

MORNING SAMPLE QUESTIONS

1. If the functional form of a curve is known, differentiation can be used to determine all of the following **EXCEPT** the:

- (A) concavity of the curve
- (B) location of inflection points on the curve
- (C) number of inflection points on the curve
- (D) area under the curve between certain bounds

2. Which of the following is the general solution to the differential equation and boundary condition shown below?

$$\frac{dy}{dt} + 5y = 0; y(0) = 1$$

- (A) e^{5t}
- (B) e^{-5t}
- (C) $e^{\sqrt{-5t}}$
- (D) $5e^{-5t}$

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3. If D is the differential operator, then the general solution to $(D + 2)^2 y = 0$ is:
- (A) $C_1 e^{-4x}$
 - (B) $C_1 e^{-2x}$
 - (C) $e^{-4x}(C_1 + C_2 x)$
 - (D) $e^{-2x}(C_1 + C_2 x)$
4. A particle traveled in a straight line in such a way that its distance S from a given point on that line after time t was $S = 20t^3 - t^4$. The rate of change of acceleration at time $t = 2$ is:
- (A) 72
 - (B) 144
 - (C) 192
 - (D) 208

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5. Which of the following is a unit vector perpendicular to the plane determined by the vectors $\mathbf{A} = 2\mathbf{i} + 4\mathbf{j}$ and $\mathbf{B} = \mathbf{i} + \mathbf{j} - \mathbf{k}$?

(A) $-2\mathbf{i} + \mathbf{j} - \mathbf{k}$

(B) $\frac{1}{\sqrt{5}}(\mathbf{i} + 2\mathbf{j})$

(C) $\frac{1}{\sqrt{6}}(-2\mathbf{i} + \mathbf{j} - \mathbf{k})$

(D) $\frac{1}{\sqrt{6}}(-2\mathbf{i} - \mathbf{j} - \mathbf{k})$

6. If f' denotes the derivative of a function of $y = f(x)$, then $f'(x)$ is defined by:

(A) $\lim_{\Delta y \rightarrow 0} \frac{\Delta x}{\Delta y}$

(B) $\lim_{\Delta y \rightarrow 0} \frac{\Delta y}{\Delta x}$

(C) $\lim_{\Delta x \rightarrow 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$

(D) $\lim_{\Delta y \rightarrow 0} \frac{f(x - \Delta x) + f(x)}{\Delta y}$

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7. What is the area of the region in the first quadrant that is bounded by the line $y = 1$, the curve $x = y^{3/2}$, and the y -axis?

- (A) $2/5$
- (B) $3/5$
- (C) $2/3$
- (D) 1

8. Three lines are defined by the three equations:

$$\begin{aligned}x + y &= 0 \\x - y &= 0 \\2x + y &= 1\end{aligned}$$

The three lines form a triangle with vertices at:

- (A) $(0, 0), \left(\frac{1}{3}, \frac{1}{3}\right), (1, -1)$
- (B) $(0, 0), \left(\frac{2}{3}, \frac{2}{3}\right), (-1, -1)$
- (C) $(1, 1), (1, -1), (2, 1)$
- (D) $(1, 1), (3, -3), (-2, -1)$

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9. The value of the integral $\int_0^{\pi} 10 \sin x dx$ is:
- (A) -10
 - (B) 0
 - (C) 10
 - (D) 20
10. You wish to estimate the mean M of a population from a sample of size n drawn from the population. For the sample, the mean is x and the standard deviation is s . The probable accuracy of the estimate improves with an increase in:
- (A) M
 - (B) n
 - (C) s
 - (D) $M + s$

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11. A bag contains 100 balls numbered from 1 to 100. One ball is removed. What is the probability that the number on this ball is odd or greater than 80?
- (A) 0.2
 - (B) 0.5
 - (C) 0.6
 - (D) 0.8
12. The standard deviation of the population of the three values 1, 4, and 7 is:
- (A) $\sqrt{3}$
 - (B) $\sqrt{6}$
 - (C) 4
 - (D) 6

