

# Fire Behavior

## Workbook Activities

The following activities have been designed to help you. Your instructor may require you to complete some or all of these activities as a regular part of your fire fighter training program. You are encouraged to complete any activity that your instructor does not assign to you, as a way to enhance your learning in the classroom.

## Chapter Review

The following exercises provide an opportunity to refresh your knowledge of this chapter.

### Matching

Match each of the terms in the left column to the appropriate definition in the right column.

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|-------------------------------|---|
| _____ 1. Endothermic          | A. The process of transferring heat through matter by movement of the kinetic energy from one particle to another   |
| _____ 2. Gas                  | B. The column of hot gases, flames, and smoke rising above a fire; also called convection column, thermal updraft, or thermal column  |
| _____ 3. Decay                | C. One of the three states of matter  |
| _____ 4. Oxidation            | D. Transfer of heat through the emission of energy in the form of invisible waves   |
| _____ 5. Conduction           | E. The process in which oxygen combines chemically with another substance to create a new compound  |
| _____ 6. Radiation            | F. The stage of fire where the fire is running out of fuel or oxygen  |
| _____ 7. Plume                | G. Reactions that absorb heat or require heat to be added   |
| _____ 8. Convection           | H. Heat transfer by circulation within a medium such as a gas or a liquid   |
| _____ 9. Nuclear fission      | I. A state of inadequate oxygenation of the blood and tissue  |
| _____ 10. Hypoxia             | J. Created by splitting the nucleus of an atom  |
| _____ 11. Flash point         | K. A fire in an enclosed building that is restricted because there is insufficient oxygen available for the fire to burn as rapidly as it would with an unlimited supply of oxygen                              |
| _____ 12. Heat flux           | L. The measure of the rate of heat transfer from one surface to another   |
| _____ 13. Incipient stage     | M. A violent release of confined energy that occurs when a mixture of flammable gases and oxygen, usually in a void or other area separate from the fire compartment, come in contact with a source of ignition |
| _____ 14. Smoke explosion     | N. The lowest temperature at which a liquid produces a flammable vapor  |
| _____ 15. Ventilation limited | O. The stage of fire development where the fire has not progressed beyond a size that can be extinguished with a portable fire extinguisher   |

## Multiple Choice

Read each item carefully, and then select the best response.

- \_\_\_\_\_ 1. A thin piece of wood burns quickly due to its
- A. mass.
  - B. composition.
  - C. weight-to-mass ratio.
  - D. large surface area.
- \_\_\_\_\_ 2. Which class of fires involves ordinary combustibles such as wood?
- A. Class A fires
  - B. Class B fires
  - C. Class C fires
  - D. Class D fires
- \_\_\_\_\_ 3. A high-volume, high-velocity, turbulent, ultra-dense black smoke that may exist in a structure fire is known as
- A. wet smoke.
  - B. temperature-enriched smoke.
  - C. liquid fire.
  - D. black fire.
- \_\_\_\_\_ 4. A very rapid chemical process that combines oxygen with another substance and results in the release of heat and light is called
- A. oxidization.
  - B. combustion.
  - C. pyrolysis.
  - D. decomposition.
- \_\_\_\_\_ 5. Which class of fires involves flammable or combustible liquids such as gasoline?
- A. Class A fires
  - B. Class B fires
  - C. Class C fires
  - D. Class D fires
- \_\_\_\_\_ 6. The initial growth of a fire is largely dependent on
- A. the type of fuel.
  - B. the amount of fuel being pyrolyzed into vapor.
  - C. thermal layering.
  - D. A and B.
- \_\_\_\_\_ 7. The movement of heat through a fluid medium such as air or a liquid is
- A. convection.
  - B. endothermic.
  - C. exothermic.
  - D. conduction.
- \_\_\_\_\_ 8. The phenomenon of gases forming into layers according to temperature is called
- A. thermal differentiation.
  - B. thermal division.
  - C. thermal layering.
  - D. thermal balance.

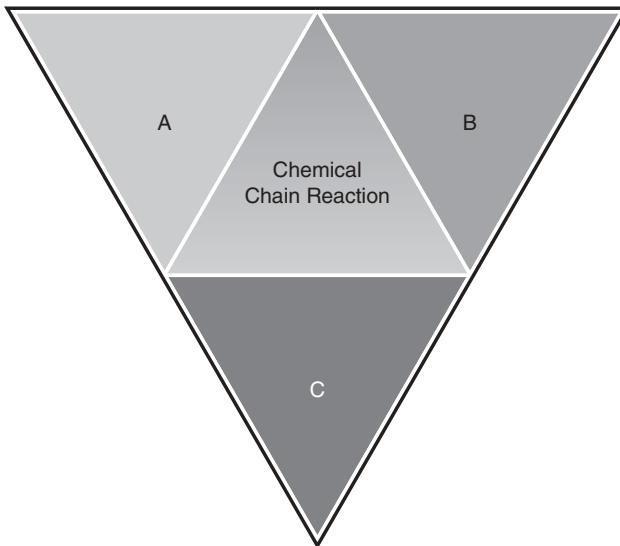
- \_\_\_\_\_ 9. The lowest temperature at which a liquid produces a flammable vapor is the
- flame point.
  - fire point.
  - ignition temperature.
  - flash point.
- \_\_\_\_\_ 10. In which stage of the fire does hot smoke and gases start to rise because of heating and becoming lighter?
- Ignition stage
  - Growth stage
  - Fully developed stage
  - Decay stage
- \_\_\_\_\_ 11. Which class of fires involves combustible metals?
- Class A fires
  - Class B fires
  - Class C fires
  - Class D fires
- \_\_\_\_\_ 12. Incomplete combustion produces
- pure air.
  - solids.
  - smoke.
  - oxidizers.
- \_\_\_\_\_ 13. The weight of a gaseous fuel is the
- gas mass.
  - vapor density.
  - explosive limit.
  - BLEVE.
- \_\_\_\_\_ 14. When reading smoke, the smoke density is an indication of
- where the fire is traveling.
  - the amount of moisture in the smoke.
  - how much fuel is in the smoke.
  - None of the above.
- \_\_\_\_\_ 15. The transfer of heat energy in the form of invisible waves is called
- radiation.
  - oxidization.
  - volatility.
  - transpiration.
- \_\_\_\_\_ 16. The four conditions that must be present for fire to take place are represented in the
- fire tetrahedron.
  - fire square.
  - fire triangle.
  - fire rectangle.
- \_\_\_\_\_ 17. Particles, vapors, and gases are the three major components of
- fumes.
  - silt.
  - smoke.
  - exhaust.
- \_\_\_\_\_ 18. The key to preventing a BLEVE is to
- flush the spill.
  - ventilate the area.
  - cool the top of the tank.
  - apply an oxidizing agent.

