PE
architectural engineering
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**

The PE Architectural Engineering exam is computer-based. It contains 85 questions and is administered one day a year via computer at approved Pearson VUE test centers. A 9.5-hour appointment time includes 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 Architectural Engineering exam uses 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.
3. You have 15 ft of distance between a building's exterior wall and the nearest property line. If your town has a sound ordinance of 55 dBA at the property line, which of the following levels from published equipment sound data represents the loudest condensing unit that can be installed?

- A. 54 dBA at 10 ft
- B. 62 dBA at 3 ft
- C. 65 dBA at 3 ft
- D. 68 dBA at 10 ft

4. An emergency generator is required for a project. The emergency generator and associated equipment are installed inside a building in a room not directly located near an exterior wall. Per NFPA 101, what are the requirements for the generator and for the room housing the generator?

Select the four that apply.

- A. The generator room must be separated from the rest of the building by fire barriers with a minimum of 1-hour fire resistance rating.
- B. The stair shaft and vestibule must be permitted to include a standby generator that is installed for the smokeproof enclosure mechanical ventilation equipment.
- C. The stair shaft and vestibule must not be permitted to include a standby generator that is installed for the smokeproof enclosure mechanical ventilation equipment.
- D. The generator room must have at least one exterior wall to provide direct ventilation from outside.
- E. Where a building is equipped with an emergency generator, a sequencing of electrical service is required, such as emergency generators and charts of all areas illuminated during power outages.
- F. The standby generator shall not be used for the stair shaft and vestibule emergency lighting power supply.
- G. The standby generator shall be permitted to be used for the stair shaft and vestibule emergency lighting power supply.
9. In the partial plan shown, assume smooth, flat ceilings throughout. The minimum number of smoke detectors required for door release service for the group doorway is ___________.

Enter your response in the blank.

10. A hydraulically calculated wet pipe sprinkler system is being installed in a two-story building with 30,000 ft² on each floor. The building is light hazard occupancy, noncombustible construction. The minimum number sprinkler system risers and standard sprinklers needed for the building is:

- [ ] A. one riser, 135 sprinklers
- [ ] B. one riser, 270 sprinklers
- [ ] C. two risers, 270 sprinklers
- [ ] D. two risers, 300 sprinklers
43. The figure shows the pump curve for a unit that is controlled by a variable frequency drive (VFD) and designed for operation at 150 gpm and 85 ft of head. Mark the impeller diameter and motor hp that will provide the least installation cost and best accommodate possible fluctuations in the system dynamics due to installation variability.

44. A geothermal heat pump system operates with an average COP of 5.8 in the summertime to provide 5 tons of cooling to a building. The average electric power input (kW) to the compressor is most nearly:

- A. 0.5
- B. 2.5
- C. 3.0
- D. 10.3
55. An air-handling unit (AHU) is serving a series of rooms with a total combined cooling load of 25 tons. The AHU transition to the main supply duct has a 40-ft equivalent length for pressure drop calculations. The main supply line has a total straight run length of 150 ft, and the few bends to just after the first takeoff point add another 100 ft of equivalent length to the total. A pressure sensor is to be located at the first takeoff point that will control the fan speed, and the basis of design is set up to assume that the pressure drop from the supply fan discharge to the sensor location does not exceed 0.5 in. of water. Use 400 cfm/ton of cooling. The recommended duct size (in.) (equivalent diameter of regular duct is selected) for this initial part of the supply duct to meet the pressure requirement is most nearly:

- A. 9
- B. 24
- C. 28
- D. 30
56. Match each symbol to its correct position on the primary secondary pumping diagram. Not all symbols will be used and some symbols may be used more than once.

![Diagram with symbols]

Symbols

- [VFD] PUMP WITH VFD
- [VFD] PUMP WITH VFD
- [MS] PUMP WITH STARTER
- [MS] PUMP WITH STARTER

COIL

CHILLER

CHILLER
82. Which of the following are tools you can use for quality control following the completion of the bidding process?

Select the three that apply.