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13. Suppose the lengths of telephone calls form a normal distribution with a mean length of 8.0 min and a standard deviation of 2.5 min. The probability that a telephone call selected at random will last more than 15.5 min is most nearly:

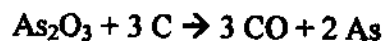
(A) 0.0013
(B) 0.0026
(C) 0.2600
(D) 0.9987

14. The volume (L) of 1 mol of H_2O at 546 K and 1.00 atm pressure is most nearly:

(A) 11.2
(B) 14.9
(C) 22.4
(D) 44.8

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15. Consider the equation:



Atomic weights may be taken as 75 for arsenic, 16 for oxygen, and 12 for carbon. According to the equation above, the reaction of 1 standard gram-mole of As_2O_3 with carbon will result in the formation of:

- (A) 1 gram-mole of As
 - (B) 28 grams of CO
 - (C) 150 grams of As
 - (D) a greater amount by weight of CO than of As
16. If 60 mL of NaOH solution neutralizes 40 mL of 0.50 M H_2SO_4 , the concentration of the NaOH solution is most nearly:
- (A) 0.80 M
 - (B) 0.67 M
 - (C) 0.45 M
 - (D) 0.33 M

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17. The atomic weights of sodium, oxygen, and hydrogen are 23, 16 and 1, respectively. To neutralize 4 grams of NaOH dissolved in 1 L of water requires 1 L of:
- (A) 0.001 normal HCl solution
 - (B) 0.01 normal HCl solution
 - (C) 0.1 normal HCl solution
 - (D) 1.0 normal HCl solution

18. Consider the following equation:

$$K = \frac{[C]^2[D]^2}{[A]^4[B]}$$

The equation above is the formulation of the chemical equilibrium constant equation for which of the following reactions?

- (A) $C_2 + D_2 \leftrightarrow A_4 + B$
- (B) $4A + B \leftrightarrow 2C + 2D$
- (C) $4C + 2D \leftrightarrow 2A + B$
- (D) $A_4 + B \leftrightarrow C_2 + D_2$

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19. The flowchart for a computer program contains the following segment:

```
VAR = 0
┌→ IF VAR < 5 THEN VAR = VAR + 2
└  OTHERWISE EXIT LOOP
  LOOP
```

What is the value of VAR at the conclusion of this routine?

- (A) 0
(B) 2
(C) 4
(D) 6
20. In a spreadsheet, the number in Cell A4 is set to 6. Then A5 is set to $A4 + \$A\4 . This formula is copied into Cells A6 and A7. The number shown in Cell A7 is most nearly:
- (A) 12
(B) 24
(C) 36
(D) 216

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21. Consider the following program segment:

```
INPUT Z, N
S = 1
T = 1
FOR K = 1 TO N
  T = T*Z/K
  S = S + T
NEXT K
```

This segment calculates the sum:

- (A) $S = 1 + ZT + 2 ZT + 3 ZT + \dots + N ZT$
- (B) $S = 1 + ZT + \frac{1}{2}ZT + \frac{1}{3}ZT + \dots + \left(\frac{1}{N}\right)ZT$
- (C) $S = 1 + \frac{Z}{1} + \frac{2Z}{2} + \frac{3Z}{3} + \dots + \left(\frac{NZ}{N}\right)$
- (D) $S = 1 + \frac{Z}{1!} + \frac{Z^2}{2!} + \frac{Z^3}{3!} + \dots + \left(\frac{Z^N}{N!}\right)$

22. In a spreadsheet, Row 1 has the numbers 2, 4, 6, 8, 10, ... , 20 in Columns A–J, and Row 2 has the numbers 1, 3, 5, 7, 9, ... , 19 in the same columns. All other cells are zero except for Cell D3, which contains the formula: $D1 + D\$1 * D2$. This formula has been copied into cells D4 and D5. The number that appears in cell D4 is most nearly:

- (A) 3
(B) 64
(C) 519
(D) 4,216

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23. An engineer testifying as an expert witness in a product liability case should:
- (A) answer as briefly as possible only those questions posed by the attorneys
 - (B) provide a complete and objective analysis within his or her area of competence
 - (C) provide an evaluation of the character of the defendant
 - (D) provide information on the professional background of the defendant
24. A professional engineer, originally licensed 30 years ago, is asked to evaluate a newly developed computerized control system for a public transportation system. The engineer may accept this project if:
- (A) he or she is competent in the area of modern control systems
 - (B) his or her professional engineering license has not lapsed
 - (C) his or her original area of specialization was in transportation systems
 - (D) he or she has regularly attended meetings of a professional engineering society

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25. You and your design group are competing for a multidisciplinary concept project. Your firm is the lead group in the design professional consortium formed to compete for the project. Your consortium has been selected as the first to enter fee negotiations with the project owner. During the negotiations, the amount you have to cut from your fee to be awarded the contract will require dropping one of the consortium members whose staff has special capabilities not available from the staff of the remaining consortium members. Can your remaining consortium ethically accept the contract?
- (A) No, because an engineer may not accept a contract to coordinate a project with other professional firms providing capabilities and services that must be provided by hired consultants.
 - (B) Yes, if your remaining consortium members hire a few new lower-cost employees to do the special work that would have been provided by the consortium member that has been dropped.
 - (C) No, not if the owner is left with the impression that the consortium is still fully qualified to perform all the required tasks.
 - (D) Yes, if in accepting an assignment to coordinate the project, a single person will sign and seal all the documents for the entire work of the consortium.
26. You have an on-site job interview to follow up on an on-campus interview with Company A. Just before you fly to the interview, you get a call from Company B asking you to come for an on-site interview at their offices in the same city. When you inform them of your interview with Company A, they suggest you stop in after that. Company A has already paid for your airfare and, at the conclusion of your interview with them, issues you reimbursement forms for the balance of your trip expenses with instructions to file for all your trip expenses. When you inform them of your added interview stop at Company B, they tell you to go ahead and charge the entire cost of the trip to Company A. You interview with Company B, and at the conclusion, they give you travel reimbursement forms with instructions to file for all your trip expenses. When you inform them of the instructions of Company A, they tell you that the only expenses requiring receipts are airfare and hotel rooms, so you should still file for all the other expenses with them even if Company A is paying for it because students always need a little spending money. What should you do?
- (A) Try to divide the expenses between both firms as best you can.
 - (B) Do as both recruiting officers told you. It is their money and their travel policies.
 - (C) File for travel expenses with only one firm.
 - (D) Tell all your classmates to sign up to interview with these firms for the trips.

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27. A company can manufacture a product using hand tools. Costs will be \$1,000 for tools and a \$1.50 manufacturing cost per unit. As an alternative, an automated system will cost \$15,000 with a \$0.50 manufacturing cost per unit. With an anticipated annual volume of 5,000 units and neglecting interest, the breakeven point (years) is most nearly:
- (A) 2.8
 - (B) 3.6
 - (C) 15.0
 - (D) never
28. A printer costs \$900. Its salvage value after 5 years is \$300. Annual maintenance is \$50. If the interest rate is 8%, the equivalent uniform annual cost is most nearly:
- (A) \$224
 - (B) \$300
 - (C) \$327
 - (D) \$350
29. The need for a large-capacity water supply system is forecast to occur 4 years from now. At that time, the system required is estimated to cost \$40,000. If an account earns 12% per year compounded annually, the amount that must be placed in the account at the end of each year in order to accumulate the necessary purchase price is most nearly:
- (A) \$8,000
 - (B) \$8,370
 - (C) \$9,000
 - (D) \$10,000

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30. A project has the estimated cash flows shown below.

	0	1	2	3	4
	-\$1,100	-\$400	+\$1,000	+\$1,000	+\$1,000

Using an interest rate of 12% per year compounded annually, the annual worth of the project is most nearly:

- (A) \$450
 - (B) \$361
 - (C) \$320
 - (D) \$226
31. You must choose between four pieces of comparable equipment based on the cash flows given below. All four pieces have a life of 8 years.

