PE

fire protection

practice exam
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About NCEES
NCEES is a nonprofit organization made up of the U.S. engineering and surveying licensing boards in all 50 states, the U.S. territories, and the District of Columbia. We develop and score the exams used for engineering and surveying licensure in the United States. NCEES also promotes professional mobility through its services for licensees and its member boards.

Engineering licensure in the United States is regulated by licensing boards in each state and territory. These boards set and maintain the standards that protect the public they serve. As a result, licensing requirements and procedures vary by jurisdiction, so stay in touch with your board (ncees.org/licensing-boards).

Exam Format
Beginning in October 2020, the PE Fire Protection exam will be computer-based. It will contain 85 questions and be administered one day per year via computer at approved Pearson VUE test centers. A 9.5-hour appointment time includes a nondisclosure agreement, a tutorial, the exam, and a break. You’ll have 8.5 hours to complete the actual exam.

In addition to traditional multiple-choice questions with one correct answer, the PE Fire Protection exam will use common alternative item types such as
• Multiple correct options—allows multiple choices to be correct
• Point and click—requires examinees to click on part of a graphic to answer
• Drag and drop—requires examinees to click on and drag items to match, sort, rank, or label
• Fill in the blank—provides a space for examinees to enter a response to the question

To familiarize yourself with the format, style, and navigation of a computer-based exam, view the demo on ncees.org/ExamPrep.

Examinee Guide
The NCEES Examinee Guide is the official guide to policies and procedures for all NCEES exams. During exam registration and again on exam day, examinees must agree to abide by the conditions in the Examinee Guide, which includes the CBT Examinee Rules and Agreement. You can download the Examinee Guide at ncees.org/exams. It is your responsibility to make sure you have the current version.

Scoring and reporting
Results for computer-based exams are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account. All results are reported as pass or fail.

Updates on exam content and procedures
Visit us at ncees.org/exams for updates on everything exam-related, including specifications, exam-day policies, scoring, and corrections to published exam preparation materials. This is also where you will register for the exam and find additional steps you should follow in your state to be approved for the exam.
11. Which of the following would be acceptable to store in an area protected by a sprinkler system designed for Group IV commodities?

Select all that apply.

- □ A. Beer
- □ B. Candles
- □ C. PVC pipe
- □ D. Small arms ammunition
- □ E. Furniture with foam plastic cushioning
- □ F. Milk containers in plastic crates

12. What are the disadvantages of specification codes?

- I. They potentially protect only against events of a type that have occurred in the past.
- II. They require more expertise to apply and review than do performance-based designs.
- III. Major fires are low-probability, high-consequence events. Because of their stochastic nature, some types of rare events have not yet occurred.
- IV. They potentially stifle innovation. Specifying certain types of methods and materials can make it difficult to introduce new methods and materials into the marketplace.

- ○ A. I, II, III only
- ○ B. II, III, IV only
- ○ C. I, III only
- ○ D. I, III, IV only

13. A test engineer is setting up a set of fire tests for a polyurethane chair using a cone calorimeter. The engineer's supervisor asks about the data the cone calorimeter can produce. Which of the following is not applicable to the data from the cone calorimeter?

- ○ A. Average mass loss rate
- ○ B. Height of flame
- ○ C. Peak heat release rate
- ○ D. Time to flameout
25. Given the balanced reaction equation of methanol, \(2 \text{CH}_3\text{OH} + 3\text{O}_2 = 2\text{CO}_2 + 4\text{H}_2\text{O}\), the calculated heat of combustion \(\Delta H_c \text{ (kJ/mol)}\) is most nearly:

- A. –1,270
- B. –1,446
- C. –2,018
- D. –2,194

26. Propane, \(\text{C}_3\text{H}_8\), burns in air to yield water, carbon dioxide, and nitrogen. Assume complete combustion of propane. The corresponding number of moles of \(\text{N}_2\) for a balanced reaction is most nearly:

- A. 37
- B. 19
- C. 10
- D. 5

27. Assuming a consistent fuel package, place the following fire scenarios in which they would yield the greatest smoke production in ascending order.

<table>
<thead>
<tr>
<th>SMOKES PRODUCTION</th>
<th>FIRE SCENARIOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEAST</td>
<td>BYSYMETRIC</td>
</tr>
<tr>
<td>GREATEST</td>
<td>CORNER (TWO WALLS INTERSECTING AT A 90° ANGLE)</td>
</tr>
<tr>
<td></td>
<td>SINGLE WALL</td>
</tr>
</tbody>
</table>
57. A fire alarm notification horn is mounted at the center of a room's ceiling. The ceiling is 8.5 m high. What is the sound pressure level (dBa) for a 1.5-m-tall person standing 8 m off-center from a 95-dBa-rated speaker?

- A. 67.3
- B. 68.4
- C. 69.3
- D. 70.4

58. Match the spot-type smoke detector spacing based on the air changes per hour.

<table>
<thead>
<tr>
<th>SPACING (ft²)</th>
<th>AIR CHANGES PER HOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>10</td>
</tr>
<tr>
<td>250</td>
<td>15</td>
</tr>
<tr>
<td>500</td>
<td>30</td>
</tr>
<tr>
<td>750</td>
<td>60</td>
</tr>
</tbody>
</table>
68. Which of the following occupancies require smoke barriers?
   