- □ A. Addenda
- □ B. On-site inspections
- □ C. Progress reports
- □ D. Schematic narrative
- □ E. Submittal review

83. Your firm has been hired by the owner's architect to provide MEP designs for a two-story mixed-use commercial building. During the schematic design review meeting, the owner and architect decide they want to add a partial floor so that the building is three stories in one section and two stories elsewhere. Which of the following should your firm expect to be issued?

- ○ A. Architect's supplemental instruction (ASI)
- ○ B. Application and certificate for payment
- ○ C. Contract amendment
- ○ D. Request for information (RFI)
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The 2-hour rated separation can be reduced between the day care and assembly because the building has an approved automatic fire sprinkler system.

The 2-hour rated separation is required between the day care and health-care occupancy. Reducing the rating due to an approved sprinkler system is not allowed for separation with health-care occupancies.

Two-hour rated separation is required between the assembly and health-care occupancy. Reducing the rating due to an approved sprinkler system is not allowed for separation with health-care occupancies.

THE CORRECT ANSWERS ARE: A, D, and E

2. The IBC requires that any new electrical work (equipment or wiring) as part of the work area in an alteration must comply with the enforced National Electrical Code. As such, the distribution and branch circuiting being replaced must comply with NFPA 70, National Electrical Code® (NEC®).

Option B per NFPA 70 700.5(D) dictates a separate ATS be provided for emergency loads, which include egress lighting and exit signs, while the other loads are categorized as optional standby. The additional ATS will necessarily require a separate panelboard and branch circuiting to support loads served from the emergency system ATS.

Option C per NFPA 70 700.8.

THE CORRECT ANSWERS ARE: B and C

3. The inverse square law for sound attenuation is used.

\[ dB_2 = dB_1 - 20 \log \left( \frac{d_2}{d_1} \right) \]

\( dB_1 \) = sound level of the source
\( dB_2 \) = sound at the property line
\( d_1 \) = distance at which usually sound data from equipment is measured (3 ft)
\( d_2 \) = distance to the property line

\[ dB_1 = 55 + 20 \log \left( \frac{15}{3} \right) = 68.98 \text{ dBA (maximum calculated)} \]

The loudest condensing unit that can be installed is with a sound level of 65 dBA at 3 ft.

THE CORRECT ANSWER IS: C
8. Based on the provided data at part load operation, the chiller has the lowest kW/ton at 25% load. The building load in October is 1,000 tons. The capacity of each chiller is 1,000 tons. At 25% chiller operation, its capacity is 250 tons. Thus, the most efficient operation for the system to meet the 1,000 tons building load is to operate four chillers at 25% load.

THE CORRECT ANSWER IS: D

9. Per NFPA 72, Section 17.7.5.6, the depth of the wall section above the doors is greater than 24 in. on one side of the doors and less than 24 in. on the other side of the doors. According to Figure 17.7.5.6.5.1(A), smoke detectors are only required on one side of the doors. The width of the group doorway is greater than 20 ft, and the distance between doors is less than 24 in., so Figure 17.7.5.6.5.3(C) applies. Therefore, a minimum of two smoke detectors are required for door release service for this group of doors.

THE CORRECT ANSWER IS: 2

10. NFPA 13, Chapter 4.5 and 10.2: The maximum floor area to be sprinklers supplied by any one sprinkler system riser on any one floor should be light hazard (52,000 ft²).

NFPA 13, Table 10.2.4.2: The maximum protection area for noncombustible construction is 225 ft²/sprinkler.

30,000 ft² on each floor < 52,000 ft² = one riser required

(30,000 ft² × two floors each)/225 ft²/sprinkler = 270 sprinklers

THE CORRECT ANSWER IS: B

11. According to IECC, Table C402.1.3, a roof with insulation entirely above the roof deck in a marine climate zone (IECC Climate Zone 4) location requires an R-value of 30 with continuous insulation.

Based on the insulation data provided, this would require three layers of 2-in.-thick insulation or 6 in. of continuous insulation.