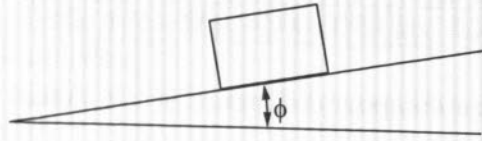
First cost	\$25,000	\$35,000	\$20,000	\$40,000
Annual costs	\$ 8,000	\$ 6,000	\$ 9,000	\$ 5,000
Salvage value	\$ 2,500	\$ 3,500	\$ 2,000	\$ 4,000

The discount rate is 12%. Ignore taxes. The most preferable top two projects and the difference between their present worth values are most nearly:

- (A) A and C, \$170
- (B) B and D, \$170
- (C) A and C, \$234
- (D) B and D, \$234

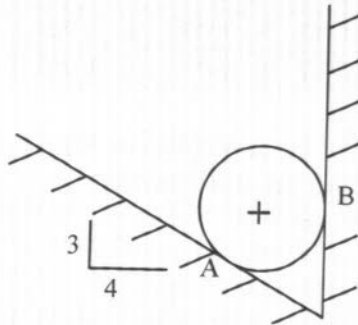
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32. Referring to the figure below, the coefficient of static friction between the block and the inclined plane is 0.25. The block is in equilibrium.



As the inclined plane is raised, the block will begin to slide when:

- (A) $\sin \phi = 1.0$
 - (B) $\cos \phi = 1.0$
 - (C) $\cos \phi = 0.25$
 - (D) $\tan \phi = 0.25$
33. A cylinder weighing 120 N rests between two frictionless walls as shown in the following figure.

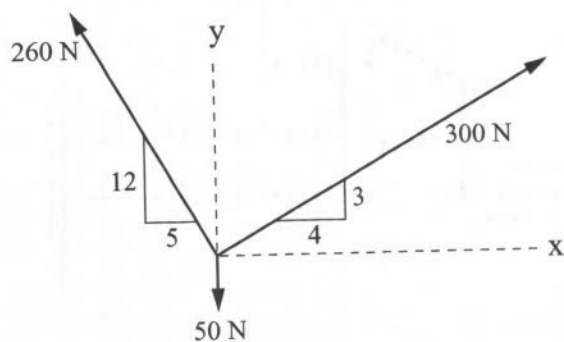


The wall reaction (N) at Point A is most nearly:

- (A) 96
- (B) 139
- (C) 150
- (D) 200

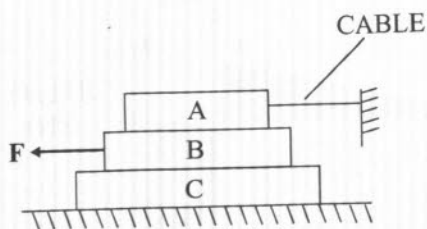
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34. Three forces act as shown below.



The magnitude of the resultant of the three forces (N) is most nearly:

- (A) 140
(B) 191
(C) 370
(D) 396
35. In the figure below, Block A weighs 50 N, Block B weighs 80 N, and Block C weighs 100 N. The coefficient of friction at all surfaces is 0.30.

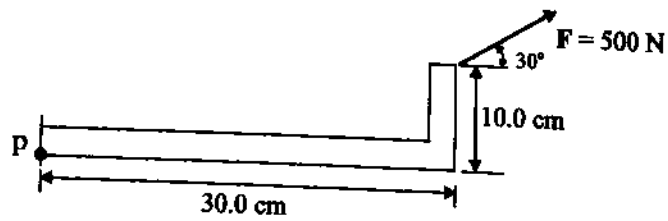


The maximum force F (N) that can be applied to Block B without disturbing equilibrium is most nearly:

- (A) 15
(B) 54
(C) 69
(D) 84

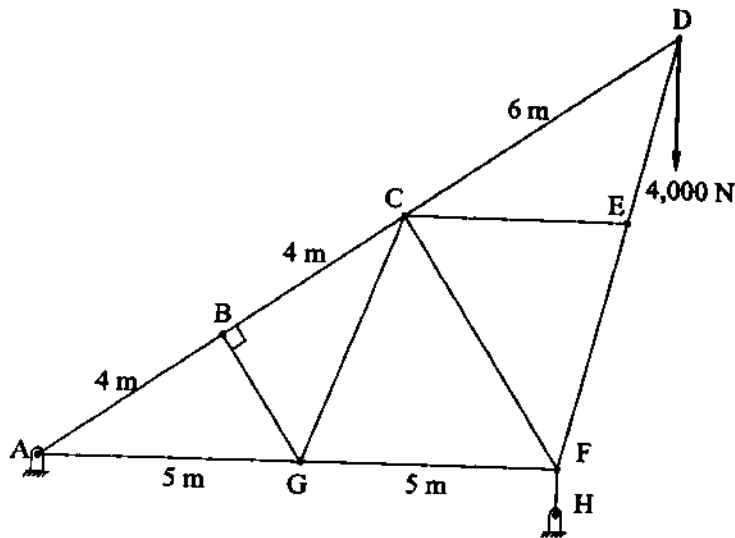
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36. The moment of force F ($\text{N}\cdot\text{m}$) shown below with respect to Point p is most nearly:



- (A) 31.7 ccw
- (B) 31.7 cw
- (C) 43.3 cw
- (D) 43.3 ccw

37. The figure below shows a simple truss.

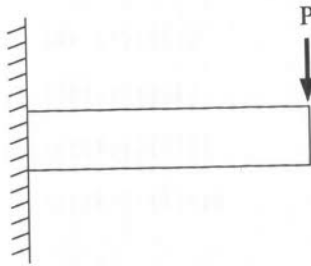


The zero-force members in the truss are:

- (A) BG, CG, CF, CE
- (B) BG, CE
- (C) CF
- (D) CG, CF

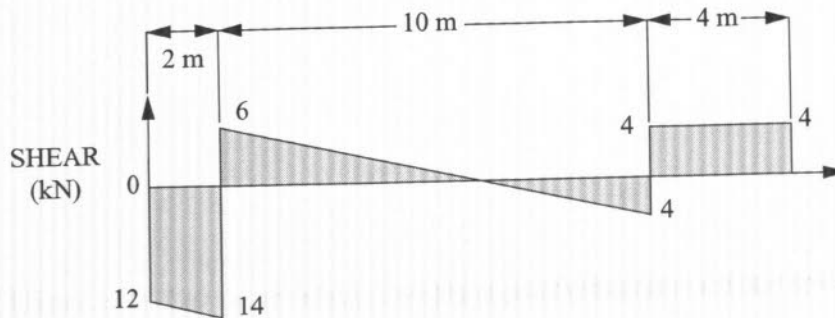
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38. The beam shown below is known as a:



- (A) cantilever beam
- (B) statically indeterminate beam
- (C) simply supported beam
- (D) continuously loaded beam

39. The shear diagram for a particular beam is shown below. All lines in the diagram are straight. The bending moment at each end of the beam is zero, and there are no concentrated couples along the beam.



The maximum magnitude of the bending moment ($\text{kN}\cdot\text{m}$) in the beam is most nearly:

- (A) 8
- (B) 16
- (C) 18
- (D) 26

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40. The piston of a steam engine is 50 cm in diameter, and the maximum steam gage pressure is 1.4 MPa. If the design stress for the piston rod is 68 MPa, its cross-sectional area (m^2) should be most nearly:

(A) 40.4×10^{-4}
(B) 98.8×10^{-4}
(C) 228.0×10^{-4}
(D) 323.0×10^{-4}

41. A shaft of wood is to be used in a certain process. If the allowable shearing stress parallel to the grain of the wood is 840 kN/m^2 , the torque ($\text{N}\cdot\text{m}$) transmitted by a 200-mm-diameter shaft with the grain parallel to the neutral axis is most nearly:

(A) 500
(B) 1,200
(C) 1,320
(D) 1,500

42. The Euler formula for columns deals with:

(A) relatively short columns
(B) shear stress
(C) tensile stress
(D) elastic buckling

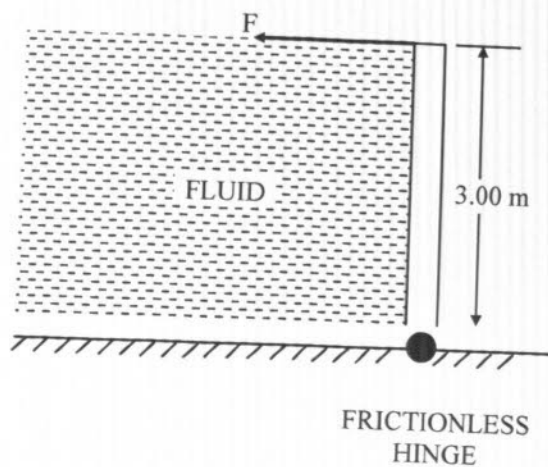
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43. The mechanical deformation of a material above its recrystallization temperature is commonly known as:
- (A) hot working
 - (B) strain aging
 - (C) grain growth
 - (D) cold working
44. In general, a metal with high hardness will also have:
- (A) good formability
 - (B) high impact strength
 - (C) high electrical conductivity
 - (D) high yield strength
45. Glass is said to be an amorphous material. This means that it:
- (A) has a high melting point
 - (B) is a supercooled vapor
 - (C) has large cubic crystals
 - (D) has no apparent crystal structure

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46. If an aluminum crimp connector were used to connect a copper wire to a battery, what would you expect to happen?
- (A) The copper wire only will corrode.
 - (B) The aluminum connector only will corrode.
 - (C) Both will corrode.
 - (D) Nothing

47. The rectangular homogeneous gate shown below is 3.00 m high \times 1.00 m wide and has a frictionless hinge at the bottom. If the fluid on the left side of the gate has a density of $1,600 \text{ kg/m}^3$, the magnitude of the force F (kN) required to keep the gate closed is most nearly:

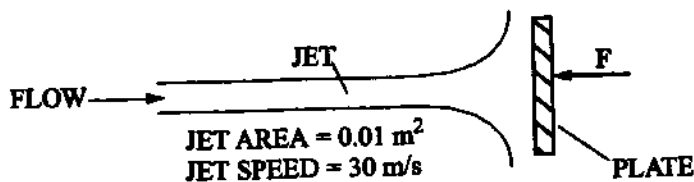


- (A) 0
- (B) 22
- (C) 24
- (D) 220

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48. Which of the following statements is true of viscosity?
- (A) It is the ratio of inertial to viscous force.
 - (B) It always has a large effect on the value of the friction factor.
 - (C) It is the ratio of the shear stress to the rate of shear deformation.
 - (D) It is usually low when turbulent forces predominate.

49. A horizontal jet of water (density = $1,000 \text{ kg/m}^3$) is deflected perpendicularly to the original jet stream by a plate as shown below.



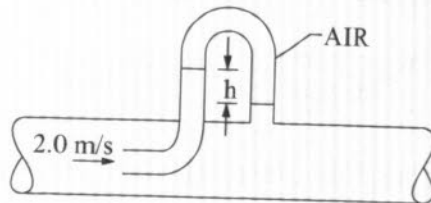
The magnitude of force F (kN) required to hold the plate in place is most nearly:

- (A) 4.5
- (B) 9.0
- (C) 45.0
- (D) 90.0

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50. Which of the following statements about flow through an insulated valve is most accurate?
- (A) The enthalpy rises.
 - (B) The upstream and downstream enthalpies are equal.
 - (C) Temperature increases sharply.
 - (D) Pressure increases sharply.

