PE

petroleum

practice exam
CONTENTS

Introduction to NCEES Exams ................................................................. 1
About NCEES
Exam format
Examinee Guide
Scoring and reporting
Updates on exam content and procedures

Exam Specifications .................................................................................. 3

PE Petroleum Practice Exam ................................................................. 9

PE Petroleum Solutions ......................................................................... 61
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.

Exam Format
The PE Petroleum exam is computer-based. It contains 85 questions and is 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 have 8.5 hours to complete the actual exam.

In addition to traditional multiple-choice questions with one correct answer, the PE Petroleum 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 video tutorials on the NCEES website.

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.
21. Bit design must address a number of conditions that sometimes are in conflict. What are the overarching design goals in bit design?

Select the three that apply.

□ A. Cheap bit costs
□ B. Long service life
□ C. Maximized ROP
□ D. Maximum wear resistance
□ E. Maximum compressive strength
□ F. Steerability

22. An artificial lift system is being considered for a highly viscous (800 cp) dead oil reservoir well capable of producing 1,000 BFPD at 6,000 ft MD. Which of the following techniques will be the most efficient lift mechanism?

○ A. Gas lift
○ B. Sucker rod pump
○ C. Progressive cavity pump
○ D. Electrical submersible pump

23. In designing a fracture stimulation down casing, you need to calculate the pressure drop through the perforations. The well was perforated from 9,310 ft to 9,322 ft using 4 shots/ft. The entry-hole diameter for the charges is 0.39 in. The job design calls for slickwater weighing 8.42 lb/gal to be pumped at 90 BPM. Assume a discharge coefficient of 0.65. The expected perforation pressure drop (psi) is most nearly:

○ A. 10
○ B. 110
○ C. 475
○ D. 725
26. The following tasks are needed to pull tubing and a packer on an onshore well that requires 10.6-lbm/gal fluid to kill it. The packer fluid has a density of 9.0 lbm/gal.

List each task in the correct order in which it should be accomplished.

<table>
<thead>
<tr>
<th>Step</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Release packer</td>
</tr>
<tr>
<td>Step 2</td>
<td>Circulate kill fluid</td>
</tr>
<tr>
<td>Step 3</td>
<td>Pull tubing</td>
</tr>
<tr>
<td>Step 4</td>
<td>Nipple down Christmas tree</td>
</tr>
<tr>
<td>Step 5</td>
<td>Using a lubricator, remove blanking plug</td>
</tr>
<tr>
<td>Step 6</td>
<td>Nipple up BOPE</td>
</tr>
<tr>
<td>Step 7</td>
<td>Using a lubricator, install and test blanking plug</td>
</tr>
</tbody>
</table>

27. In general, under what conditions will reverse ballooning due to pressure result in a tubing length increase?

   - A. When the final internal pressure exceeds the initial internal pressure
   - B. When the final external pressure exceeds the initial external pressure
   - C. When the change in external pressures exceeds the change in internal pressures
   - D. It does not occur under any conditions.
53. Which of the following statements are true with regard to atmospheric pressure?

Select all that apply.

- A. Absolute pressure is the total pressure, including both system or gauge pressure and atmospheric pressure.
- B. A gauge pressure value includes atmospheric pressure.
- C. Since atmospheric pressure affects gas molecules, the standard pressure for gas measurement is usually expressed as psi gauge.
- D. The weight of the atmosphere exerts a force of about 15 psi at sea level.
- E. Although atmospheric pressure changes, absolute pressure is constant.

54. Consider a 15-MMscf/day natural gas stream that contains 3% CO₂ at 800 psig and 120°F. The stream is to be treated with a 50-wt% solution to a CO₂ concentration of 50 ppm (molar). Rich loading of the solution is kept below 0.39 mol/mol to prevent degradation of the system. The CO₂ emission (tons/yr) from the solvent regeneration column is most nearly:

- A. 16
- B. 26
- C. 9,505
- D. 19,009,200
55. You have assembled a reservoir simulation model and are ready to begin history matching.

List the history matching steps in the correct order.