   Select all that apply.
   
   □ A. Existing health care occupancies on floors with 31 or more inpatient sleeping
   □ B. Existing ambulatory health care occupancies where the area is less than 5,000 ft²
   □ C. New detention and correctional occupancies on any story not used for resident sleeping where the occupant load is ≥ 50
   □ D. Every floor of new health care occupancies
   □ E. Every floor of new high-rise hotel occupancies

69. Which of the following methods may be used to determine the fire-resistance rating of a steel structural member?

   1. Conduct a standard test.
   2. Conduct a special experiment.
   3. Apply an analytical technique.

   ○ A. 1, 2, 3
   ○ B. 1 only
   ○ C. 3 only
   ○ D. 1, 3 only
8. According to the table provided, continuous accumulation and frequent cleaning to keep accumulation below 1/16th in. leads to Class II, Division 2 electrical equipment.

THE CORRECT ANSWER IS: D

9. At 1,250 gpm, the available pressure is 82 psi.

$$\frac{82 \text{ psi}}{110\%} = 74 \text{ psi}$$

THE CORRECT ANSWER IS: B


Class I through IV commodities are based on the assumption that they are stored on wood pallets. When reinforced polypropylene plastic pallets are used, the classification of the commodity unit is increased two commodity classes. Since paper and cardboard are Class III commodities and are being stored on reinforced polypropylene plastic pallets, the classification of the commodity unit is increased two classes to Group A Plastic.

THE CORRECT ANSWER IS: D


Beer, PVC pipe, and small arms ammunition are all acceptable to store in an area designed for Group IV commodities. However, only small arms ammunition is explicitly a Group IV commodity. Beer is either a Group I or a Group II, depending upon packaging, and PVC pipe is a Group III commodity.

THE CORRECT ANSWERS ARE: A, C, D
12. Specification codes have the following disadvantages:

They potentially protect only against events of a type that have occurred in the past.

Major fires are low-probability, high-consequence events. Because of their stochastic nature, some types of rare events have not yet occurred.

They potentially stifle innovation. Specifying certain types of methods and materials can make it difficult to introduce new methods and materials into the marketplace.

The answer relies on common engineering knowledge and a basic understanding of the origin and development of codes.

THE CORRECT ANSWER IS: D

13. The height of a flame cannot be measured using a cone calorimeter. This can be derived by a review of the cone calorimeter apparatus or through familiarity with the test methodology.

THE CORRECT ANSWER IS: B

14. In identifying a design fire scenario that is severe but reasonable, the first challenge arises in identifying this as a balcony spill plume scenario.

The second challenge lies in identifying the correct equation to use based on the height of the smoke layer relative to selecting the correct equation and based on units of measurements given. In this problem the height of the smoke layer is less than 50 ft, making NFPA 92, *Standard for Smoke Control Systems*, Equation 5.5.2.1.a the correct equation to apply. Equations 5.5.2.1.b (SI units), 5.5.2.8.a (a height of the smoke layer over 50 feet), and 5.5.2.8.b (SI units and height of the smoke layer over 50 ft) are incorrect equations.

The third challenge is selecting the correct height between the underside of the balcony above the fire and the corresponding distance to the smoke layer interface height. Since this is a balcony spill scenario, the height (H) will be the floor-to-floor height. The underside of the balcony to the smoke layer interface (Z_b) will measure from the third floor (this floor is the underside of the balcony above the fire on the second floor) to the smoke layer interface.

THE CORRECT ANSWER IS: B

15. NFPA 13, *Standard for the Installation of Sprinkler Systems*, Section 5.6, correctly identifies gypsum board as a Class I commodity and oil-based paint in a metal container as a Class IV commodity. All requirements of 5.6.1.2.3 must be met. The facility does not meet subsection (2).

THE CORRECT ANSWER IS: A
24. The heat release rate can be determined using the power law relationship noted in the Fire Growth and Heat Release Rates section in the *PE Fire Protection Reference Handbook*.

\[
Q = \left( \frac{1.055}{t_g^p} \right) t^p
\]

\( t_g = 350 \text{ s} \)

\( p = 2 \) (for \( t^2 \) fire)

\( t = 180 \text{ s} \)

\[
Q = \left( \frac{1.055}{350^2} \right) (180^2) = 279 \text{ kW}
\]

**THE CORRECT ANSWER IS: C**

25. \( \Sigma \Delta H_f \) (Products) – \( \Sigma \Delta H_f \) (Reactants) = –1,446 kJ/mol

Heat of combustion can be calculated by subtracting the summation of heats of formation of the reactants from the summation of heats of formation of the products, as shown: \( \Delta H_c = \Sigma \Delta H_f \) (Products) – \( \Sigma \Delta H_f \) (Reactants). Heats of formation can be found in the Fire Dynamics Fundamentals chapter in the *PE Fire Protection Reference Handbook*.

\[
\Sigma \Delta H_f \text{ (Products)} = 2\text{CO}_2 + 4\text{H}_2\text{O} = 2(-393.52) + 4(-285.8) = -1930.24 \text{ kJ/mol}
\]

\[
\Sigma \Delta H_f \text{ (Reactants)} = 2\text{CH}_3\text{OH} + 3\text{O}_2 = 2(-242.1) + 3(0) = -484.2 \text{ kJ/mol}
\]

A value of 0 is used for \( \text{O}_2 \) since the calculation is for heat of combustion for methanol.