THE CORRECT ANSWER IS: C
43. The motor hp is 7.5, so if the system curve changes for operation to the right of the current location, the motor will not be overloaded. The maximum impeller diameter is 9.75 in. At this impeller diameter the pump curve is completely below the 7.5 hp motor size.

44. 5 ton × 12,000 Btu/hr-ton / 5.8 = 10,345 Btu/hr electrical
    10,345 Btu/hr/3,413 Btu/hr/kW = 3 kW

    THE CORRECT ANSWER IS: C

45. To get 11,500 cfm, a fan with the same diameter would need to be rotated faster. Use fan affinity laws in the PE Architectural Reference Handbook.
    \[ N_2 = N_1 \times \frac{Q_2}{Q_1} = 850 \text{ rpm} \times \frac{11,500}{10,000} = 978 \text{ rpm (~980 rpm)} \]

    Use Equation 1.b for the same diameter fan and same air density.
    \[ P_2 = P_1 \times \left( \frac{N_2}{N_1} \right)^2 = 3 \text{ in. water} \times (978/850)^2 = 3 \times (1.15)^2 = 3.96 \text{ in. water (~4.0 in.)} \]

    THE CORRECT ANSWER IS: D
53. NFPA 13, 4.5.1—The maximum floor area to be protected by sprinklers supplied by any one sprinkler system riser on any one floor shall be light hazard (52,000 ft²).

NFPA 13, Table 10.2.4.2.1(a)—The maximum protection area for noncombustible construction shall be 225 ft²/sprinkler.

30,000 ft² each floor < 52,000 ft², one riser required.

\[(30,000 \text{ ft}^2 \times 2 \text{ floors each}) / 225 \text{ ft}^2/\text{sprinkler} = 270 \text{ sprinklers.}\]

**THE CORRECT ANSWER IS: B**

54. Based on the *PE Architectural Reference Handbook*, the new pump power would be:

\[Whp = Q\Delta h/(3,960 \eta) = 550 \times 55/(3,960 \times 0.78) = 9.79 \text{ hp (9.8 hp)}\]

**THE CORRECT ANSWER IS: C**

55. The total airflow required is 25 tons × 400 cfm/ton = 10,000 cfm.

The equivalent length from the fan discharge to the pressure sensor point is 40 + 150 + 100 = 290 ft.

To meet the pressure drop requirement, the friction loss (in. of water/100 ft) should be kept to 0.5 in./2.9 = 0.172

From the ASHRAE pressure loss diagram, at 10,000 cfm the duct equivalent diameter should be at least 30 in.

**THE CORRECT ANSWER IS: D**
56. Constant speed pumps flow through the chillers. Variable speed pumps flow through the secondary system.

57. See column "All Room Air Exhausted Directly to Outdoors (j)" and look down at the "Emergency department public waiting area" row. It shows all air is exhausted so there is no air to return.

THE CORRECT ANSWER IS: A

58. \[ 200 \times 50 \times 0.98 / (3,960 \times 0.6) = 4.12 \]

THE CORRECT ANSWER IS: C
79.

First

- Fire suppression
- Forced air ventilation
- Electrical distribution feeders
- Pressurized fluid distribution
- Safety and signaling

Last
- Communication

THE CORRECT ANSWERS ARE SHOWN ABOVE.

80. A request for information is initiated by the contractor as a way to formally ask a question and have a documented response from the design team.

THE CORRECT ANSWER IS: D

81. D is a textbook example of differing site conditions that may likely warrant a change order. But there are technical considerations that must be evaluated by the architect and engineer, and there are likely cost implications that the owner needs to evaluate before deciding how to proceed.

THE CORRECT ANSWER IS: D

82. On-site inspections and progress reports are used to track any issues during construction. A submittal review happens right after completion of the bidding process. All are used as quality control tools.

THE CORRECT ANSWERS ARE: B, C, and E

83. Contract amendment – there is a change in the scope of your firm’s work.

THE CORRECT ANSWER IS: C