<table>
<thead>
<tr>
<th>Step</th>
<th>History Matching Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Match individual well behavior.</td>
</tr>
<tr>
<td>2</td>
<td>Complete a gross match of pressure gradients.</td>
</tr>
<tr>
<td>3</td>
<td>Match pressure more precisely in small groups of blocks.</td>
</tr>
<tr>
<td>4</td>
<td>Match volumetric-average pressure levels.</td>
</tr>
</tbody>
</table>

56. Which properties affect the estimate of the time to the end of wellbore storage?

Select the **three** that apply.

- [ ] A. Fluid flow rate
- [ ] B. Fluid mobility
- [ ] C. Storativity
- [ ] D. Transmissivity
- [ ] E. Reservoir pressure
- [ ] F. Flowing bottom-hole pressure
64. Which of the following materials are among the principal groups of macerals found in coal-bed methane reservoirs?

Select the four that apply.

☐ A. Montmorillonite
☐ B. Exinite
☐ C. Inertinite
☐ D. Vermiculite
☐ E. Vitrinite
☐ F. Liptinite
☐ G. Barite

65. Slim-tube miscibility tests are performed at different pressures on an oil sample from a field being vetted for miscible-gas-injection enhanced oil recovery. The gas compositions are held constant across all slim-tube tests. The results of the slim-tube tests are plotted on the following graph.

The minimum miscibility pressure (psig) is most nearly:

☐ A. 3,500
☐ B. 4,000
☐ C. 4,200
☐ D. 5,500
82. You are drilling the one thousandth well in a very large unit. The well design and reservoir are shown below. When completed, the well is planned to be fracture stimulated to achieve optimal production rates.

By mistake, the intermediate casing point is set too shallow. When the reservoir is drilled, it becomes clear that there is 70 ft of sensitive shale exposed in the final hole section. What risks have changed because of the exposed shale in the production interval?

Match the correct risk status on the right to each risk on the left.

![Diagram showing sensitive shale](image)

<table>
<thead>
<tr>
<th>Risks</th>
<th>Risk Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale may slough and pack off the open hole section.</td>
<td></td>
</tr>
<tr>
<td>Shale may slough and production casing might not land at TD.</td>
<td>New risk to manage</td>
</tr>
<tr>
<td>The production casing grade may need to be changed.</td>
<td></td>
</tr>
<tr>
<td>Shale may slough so it cannot achieve the planned electric line logging.</td>
<td>Not a new risk to manage</td>
</tr>
<tr>
<td>Shale may slough, and the wiper trip before running casing might accidentally sidetrack through the reservoir.</td>
<td></td>
</tr>
<tr>
<td>An induction log may need to be run instead of a resistivity log.</td>
<td></td>
</tr>
<tr>
<td>This well is too risky and should be abandoned immediately.</td>
<td></td>
</tr>
</tbody>
</table>
84. XYZ Resources has been approached to sell one of its producing assets. The property will be evaluated for disposition based on the following cash flow information:

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue</th>
<th>After-Tax Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,500,000</td>
<td>2,500,000</td>
</tr>
<tr>
<td>2</td>
<td>4,050,000</td>
<td>2,600,000</td>
</tr>
<tr>
<td>3</td>
<td>3,600,000</td>
<td>2,700,000</td>
</tr>
<tr>
<td>4</td>
<td>3,240,000</td>
<td>2,800,000</td>
</tr>
<tr>
<td>5</td>
<td>2,916,000</td>
<td>2,900,000</td>
</tr>
</tbody>
</table>

Assume the wells are abandoned in Year 6 and the cost of abandonment is offset by the salvage value of the surface equipment. The annual discount rate is 6% compounded annually. Discounting occurs at the end of each year.

If the company will not accept any offers less than the present worth of the asset based on cash flow analysis, the minimum acceptable sales price of the asset is $___________________.

Enter your response in the blank.

85. A well currently produces 15 BOPD and 800 BWPD. A production log indicates that 90% of the water and 10% of the oil is being produced from the lowest set of perforations. The well is rod pumped and has a fluid level 500 ft above the top perf. A workover procedure is developed to set a bridge plug above the lowest set of perforations. The reduction in produced water will allow the well to be pumped off and will increase oil production from the perforations above the bridge plug by 50%.