- \_\_\_\_\_ 19. A fire requires fuel that is in the form of
- A. combustible vapors.
  - B. solid.
  - C. liquid.
  - D. particles.
- \_\_\_\_\_ 20. The range of gas-air mixtures that will burn varies
- A. from one fuel to another.
  - B. with the amount of energy present.
  - C. with the vapor pressure.
  - D. with the vapor density.

## Labeling

Label the following diagram with the correct terms.

1. The fire tetrahedron



## Vocabulary

Define the following terms using the space provided.

1. Lower explosive limit:

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2. Ignition temperature:

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3. Flash point:

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4. BLEVE:

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5. Thermal layering:

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6. Fire triangle:

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7. Flashover:

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8. Fully developed stage:

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9. Roll-over:

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10. Smoke explosion:

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## Fill-In

Read each item carefully, and then complete the statement by filling in the missing word(s).

1. A fire involving a liquid fuel can be extinguished by shutting off the \_\_\_\_\_ of fuel, or using \_\_\_\_\_ to exclude oxygen from the fuel.
2. Carbon \_\_\_\_\_ is deadly in small quantities.
3. Research indicates that fires in modern residential occupancies are likely to enter a \_\_\_\_\_ decay stage prior to the arrival of the first engine company.
4. For a fuel to burn, it must be changed into a \_\_\_\_\_.
5. Because smoke is the product of incomplete combustion and contains unburned hydrocarbons, we need to remember that it is a form of \_\_\_\_\_.
6. When hot fire gases are exhausted from a fire building, if they are above the \_\_\_\_\_ of the gases, they may ignite upon mixing with a fresh supply of oxygen.
7. Matter exists in three states: \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
8. \_\_\_\_\_ is a high-volume, high-density, high-velocity, turbulent, ultra-dense black smoke.
9. The amount of liquid that is vaporized when it is heated relates to the \_\_\_\_\_ of the liquid.
10. Reactions that produce heat are referred to as \_\_\_\_\_ reactions.

## True/False

If you believe the statement to be more true than false, write the letter "T" in the space provided. If you believe the statement to be more false than true, write the letter "F."

1. \_\_\_\_\_ The size and shape of the fuel will greatly impact the ability of the fuel to ignite.
2. \_\_\_\_\_ A roll-over is when smoke traveling some distance from the fire comes in contact with a source of ignition, often in a violent manner.
3. \_\_\_\_\_ Flashover is a slow change or transition from the growth stage to the fully developed stage.
4. \_\_\_\_\_ A column of hot black smoke coming into contact with an adequate supply of oxygen and an ignition source can ignite suddenly and violently.
5. \_\_\_\_\_ The flash point is the lowest temperature at which a liquid produces enough vapor to sustain a continuous fire.
6. \_\_\_\_\_ A backdraft can occur when oxygen is introduced into a closed, superheated room.
7. \_\_\_\_\_ The three basic ingredients required to create a fire are fuel, oxygen, and air.
8. \_\_\_\_\_ Gas has neither independent shape nor volume and tends to expand indefinitely.
9. \_\_\_\_\_ A smoke explosion usually occurs when a mixture of flammable gases and oxygen are present in the fire compartment.
10. \_\_\_\_\_ Mechanical, electrical, and chemical energy can be converted to heat.

## Short Answer

Complete this section with short written answers using the space provided.

1. List the four key attributes of smoke that must be considered when reading smoke.

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2. Explain how the color of smoke may provide an indication as to the location of the fire.

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3. Explain how the widespread use of plastics in modern structures has affected fire behavior.

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4. Identify the four basic methods of extinguishing fires.

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## Fire Alarms

The following real case scenarios will give you an opportunity to explore the concerns associated with fire behavior. Read each scenario, and then answer each question in detail.

1. It is 3:00 in the afternoon when your engine company is dispatched to a kitchen fire in a multifamily condominium unit. You and your Lieutenant enter the unit, and it appears that the kitchen has flashed over. You are on the nozzle, and your Lieutenant tells you this is a hot fire and not to disrupt the thermal balance. How should you proceed?

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2. Your engine company is dispatched to a two-story, single-family home in a newer development. Upon arrival, you find there is no flame visible and the window glass is smoke-stained with a lot of heat inside. Upon investigation, you see smoke emanating under pressure from cracks. The smoke is puffing and being drawn back as if it were breathing. How should you proceed?

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