(Common to all candidates)

(Answer ALL questions)

21. The r.m.s value of the current $i(t)$ in the circuit shown below is
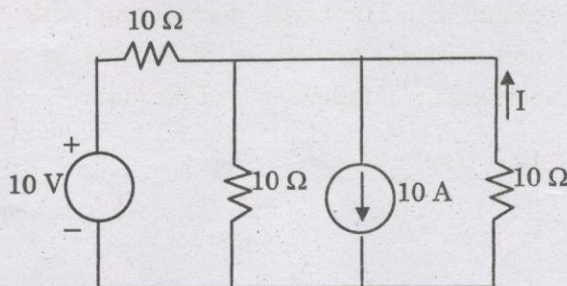

(1.0 sin t) V
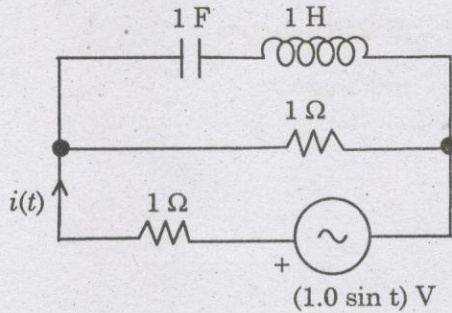
1. $\dfrac{1}{2}$ A

2. $\dfrac{1}{\sqrt{2}}$ A

3. 1 A

4. $\sqrt{2}$ A

22. The average power delivered to an impedance $(4 - j3)\Omega$ by a current $5\cos(100\pi t + 100)$ is

1. 44.2 W

2. 50 W

3. 62.5 W

4. 125 W

23. The current shown in the circuit given below is equal to

1. 3 A

2. 2.67 A

3. 6 A

4. 9 A

24. Three similar resistors are connected in star across 400 V, 3 phase lines. The line current is 5 A. The value of the resistance is

1. 46.2 Ω

2. 4.62 Ω

3. 80 Ω

4. 40 Ω

25. The terminal voltage of a battery is 14 V at no load. When the battery is supplying 100 A of current to a load the terminal voltage drops to 12 V. Then the source impedance is

1. 0.2 Ω

2. 1.4 Ω

3. 1.2 Ω

4. 0 Ω

26. An 50-dB sound relative to a 20-dB sound is more intense by a factor of

1. 3

2. 30

3. 70

4. 10^3

27. The diameter of atoms in a FCC crystal (if 'a' is lattice parameter) is

1. a

2. $a/2$

3. $a/\sqrt{2}$

4. $(a/2)\sqrt{3}$

28. In an air-wedge experiment if the space between the two glass plates $(n = 1.52)$ contains water $(n = 1.33)$ then the fringe spacing

1. is reduced by a factor of 1.33

2. is increased by a factor of 1.33

3. is reduced by a factor of 1.52

4. remains the same

29. Photons in a vacuum have the same
    1. speed
    2. energy
    3. wavelength
    4. frequency

30. In a helium-neon laser, the laser light arises from a transition from a ——————— state to a ——————— state.
    1. He, Ne
    2. He, He
    3. Ne, Ne
    4. Ne, He

31. During ductile fracture, the dislocation motion occurs
    1. in high atomic density planes and in high atomic density directions
    2. in low atomic density planes and in low atomic density directions
    3. in high atomic density planes and in low atomic density directions
    4. in low atomic density planes and in high atomic density directions

32. A Bloch wall is a narrow region in which the orientation of atomic moments changes systematically by
    1. 45°
    2. 60°
    3. 90°
    4. 180°

33. In a conductor, the flow of electrons is affected by
    1. crystal defects
    2. impurity atoms
    3. thermal vibrations
    4. all of the above

34. Fermi level for an extrinsic semiconductor depends on
    1. donor element
    2. impurity concentration
    3. temperature
    4. all of the above

35. ——————— is not a characteristic property of a ceramic material.
    1. Low compressive strength
    2. High compressive strength
    3. Low tensile strength
    4. Low fracture toughness