Unfortunately, the bridge plug sets out of zone, isolating 40% of the projected post-workover production below the plug. A rig to mill out the bridge plug will cost $20,000 for MIRU and RDMO with a daily all-inclusive rate of $14,500. It will cost an additional $2,500 to run a new bridge plug as originally planned. The average price of oil for the next 12 months is forecasted to be $68/bbl. If one year "going forward" undiscounted payout is required, the maximum number of rig days that can be spent attempting to mill out the plug is _________________.

Enter your response in the blank.
19. The strength of G pipe can be calculated if not known by rationing the strength of S135 pipes as shown in the "Drillpipe Properties" table (Bourgoyne et al. 1986f) in SPE Petroleum Engineering Certification and PE License Exam Reference Guide.

Tensile strength 2 3/8 pipe: \( G = 137,000 \text{ lbf} \), \( S = 176,000 \text{ lbf} \)
S135 has a yield of 135,000 lbf/in\(^2\)

Therefore:

\[
\text{Yield of } G = 135,000 \times \frac{137,000 \text{ lbf}}{176,000 \text{ lbf}} = 105,000 \text{ lbf/in}^2
\]

THE CORRECT ANSWER IS: C

20. Cement between casing and formation are essential for
- Protecting the water table and surface from leaks
- Supporting the casing
- Isolating producing zones

THE CORRECT ANSWERS ARE: A, B, C, AND F

21. There is a difference between a design parameter and an overarching design goal that has to optimize competing parameters. Cheap bit costs, maximum wear resistance, and maximum compressive strength are design parameters. Regardless of conditions, maximized ROP, long service life, and steerability are overarching design goals.

THE CORRECT ANSWERS ARE: B, C, AND F

22. An electrical submersible pump (ESP) is an excellent applicator as high as 1,000 cp with high-volume lift capability and up to 52,000 BFPA in shallow as well. Typical is 200–20,000 BFPD.

THE CORRECT ANSWER IS: D
PE PETROLEUM SOLUTIONS

23. Refer to *SPE Petroleum Engineering Certification and PE License Exam Reference Guide* under "Production Engineering, General Fracturing Treatment Formulas":

Perforation Friction

\[ \Delta P_{pf} = 0.2369 \frac{q^2 \rho}{n^2 D_P^4 C^2} \]

\( \Delta P_{pf} \) = pressure drop caused by perforation friction, psi
\( Q \) = total flow rate, BPM
\( \rho \) = fluid density, lbm/gal
\( N \) = number of perforations
\( D_P \) = perforation diameter, in.
\( C \) = discharge coefficient

\[ \Delta P_{pref} = \frac{\rho Q^2 (0.2369)}{C^2 N^2 H^4} \]

\[ = \frac{(8.42)(90)^2 (0.2369)}{(0.65)^2 (48)^2 (0.39)^4} \]

\[ = \frac{(8.42)(8,100) (0.2369)}{(0.4225)(2,304)(.0231)} \]

\[ = 717.5 \text{ psi} \Rightarrow 725 \text{ psi} \]

THE CORRECT ANSWER IS: D

24. Larger entry holes and increased density do enhance inflow to the well. With gravel-packing being used in a variety of downhole situations, including cased-hole environments, specifics are required. Deep holes are not required, due to higher perm, yet perforation damage and cleaning can create formation damage.

THE CORRECT ANSWER IS: C

25. Decreasing tubing size is the only option that does not minimize gas interference/gas locking.

THE CORRECT ANSWERS ARE: A, B, C, D, E, AND F
26. To ensure proper well control:
   Step 1. Using a lubricator, install and test blanking plug in tubing hanger.
   Step 2. Nipple down Christmas Tree.
   Step 3. Nipple up BOPE.
   Step 4. Using a lubricator, remove blanking plug.
   Step 5. Release packer.
   Step 6. Circulate kill fluid.
   Step 7. Pull tubing.

