PE

electrical and computer:

power

practice exam
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About NCEES
The National Council of Examiners for Engineering and Surveying (NCEES) is a nonprofit organization made up of engineering and surveying licensing boards from all U.S. states and territories. Since its founding in 1920, NCEES has been committed to advancing licensure for engineers and surveyors in order to protect the health, safety, and welfare of the American public.

NCEES helps its member licensing boards carry out their duties to regulate the professions of engineering and surveying. It develops best-practice models for state licensure laws and regulations and promotes uniformity among the states. It develops and administers the exams used for engineering and surveying licensure throughout the country. It also provides services to help licensed engineers and surveyors practice their professions in other U.S. states and territories.

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.

Exam-day schedule
Be sure to arrive at the exam site on time. Late-arriving examinees will not be allowed into the exam room once the proctor has begun to read the exam script. The report time for the exam will be printed on your Exam Authorization. Normally, you will be given 1 hour between morning and afternoon sessions.

Admission to the exam site
To be admitted to the exam, you must bring two items: (1) your Exam Authorization and (2) a current, signed, government-issued identification.

Examinee Guide
The NCEES Examinee Guide is the official guide to policies and procedures for all NCEES exams. All examinees are required to read this document before starting the exam registration process. You can download it at ncees.org/exams. It is your responsibility to make sure that you have the current version.

NCEES exams are administered in either a computer-based format or a pencil-and-paper format. Each method of administration has specific rules. This guide describes the rules for each exam format. Refer to the appropriate section for your exam.

Scoring and reporting
NCEES typically releases exam results to its member licensing boards 8–10 weeks after the exam. Depending on your state, you will be notified of your exam result online through your MyNCEES account or via postal mail from your state licensing board. Detailed information on the scoring process can be found at ncees.org/exams.

Staying connected
To keep up to date with NCEES announcements, events, and activities, connect with us on your preferred social media network.
122. To determine the demand component of a customer's monthly bill, an electric utility uses a revenue meter that registers maximum demand for each billing period. Demand is calculated as the average power consumption over a 15-min time interval. The customer's power consumption over four such 15-min intervals is shown in the figure. If the maximum demand registered at time $t = 0$ min is 35 kW, the maximum demand (kW) registered at $t = 60$ min is most nearly:

(A) 35.0  
(B) 50.0  
(C) 62.5  
(D) 75.0

123. A room with a floor area of 50 ft × 30 ft and a ceiling height of 10 ft has luminaires suspended 2 ft from the ceiling. Assuming a working plane of 30 in. and a required illumination level of 50 fc, the net luminous flux (lumens) using fixtures with a coefficient of utilization of 0.78 is most nearly:

(A) 48,000  
(B) 58,000  
(C) 75,000  
(D) 96,000
126. A grounded industrial power system would be least likely to improve:

(A) the load power factor
(B) service reliability
(C) personnel safety
(D) lightning protection

127. A transformer is rated 3-phase, 25 MVA, 66-12.47 kV, delta-wye connected, 8% impedance. On a 100-MVA base, the per-unit impedance is most nearly:

(A) 0.08
(B) 0.16
(C) 0.24
(D) 0.32
525. A single-phase transformer rated 50 kVA, 2,300/120 V is connected as an autotransformer as shown in the figure to boost the voltage of a 2,300-V bus. The rating (kVA) of the autotransformer is most nearly:

(A) 50
(B) 960
(C) 1,010
(D) 1,500

526. Each time a piece of equipment fails, it takes 12 hours to repair and return it to service. In order to have the equipment available at least 99.5% of the time, the maximum mean time between failures (MTBF) of the equipment (hours) is most nearly:

(A) 2,388
(B) 4,000
(C) 4,391
(D) 8,748
527. The contacts of a general-purpose industrial relay are rated 30 A at 240-V alternating current. The rated life of the relay is $100 \times 10^3$ cycles (at 30 A, 240 V ac). Which load would most likely cause the greatest reduction in the life (cycles) of the relay?

(A) 1-hp, 120-V ac single-phase motor
(B) 1 1/2-hp, 240-V ac single-phase motor
(C) 30-A, 96-LRA (locked rotor amps), 120-V ac single-phase motor
(D) 30-A, 28-V dc load

528. A test of a 10-kVA, 2,300/230-V, single-phase transformer gives an open-circuit test power consumption of 69 W, and a short-circuit test reveals a resistance referred to the high-voltage side of 10.9 Ω. The efficiency of this transformer, operated at full load and unity power factor, is most nearly:

(A) 97.3%
(B) 97.6%
(C) 97.9%
(D) 99.3%
122. The average power consumption in each of the four time intervals is as follows:

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Average Power Consumption (kW)</th>
<th>Max Demand at Start of Interval (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>37.5</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>62.5</td>
<td>37.5</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>62.5</td>
</tr>
<tr>
<td>(5)</td>
<td>?</td>
<td>62.5</td>
</tr>
</tbody>
</table>

Thus, 62.5 kW is the maximum demand registered at time t = 60 min.

