PE
environmental practice exam
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 April 2019, the PE Environmental exam will be computer-based. It will contain 80 questions and be administered year-round via computer at approved Pearson VUE test centers. A 9-hour appointment time includes a tutorial, the exam, and a break. You’ll have 8 hours to complete the actual exam.

In addition to traditional multiple-choice questions with one correct answer, the PE Environmental 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.
NCEES Principles and Practice of Engineering Examination
ENVIRONMENTAL CBT Exam Specifications
Effective Beginning with the April 2019 Examinations

- The exam topics have not changed since April 2018 when they were originally published.
- The PE Environmental exam is computer-based. It is closed book with an electronic reference.
- Examinees have 9 hours to complete the exam, which contains 80 questions. The 9-hour time includes a tutorial and an optional scheduled break. Examinees work all questions.
- The exam uses both the International System of units (SI) and the U.S. Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.

<table>
<thead>
<tr>
<th>Number of Questions</th>
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<tbody>
<tr>
<td>1. Water</td>
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<tr>
<td>A. Principles</td>
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<tr>
<td>1. Hydraulics/fluid mechanics</td>
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<tr>
<td>2. Chemistry</td>
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<tr>
<td>3. Biology/microbiology</td>
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<tr>
<td>4. Fate and transport</td>
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<tr>
<td>5. Sampling and measurement methods</td>
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<tr>
<td>6. Hydrology/hydrogeology</td>
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<tr>
<td>7. Codes, standards, regulations, and guidelines</td>
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<tr>
<td>B. Wastewater</td>
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<tr>
<td>1. Sources of pollution and minimization/prevention</td>
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<tr>
<td>2. Treatment technologies and management</td>
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<tr>
<td>3. Collection systems</td>
</tr>
<tr>
<td>4. Residuals (sludge) management</td>
</tr>
<tr>
<td>5. Water reuse</td>
</tr>
<tr>
<td>C. Stormwater</td>
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<tr>
<td>1. Sources of pollution</td>
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<td>2. Treatment technologies and management</td>
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<td>3. Collection systems</td>
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<tr>
<td>D. Potable Water</td>
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<tr>
<td>1. Source water quality</td>
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<tr>
<td>2. Treatment technologies and management</td>
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<tr>
<td>3. Distribution systems</td>
</tr>
<tr>
<td>4. Residuals management (solid, liquid, and gas)</td>
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E. Water Resources 2–4
1. Sources of pollution
2. Watershed management and planning
3. Source supply and protection

2. Air 14–22
A. Principles 7–11
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2. Codes, standards, regulations, and guidelines
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B. Pollution Control 7–11
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2. Emissions characterization, calculations, and inventory
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3. Solid and Hazardous Waste 11–18
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2. Fate and transport
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4. Risk assessment
5. Sampling and measurement methods
6. Minimization, reduction, and recycling
7. Mass and energy balance
8. Hydrology, hydrogeology, and geology

B. Municipal and Industrial Solid Waste 4–6
1. Storage, collection, and transportation systems
2. Treatment and disposal technologies and management

C. Hazardous, Medical, and Radioactive Waste 2–4
1. Storage, collection, and transportation systems
2. Treatment and disposal technologies and management

4. Site Assessment and Remediation 12–19
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1. Codes, standards, regulations, and guidelines
2. Chemistry/biology
3. Hydrology/hydrogeology
4. Sampling and measurement methods

B. Applications 7–11
1. Site assessment and characterization
2. Risk assessment
3. Fate and transport
4. Remediation alternative identification
5. Remediation technologies and management
5. **Environmental Health and Safety** 7–11
   A. Principles 3–5
      1. Health and safety
      2. Security, emergency plans, and incident response procedures
      3. Codes, standards, regulations, and guidelines
   B. Applications 4–6
      1. Industrial hygiene
      2. Exposure assessments (e.g., chemical, biological, radiation, noise)
      3. Indoor air quality

6. **Associated Engineering Principles** 5–9
   A. Principles 2–4
      1. Statistics
      2. Sustainability
   B. Applications 3–5
      1. Engineering economics
      2. Project management
      3. Mass and energy balance
      4. Data management (e.g., GIS mapping, asset management, data visualization)
ENVIRONMENTAL PRACTICE EXAM
6. Shown below is a schematic diagram of a conventional wastewater treatment plant. Place the treatment plant components in their correct positions on the diagram.

![Diagram of a conventional wastewater treatment plant]

WASTWATER TREATMENT PLANT COMPONENTS

- Biological Aeration
- Disinfection
- Preliminary Treatment
- Primary Settling
- Recirculation
- Secondary Settling
- Sludge Thickening and Disposal

7. Assume a 12-in. concrete \((n = 0.013)\) trunk sewer has a slope of 0.004. The minimum depth (in.) required to maintain a self-cleansing velocity of 2 fps is:

- A. 4.5
- B. 7.0
- C. 8.4
- D. It is impossible to achieve a cleansing velocity at this slope.
33. Which of the following will control NOx formation for internal combustion engines?