   The focus of this question is the use of a blanking plug placed in the tubing hanger to allow the swap-out of the BOPE and Christmas tree.

   **THE CORRECT ANSWERS ARE SHOWN IN THE ORDER LISTED ABOVE.**

27. Pressure in the annulus begins to squeeze on the tubing, causing it to elongate. This is called reverse ballooning.

   **THE CORRECT ANSWER IS: B**

28. Vogel's IPR: \[ q_{o}/q_{omax} = 1 - 0.2 \frac{p_{wf}}{p_r} - (\frac{p_{wf}}{p_r})^2 \]

   \[ q_{omax} = \frac{420}{\{1 - 0.2 (1,100/2,200) - 0.8 (1,100/2,200)^2\}} = 600 \text{ STB/day} \]

   **THE CORRECT ANSWER IS: C**

29. Enrichment of the injectant could occur only up to the point where the bubble point and dew point converge. Reservoir Oil B is to the left of the limiting tie line, so the injectant cannot become first-contact miscible.

   **THE CORRECT ANSWER IS: B**

30. Mid perf is 8,130 ft.

   5 1/2 in., 17-lb casing has 0.976 gal/ft \times 8,130 \text{ ft} = 7,938.0 \text{ gal} \approx 189 \text{ bbls}

   **THE CORRECT ANSWER IS: B**
52. PE PETROLEUM SOLUTIONS

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Characteristic</th>
</tr>
</thead>
</table>
| A             | • Inlet line is smaller than PSV ⇒ chatter inlet, indicated by the reducer  
• FP value is good but does not compensate |
| D             | • Reduced port valve installed in inlet line ⇒ choice point upstream of the PSV orifice ⇒ chatter  
• Inlet line size is large but does not offset RP valve |
| E             | • Reduced port valve in inlet line ⇒ choke point upstream of the PSV orifice ⇒ chatter |

THE CORRECT ANSWERS ARE: A, D, AND E

53. Option A is true since the absolute pressure is the sum of both the system and the atmosphere.  
Option B is false as gauge pressure does not include atmospheric pressure.  
Option C is false since gas measurement is based on absolute pressures.  
Option D is true since atmospheric pressure is generally close to 15 psi at sea level.  
Option E is false since absolute pressure changes with changes in atmospheric and system pressures.

THE CORRECT ANSWERS ARE: A AND D

54. 

\[
15 \text{ MMscf/day} \times \left( \frac{0.03 \text{ mol CO}_2}{\text{mol total}} - \frac{50}{10^6} \right) = 0.45 \text{ MMscf/day}
\]

\[
0.45 \text{ MMscf/day} \times \frac{109.8 \text{ lb mole}}{1 \text{ MMscf/day}} \times \frac{44 \text{ lb}}{1 \text{ lb mole}} = 2,170 \text{ lb/hr}
\]

OR

\[
0.45 \frac{\text{MMscf}}{\text{day}} \times \frac{10^6 \text{ ft}^3}{1 \text{ MMscf}} \times \frac{1 \text{ lb mole}}{379.48 \text{ ft}^3} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{44 \text{ lb}}{1 \text{ lb mole}} = 2,174 \text{ lb/hr}
\]

\[
2,170 \frac{\text{lb CO}_2}{\text{hr}} \times \frac{1 \text{ ton}}{2,000 \text{ lb}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{365 \text{ day}}{1 \text{ year}} = 9,505 \text{ tons/year}
\]

\[
\frac{V}{W} = \frac{ZRT}{P} = \frac{(1.0)(10.732)(519.67) \text{ ft}^3}{14.697 \text{ lb mole}} = 379.48 \frac{\text{ft}^3}{\text{lb mole}}
\]

THE CORRECT ANSWER IS: C
55. Step 1. Match volumetric-average pressure levels.
   Step 2. Complete a gross match of pressure gradients.
   Step 3. Match pressure more precisely in small groups of blocks.
   Step 4. Match individual well behavior.

   History-matching should be completed from macro- to micro-level to first ensure a match to gross in-place volumes and drive mechanisms and then focus on more localized impacts of heterogeneity.