**THE CORRECT ANSWER IS: B**

26. Air is represented as \((\text{O}_2 + 3.76 \text{N}_2)\). The reaction is \(\text{C}_3\text{H}_8 + \_\text{O}_2 + 3.76 \text{N}_2 \rightarrow \_\text{H}_2\text{O} + \_\text{CO}_2 + \_\text{N}_2\). The reaction requires 10 \text{O} to balance, or 5 \text{O}_2, so the answer is \(5 \times 3.76 = 18.8 \sim 19\).

**THE CORRECT ANSWER IS: B**
27. Smoke production is a function of air entrainment. As such, a corner plume entrains air from one fourth of its perimeter; along a wall, one half of its perimeter; axisymmetric, the entire perimeter.

THE CORRECT ANSWERS ARE SHOWN ABOVE

28. Refer to the Plumes and Flames section in the *PE Fire Protection Reference Handbook*.

\[ \Delta T_0 = 9.1 \left( \frac{T_\infty}{g c_p \rho_\infty^2} \right)^{1/3} \dot{Q}_c^{2/3} \left( z - z_0 \right)^{-5/3} \]

\[ \dot{Q}_c = 0.70 \dot{Q} = 0.70 \times 3000 \text{ kW} = 2100 \text{ kW} \]
\[ z_0 = 0.5 \text{ m}, \quad Z = 6 \text{ m} \]

\[ g = 9.81 \text{ m/s}^2 \]
\[ c_p = 1.00 \text{ kJ/kgK} \]
\[ \rho_\infty = 1.2 \text{ kg/m}^3 \]
\[ T_\infty = 293 \text{ K} \text{ (for normal atmospheric conditions)} \]

\[ \Delta T = 25.0 \text{ Km}^{5/3} \text{ kW}^{-2/3} \left( (2100 \text{ kW})^{2/3} (6 - 0.5)^{-5/3} \right) = 25.0 \times (163.99) (0.058) \]
\[ \Delta T = 239 \text{ k} \]
\[ T = T_\infty + \Delta T = 293 \text{ k} + 239 \text{ k} = 532 \text{ k} \]

THE CORRECT ANSWER IS: C
57. Refer to the Audibility Design section in the *PE Fire Protection Reference Handbook*.

\[
L_p = L_w + C_1 + C_2
\]
\[
L_p = 95 \text{ dBA} + 5 + (-31.6)
\]
\[
L_p = 68.4 \text{ dBA}
\]

C₁ is for a horn located not within 1 m of wall.

C₂ is for the distance obtained by Pythagorean theorem using and interpolating between 6 and 12 m distance.

\[
\begin{align*}
10.6 \text{ m} & \\
7 \text{ m} & \\
8 \text{ m} & 
\end{align*}
\]

THE CORRECT ANSWER IS: B

58. Refer to NFPA 72, *National Fire Alarm Code*, 2016 ed., Table 17.7.6.3.3.2

<table>
<thead>
<tr>
<th>SPACING (ft²)</th>
<th>125</th>
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<td>60</td>
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<td>15</td>
<td>10</td>
<td></td>
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</tbody>
</table>

THE CORRECT ANSWERS ARE SHOWN ABOVE.


\[
A_e = \frac{(30,000 \text{ ft}^3/\text{min})}{(200 \text{ ft/min})} = 150 \text{ ft}^2
\]

THE CORRECT ANSWER IS: C
66. Refer to the Timber/Wood section in the *PE Fire Protection Reference Handbook*.

The following times are calculated:

   A) 40 min
   B) 5 + 15 = 20 min
   C) 20 + 15 = 35 min
   D) 35 min (sep. item in table)

So A provides the greatest fire-resistance rating.

**THE CORRECT ANSWER IS: A**

67. Refer to the table provided.

   Type I (4, 4, 3) does not exist.
   Type I (4, 4, 2) → Roof assembly and column ratings aren't met.
   Type I (3, 3, 2) → Roof assembly rating not met.
   Next is II (2, 2, 2) and it meets, or exceeds, all ratings.

**THE CORRECT ANSWER IS: D**


**THE CORRECT ANSWERS ARE: A, C**

69. All three methods are acceptable.

**THE CORRECT ANSWER IS: A**

70. Refer to NFPA 101, *Life Safety Code*, 2018 ed., Section 7.2.2.5.2 and Section 7.2.2.6.3.

**THE CORRECT ANSWER IS: C**


3/4 hr

**THE CORRECT ANSWER IS: C**