Select all that apply.

□ A. A positive crankcase ventilation system
□ B. A three-way catalytic converter
□ C. An exhaust gas recirculation system
□ D. Oxygenated fuels
□ E. Valve timing

34. Butyraldehyde (BA) is produced at a rate of 5,000 gpd and fed to a 30,000-gal tank held at 30°C and 771-mm Hg absolute pressure under nitrogen. The vent is cooled to –18°C in a refrigerated condenser. Data for BA is as follows:

<table>
<thead>
<tr>
<th>MW</th>
<th>72.11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor pressure at 30°C</td>
<td>150 mm Hg</td>
</tr>
<tr>
<td>Vapor pressure at –18°C</td>
<td>10 mm Hg</td>
</tr>
</tbody>
</table>

The amount of BA condensed (lb/day) is most nearly:

○ A. 8.8
○ B. 22.5
○ C. 24.7
○ D. 135
48. A municipal landfill uses a compacted 1.08-m-thick clay liner that has a hydraulic conductivity of $1 \times 10^{-7}$ cm/s. If the depth of the leachate above the clay liner is 30 cm and the porosity of the clay is 55%, the time (years) required for the leachate to migrate through the liner is most nearly:

- A. 15
- B. 17
- C. 25
- D. 27

49. Sources of leachate in a well-designed landfill cell can come from which of the following sources?

Select all that apply.

- A. Precipitation
- B. Water in the solid waste
- C. Overland flow from other landfill cells
- D. Water entering the side of the landfill cell from the surrounding cells and area
- E. Water entering the bottom of the landfill cell

50. A membrane-lined landfill leachate collection system consists of HDPE pipes with a Manning's $n$ coefficient of 0.009. The slope of the pipe is 1.2%. The peak flow of the cell of the landfill is 0.45 cfs. The required leachate collection pipe nominal size (in.) is most nearly:

- A. 4
- B. 6
- C. 8
- D. 10
63. The natural attenuation of tetrachloroethene-contaminated sites can be enhanced by introducing:

- A. dissolved oxygen
- B. hydrogen-release compounds
- C. slow oxygen-release compounds
- D. none of the above

64. If the chronic daily intake of benzene in a contaminated groundwater source is 0.002 mg/(kg•day) and the oral cancer slope factor is 0.029 [mg/(kg•day)]⁻¹, the expected number of increased cancer cases in a community of 50,000 people consuming the groundwater is __________.

Enter your response in the blank.

65. The respiratory protection equipment required to enter an abandoned UST to remove sludge that is contaminated with an unknown hydrocarbon is:

- A. SCSR (self-contained self-rescuer)
- B. a filter mask with organic vapor cartridge
- C. SCBA operated in pressure-demand mode
- D. SCUBA with anti-fog mask

66. A noise level of 100 dBA exists for 5 min and is followed by 50 min of a 60-dBA noise. The equivalent continuous constant noise level (dBA) for the entire 55-min period is most nearly:

- A. 80
- B. 90
- C. 100
- D. 160
ENVIRONMENTAL SOLUTIONS
5. \[ C_2H_4O_2 + 2 \text{O}_2 \rightarrow 2 \text{CO}_2 + 2 \text{H}_2\text{O} \]

Flow rate = \[ \frac{25 \text{ gal}}{\text{min}} \times \frac{1,440 \text{ min}}{\text{day}} \times \frac{1}{10^6} \]

= 0.036 MGD

Weight of oxygen used = 3,500 mg/L × 8.34 lb/gal × 0.036 MGD

= 1,050.84 lb/day

= 43.78 lb/hr

MW of oxygen = 2(16) = 32

MW of acetic acid = (2)(12) + (4)(1) + 2(16) = 60

1 mole of acetic acid requires 2 moles of oxygen.

\[ \frac{60(1)}{2(32)} \times 43.78 \text{ lb/hr} = 41.04 \text{ lb/hr} \]

THE CORRECT ANSWER IS: B

6.

THE CORRECT POSITION OF EACH COMPONENT IS SHOWN ABOVE.
32. For a strong sunny day with winds at 4 m/s, atmospheric stability is Class B (moderately unstable).

Using the figure on the left, at 1 km (1,000 m) and Line B, $\sigma_z = 125$ m.

Using the figure on the right, at 1 km (1,000 m) and Line B, $\sigma_y = 175$ m.

$$C = \frac{Q}{\pi U \sigma_y \sigma_z} \exp \left(\frac{-H^2}{2\sigma_z^2}\right) \exp \left(\frac{-y^2}{2\sigma_y^2}\right)$$
$$= \frac{2}{(3.14)(4)(175)(125)} \exp \left(-\frac{(100)^2}{2(125)^2}\right) \exp \left(-\frac{0^2}{2(175)^2}\right)$$
$$= \frac{2}{274,750} \exp(-0.32) \exp^0$$
$$= 7.28 \times 10^{-6} \times 0.726(1)$$
$$= 5.29 \times 10^{-6} \text{ g/m}^3$$
$$= 5.3 \mu\text{g/m}^3$$

**THE CORRECT ANSWER IS: C**

33. The positive crankcase ventilation system adjusts the rate of removal of "blowby" gases to maintain the air/fuel ratio. NOx formation is affected by the A/F.