   **THE CORRECT ANSWERS ARE SHOWN IN THE ORDER LISTED ABOVE.**

56. Different parts of the pressure response begin and end at certain times; these are calculated by use of the parameters $t_D$ and $t_{DA}$ defined below:

   $$t_D = \frac{kt}{(\mu C r_w^2)} \text{ or } t_{DA} = 0.000264 \frac{kt}{(\mu C t A)}$$

   The transition time will occur at the specific moment regardless of the rate at which the well is flowing. The transition time is not impacted by reservoir pressure or flowing bottom-hole pressure, as can be observed from the above equations, but it is affected by the fluid mobility, storativity, and transmissivity.

   **THE CORRECT ANSWERS ARE: B, C, AND D**
64. Macerals are organic materials found in coal and include Vitrinite, Exinite (also known as Liptinite), and Inertinite. Montmorillonite, Vermiculite, and Barite are inorganic materials and are not macerals.

THE CORRECT ANSWERS ARE: B, C, E, AND F

65. A slope change occurs when miscibility is achieved. The minimum miscibility pressure is where the two trend lines intersect, which is ~4,200 psig.

THE CORRECT ANSWER IS: C
82. The sensitive, sloughing shale should have been completely behind the intermediate casing. This mistake adds risk to the successful completion of the reservoir section.

- Shale may slough and pack off the open hole section. **New risk to manage**
- Shale may slough and production casing might not land at TD. **New risk to manage**
- The production casing grade may need to be changed. **Not a new risk to manage**
- Shale may slough so it cannot achieve the planned electric line logging. **New risk to manage**
- Shale may slough, and the wiper trip before running casing might accidentally sidetrack through the reservoir. **New risk to manage**
- An induction log may need to be run instead of a resistivity log. **Not a new risk to manage**
- This well is too risky and should be abandoned immediately. **Not a new risk to manage**

**THE CORRECT ANSWERS ARE SHOWN IN THE ORDER LISTED ABOVE.**

83. Management of change (MOC) comes into effect where there is a change in the process. The activities below are **not** changes to the process.

Pull the PSV, verify that it works properly, and reinstall--Routine maintenance activity
Replace the discharge piping with the same size pipe--This is a replacement in kind.
Add supports to the discharge piping--This does not change the process.

**THE CORRECT ANSWERS ARE: A, B, AND E**
84. The minimum acceptable sales price is $4,293,422.

\[
\begin{align*}
\text{Year 1} &= (4,500,000 - 2,500,000) \times \frac{1}{(1 + 0.06)^1} = 1,886,792 \\
\text{Year 2} &= (4,050,000 - 2,600,000) \times \frac{1}{(1 + 0.06)^2} = 1,290,494 \\
\text{Year 3} &= (3,600,000 - 2,700,000) \times \frac{1}{(1 + 0.06)^3} = 755,657 \\
\text{Year 4} &= (3,240,000 - 2,800,000) \times \frac{1}{(1 + 0.06)^4} = 348,521 \\
\text{Year 5} &= (2,916,000 - 2,900,000) \times \frac{1}{(1 + 0.06)^5} = 11,956
\end{align*}
\]

\text{THE CORRECT ANSWER IS: $4,293,420$}

85. Production if bridge plug is set correctly:
\[90\% \times 15 \text{ BOPD} = 13.5 \text{ BOPD}\]

Plus increase from being pumped off:
\[13.5 \text{ BOPD} \times 1.5 = 20.25 \text{ BOPD}\]

Incremental cash flow = \[40\% \times 20.25 \text{ BOPD} \times \$68/\text{BOPD} = \$550.80/\text{day} \times \text{365 day/yr} \times \$550.80/\text{day} = \$201,042/\text{year}\]

Undiscounted payout:
\[\$201,042/\text{yr} - \$22,500 = \$178,542\]
\[\$178,542/\text{yr} / \$14,500/\text{day} = 12.30 \text{ days}\]

So 12 days is the maximum that can be spent milling and still pay out in 1 year.

\text{THE CORRECT ANSWER IS: 12}