51. The pitot tube shown below is placed at a point where the velocity is 2.0 m/s. The specific gravity of the fluid is 2.0, and the upper portion of the manometer contains air. The reading h (m) on the manometer is most nearly:



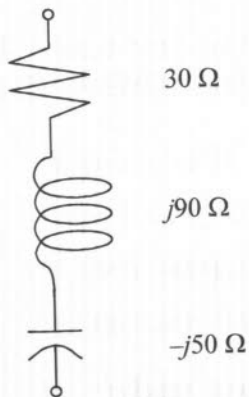
- (A) 20.0
- (B) 10.0
- (C) 0.40
- (D) 0.20

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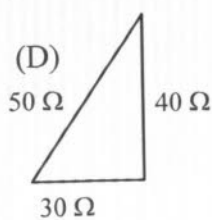
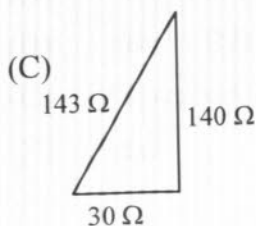
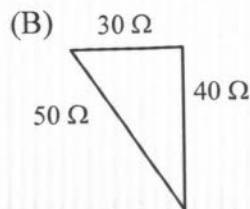
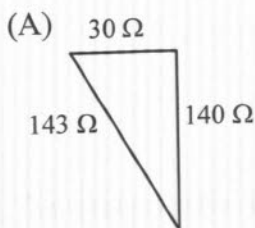
52. If the complex power is 1,500 VA with a power factor of 0.866 lagging, the reactive power (VAR) is most nearly:

- (A) 0
- (B) 750
- (C) 1,300
- (D) 1,500

53. Series-connected circuit elements are shown in the figure below.



Which of the following impedance diagrams is correct according to conventional notation?

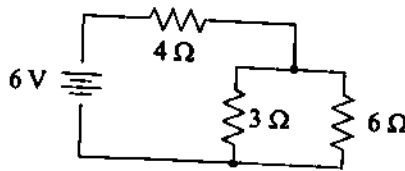


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54. A $10\text{-}\mu\text{F}$ capacitor has been charged to a potential of 150 V . A resistor of $25\ \Omega$ is then connected across the capacitor through a switch. When the switch is closed for ten time constants, the total energy (joules) dissipated by the resistor is most nearly:

- (A) 1.0×10^{-7}
- (B) 1.1×10^{-1}
- (C) 9.0×10^1
- (D) 9.0×10^3

55. The connecting wires and the battery in the circuit shown below have negligible resistance.



The current (amperes) through the $6\text{-}\Omega$ resistor is most nearly:

- (A) $1/3$
- (B) $1/2$
- (C) 1
- (D) $3/2$

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56. The term $\frac{(1-i)^2}{(1+i)^2}$, where $i = \sqrt{-1}$, is most nearly:
- (A) -1
 - (B) $-1 + i$
 - (C) 0
 - (D) $1 + i$
57. An insulated tank contains half liquid and half vapor by volume in equilibrium. The release of a small quantity of the vapor without the addition of heat will cause:
- (A) evaporation of some liquid in the tank
 - (B) superheating of the vapor in the tank
 - (C) a rise in temperature
 - (D) an increase in enthalpy
58. The heat transfer during an adiabatic process is:
- (A) reversible
 - (B) irreversible
 - (C) dependent on temperature
 - (D) zero

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59. An isentropic process is one which:
- (A) is adiabatic but not reversible
 - (B) is reversible but not adiabatic
 - (C) is adiabatic and reversible
 - (D) occurs at constant pressure and temperature
60. The universal gas constant is $8.314 \text{ kJ}/(\text{kmol}\cdot\text{K})$. The gas constant $[(\text{kJ}/(\text{kg}\cdot\text{K}))]$ of a gas having a molecular weight of 44 is most nearly:
- (A) 0.19
 - (B) 0.38
 - (C) 0.55
 - (D) 5.3

**IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY WISH
TO CHECK YOUR WORK ON THIS TEST.**