36. The dimensions of dynamic viscosity are
    1. $M^1 L^2 T^1$
    2. $M^0 L^2 T^{-1}$
    3. $M^1 L^2 T^{-2}$
    4. $M^1 L^{-1} T^{-1}$

37. The appropriate conservation law applicable for solving hydraulic machines problem is
    1. Conservation of mass
    2. Conservation of momentum
    3. Conservation of moment of momentum
    4. Conservation of energy

38. The appropriate velocity profile for a turbulent boundary layer is
    1. Linear
    2. Parabolic
    3. Logarithmic
    4. Spiral

39. The appropriate type of hydraulic turbine for high head and low discharge is
    1. Pelton Wheel
    2. Francis Turbine
    3. Bulb Turbine
    4. Kaplan Turbine

40. A wastewater sample of 2 ml is made up to 300 ml in a BOD bottle with distilled water. Initial DO of the sample is 8 mg/l and after 5 days it is 2 mg/l. What is its BOD_5?
    1. 750 mg/l
    2. 900 mg/l
    3. 1000 mg/l
    4. 1200 mg/l

41. Static equilibrium for a body applied with a system of concurrent non-coplanar forces are

1. $\Sigma F_x = 0$, $\Sigma F_y = 0$

2. $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$, $\Sigma M_x = 0$, $\Sigma M_y = 0$, $\Sigma M_z = 0$

3. $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$

4. $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M_{z-axis} = 0$

42. Area moment of inertia of the beam is

1. proportional to applied moment

2. proportional to inertia force

3. proportional to resistance to motion

4. proportional to frictional force

43. A body of mass 3 kg is dropped from a building, the velocity of the body after 3 is

1. 9.81 m/s²

2. 19.62 m/s²

3. 0

4. 29.4 m/s²

44. The theorem used for equilibrium of a particle applied with three concurrent coplanar forces is

1. Varignon's theorem

2. Lame's theorem

3. Parallelogram theorem

4. Pythagoras theorem

45. The force required to slide the body of weight 200 N placed on horizontal surface of co-efficient friction 0.2 is

1. 200 N

2. 100 N

3. 400 N

4. 40 N

46. A cylindrical gas tank 1 m long, inside diameter of 20 cm, is evacuated and then filled with carbon dioxide gas at 25°C. To what pressure should it be charged if there should be 1.2 kg of carbon dioxide?

1. 25 Mpa

2. 2.15 Mpa

3. 3.5 Mpa

4. 2.25 Mpa

47. In which of the paths between initial state i and final state f in the figure given below is the work done on the gas the greatest?
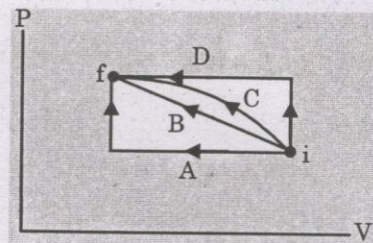
1. A

2. B

3. D

4. C

48. A 1-kg block of ice at 0°C is placed into a perfectly insulated, sealed container that has 2 kg of water also at 0°C. The water and ice completely fill the container, but the container is flexible. After some time one can expect that

1. the water will freeze so that the mass of the ice will increase

2. the ice will melt so that the mass of the ice will decrease

3. both the amount of water and the amount of ice will remain constant

4. both the amount of water and the amount of ice will decrease

49. Which of the following processes must violate the first law of thermodynamics?

1. $W > 0$, $Q < 0$, and $\Delta E_{int} = 0$

2. $W > 0$, $Q < 0$, and $\Delta E_{int} > 0$

3. $W > 0$, $Q < 0$, and $\Delta E_{int} < 0$

4. $W > 0$, $Q > 0$, and $\Delta E_{int} < 0$

50. A system is taken from state A to state B along two different paths 1 and 2. The heat absorbed and work done by the system along these paths are Q_1 and Q_2 and W_1 and W_2 respectively. Then

1. $Q_1 = