. enclosed space within a building.
 - B. space divided into separate areas.
 - C. open space with no complete fire barrier dividing it.
 - D. bay, cell, chamber, vault or cubicle within a building.
- _____ 70. What construction features tend to contain fires for a longer period of time, thus creating fuel-rich, ventilation-limited environments? (172) [4.3.10, 4.3.11]
- A. Energy-efficient designs
 - B. High ceilings and atriums
 - C. Heat-reflective wall treatments
 - D. Tile, stone, and concrete flooring
- _____ 71. Which statement BEST describes a fire in a large compartment or a compartment with a high ceiling? (173) [4.3.10, 4.3.11]
- A. The fire will normally develop more rapidly than one in a small compartment.
 - B. Lack of ventilation becomes the limiting factor more quickly in a large compartment than it would in a smaller compartment.
 - C. Open plan commercial structures have limited fuel loads and numerous physical barriers to prevent the spread of fire and smoke in the space.
 - D. In structures with high ceilings, a large volume of hot smoke and fire gases can accumulate at the ceiling level, while conditions at floor level remain relatively unchanged.
- _____ 72. Fire spreading from a wall to a nearby couch due to radiant heat transfer is an example of: (174) [4.3.11]
- A. insulation.
 - B. conduction.
 - C. heat reflectivity.
 - D. heat conductivity.

-
- _____ 73. The use of engineered or lightweight construction and trussed support systems pose a danger to firefighters because engineered trusses: (174) [4.3.10]
- A. can fail after 5 to 10 minutes of exposure to fire.
 - B. are not required to meet any special building code requirements.
 - C. add more to the fuel load of a fire than natural building materials do.
 - D. obstruct the ability to identify dangerous building conditions from the exterior.
- _____ 74. Where might firefighters be MOST likely to encounter inoperative standpipes and sprinkler systems? (175) [4.3.10]
- A. Buildings under demolition
 - B. Open-plan commercial structures
 - C. Residential structures built prior to 1990
 - D. Structures at the wildland/urban interface
- _____ 75. Which type of buildings are subject to rapid fire spread because many of the protective features such as gypsum wallboard and automatic fire suppression systems are not in place? (175) [4.3.10, 4.3.11]
- A. Buildings under construction
 - B. Buildings at the wildland/urban interface
 - C. Buildings with a bowstring truss roof design
 - D. Commercial buildings constructed prior to 1990