THE CORRECT ANSWER IS: (C)

123. Total (net) lumens = \[\text{(req. fc)} \times \text{(width of room)} \times \text{(length of room)} / \text{coeff. of utilization (CU)}\]
\[= \frac{50 \times 30 \times 50}{0.78} = 75,000 / 0.78 = 96,154 \text{ lm}\]

THE CORRECT ANSWER IS: (D)

124. Battery voltage does not influence self-discharge rate.

THE CORRECT ANSWER IS: (D)

125. The transformers will load in inverse proportion to their impedances.

Converting \(T_1\) impedance to \(T_2\) base: \(j0.045 \left( \frac{2,000}{1,000} \right) = j0.09\)

\[
\frac{\text{Load}_{T_1}}{\text{Load}_{T_2}} = \frac{Z_{T_2}}{Z_{T_1}}
\]

When \(T_1\) is fully loaded to 1,000 kVA,

\[
\text{Load}_{T_2} = (1,000) \left( \frac{0.09}{0.06} \right) = 1,500 \text{ kVA}
\]

Total load = 1,500 + 1,000 = 2,500 kVA

THE CORRECT ANSWER IS: (B)
126.  Load power factor doesn't depend on the system grounding under steady state.

**THE CORRECT ANSWER IS: (A)**

127.  Transformer impedance on the new base = \(0.08 \left( \frac{100 \text{ MVA}}{25 \text{ MVA}} \right) = 0.32 \text{ pu}\)

**THE CORRECT ANSWER IS: (D)**

128.  A 3-phase induction motor in which the inverter allows the voltage-to-frequency ratio to increase may saturate. Option (B).

Operating a 50-Hz transformer at higher than rated frequency will reduce the chances of saturating the transformer. Eliminate (A).

Geomagnetic storms do not cause saturation in delta transformers since the delta is not referenced to ground. Eliminate (C).

The normal current transformer configuration is with a short-circuited secondary winding. Opening the secondary circuit could cause saturation. Eliminate (D).

**THE CORRECT ANSWER IS: (B)**

129.  Feeder impedance = \(\left( \frac{250 \text{ ohm}}{1,000} \right) (0.029 + j0.048)\) \((\text{NEC® Chapter 9, Table 9})\)

\[= 0.00725 + j0.0120\]

\[V_{\text{Panel A}} = \left( \frac{480}{\sqrt{3}} \right) \angle 0^\circ \left( 400 \angle -\cos^{-1}0.80 \right) (0.00725 + j0.0120) = 271.94 \angle -0.44^\circ\]

\[|V_{\text{Phase to Phase}}| = 271.94 \times \sqrt{3} = 471 \text{ V}\]

An alternate solution may use the approximation for effective \(Z\) given in Note 2, Chapter 9, Table 9 of the \textit{NEC®}. This approach will also result in Option (B).

**THE CORRECT ANSWER IS: (B)**
523. \[ P_T = P_1 \text{ (kW)} + P_2 \text{ (kW)} \]
\[ P_1 = S_1 \text{ (kVA)} \times PF_1 = 293 \text{ kVA} \times 0.82 = 240 \text{ kW} \]
\[ P_2 = S_2 \text{ (kVA)} \times PF_2 = 1,131 \text{ kVA} \times 0.90 = 1,018 \text{ kW} \]
\[ P_T = 240 \text{ kW} + 1,018 \text{ kW} \]
\[ = 1,258 \text{ kW} \]

THE CORRECT ANSWER IS: (D)

524. \[ P_{OC} = 460 \text{ W} \]
\[ P_{50\%} = 2,370 - 460 = 1,910 \text{ W} \]
\[ P_{100\%} = (4)(1,910) = 7,640 \text{ W} \]
\[ P_T = 7,640 + 460 = 8,100 \text{ W} \]

THE CORRECT ANSWER IS: (B)

525. \[ \text{VA} = 2,300 (21.74 + 416.7) \]
\[ = 1,008 \text{ kVA} \]

THE CORRECT ANSWER IS: (C)

526. \[ A = \frac{\text{MTTF}}{\text{MTTF} + \text{MTTR}} \]
\[ \text{MTTF} = \frac{A \times \text{MTTR}}{1 - A} = \frac{0.995 \times 12}{(1 - 0.995)} = 2,388 \]

THE CORRECT ANSWER IS: (A)
527. The life of a contact will be less for dc loads. DC flows in one direction only and supports sustained arcing much better than alternating current. DC also tends to remove material from one contact to the other more quickly. For the example shown (TYCO Electronics Data Sheet 10-2010, rev. 1010), the cycle life for the 30-A, 28-V dc load was half that for the alternating current loads shown.

THE CORRECT ANSWER IS: (D)

528.  
\[ I_L = \frac{10 \text{ K}}{2,300} = 4.35 \text{A} \]
\[ P_{FL} = (4.35)^2 (10.9) = 206 \text{ W} \]
\[ P_{\text{lost}} = 206 + 69 = 275 \text{ W} \]
\[ P_{\text{out}} = (10 \text{kVA})(1) = 10 \text{kW} \]
\[ \text{EFF} = \frac{10 \text{kW}}{10.275 \text{kW}} \times 100 = 97.3\% \]

THE CORRECT ANSWER IS: (A)

529. Regulation = \[ \frac{|V_{NL}| - |V_{FL}|}{|V_{FL}|} = \frac{1.05 - 1.0}{1.0} = 0.05 = 5\% \]

THE CORRECT ANSWER IS: (B)

530. \[ I_{SC} = \frac{1.0}{0.04 + 0.025} = 15.4 \text{ pu on 1 MVA base} \]
\[ I_{\text{BASE}, 480} = \frac{10^6}{\sqrt{3}(480)} = 1,203 \text{ A} \]
\[ I_{SC} = (15.4)(1,203) = 18,526 \text{ A} \]

THE CORRECT ANSWER IS: (B)