A three-way catalytic converter simultaneously converts hydrocarbons and carbon monoxide to carbon dioxide and reduces NOx to N2.

An exhaust gas recirculation system recirculates a portion of the exhaust stream to the incoming air/fuel mixture to reduce the combustion temperature and decrease the production of NOx.

Oxygenated fuels are required by the Clean Air Act Amendments of 1990 to address high levels of carbon monoxide emissions in non-attainment areas. They do not affect NOx formation.

Adjustments to valve timing in internal combustion engines can reduce residence time at peak temperature to control NOx formation.

**THE CORRECT ANSWER IS: A, B, C, E**
47. Newspaper: $6.4 \times 7,200 = 46,100 \text{ Btu/100 lb}$
   Corrugated board: $9.0 \times 7,000 = 63,000$
   Ferrous: $5.0 \times 300 = 1,500$
   Aluminum: $1.0 \times 0 = 0$
   Glass: $6.5 \times 60 = 390$

   $110,990 \text{ Btu/100 lb}$

   $\left( \frac{110,990 \text{ Btu}}{100 \text{ lb}} \right) (0.50)(0.75)(600 \text{ tpd})(2,000 \text{ lb/ton}) = 499.5 \times 10^6 \text{ Btu/day}$

   **THE CORRECT ANSWER IS: A**

48. Darcy velocity calculation:

   \[ V = K \left( \frac{dh}{dr} \right) \]
   \[ dh/dr = (0.30 + 1.08)/1.08 = 1.28 \]
   \[ V = (1 \times 10^{-7})(1.28) = 1.28 \times 10^{-7} \text{ cm/s} \]

   Seepage velocity calculation:

   \[ V' = \left( \frac{K(dh/dr)}{n} \right) \]
   \[ = (1.28 \times 10^{-7})/0.55 = 2.33 \times 10^{-7} \text{ cm/s} \]

   Travel time calculation:

   \[ t = \frac{\text{distance}}{\text{velocity}} \]
   \[ = (1.08)(100)/(2.33 \times 10^{-7}) \]
   \[ = 4.64 \times 10^8 \text{ sec or 14.7 years} \]

   **THE CORRECT ANSWER IS: A**

49. Although all are potential sources of leachate, the design of the liner system should preclude D and E. Proper cell design should eliminate overland flow of water from one landfill cell to another (C).

   **THE CORRECT ANSWER IS: A, B**
62.  \[ C_t = C_0 e^{-kt} \]
\[ \frac{C_t}{C_0} = e^{-kt} \]
\[ \ln \frac{C_t}{C_0} = -kt \]
\[ k = 0.002 \text{ day}^{-1} \]
\[ C_0 = 17 \text{ mg/kg} \]
\[ C_t = 5 \text{ mg/kg} \]
\[ t = \frac{\ln \left( \frac{C_t}{C_0} \right)}{-k} = \frac{\ln \left( \frac{5}{17} \right)}{-0.002} = \frac{\ln 0.294}{-0.002} = \frac{-1.22}{-0.002} = 610 \text{ days} \]
\[ = 1.67 \text{ years} \]

**THE CORRECT ANSWER IS: C**

63.  The dynamic pathway of chlorinated compounds is reductive dehalogenation.

**THE CORRECT ANSWER IS: B**

64.  The expected number of increased cancer cases in the community from people consuming the groundwater is:

Given: Population is 50,000  
Chronic Daily Intake of Benzene (CDI) = 0.002 mg/kg•day  
Oral Cancer Potency Factor (CPF) = 0.029[mg/(kg•day)]\(^{-1}\)

Number of Additional Cancer Cases (NACC)
\[ NACC = \text{(population)} \cdot \text{(CDI)} \cdot \text{(CPF)} \]
\[ = (50,000) \cdot (0.002 \text{ mg/kg•day}) \cdot (0.029[\text{mg/(kg•day)}]^{-1}) \]
\[ = 2.9 \]
\[ NACC = 3 \text{ additional cancer cases} \]

**THE CORRECT ANSWER IS: 3**
PE Practice Exams Published by NCEES

Chemical
Civil: Construction
Civil: Geotechnical
Civil: Structural
Civil: Transportation
Civil: Water Resources and Environmental
Electrical and Computer: Computer Engineering
Electrical and Computer: Electrical, Controls, and Communications
Electrical and Computer: Power
Mechanical: HVAC and Refrigeration
Mechanical: Machine Design and Materials
Mechanical: Thermal and Fluids Systems
Structural Engineering

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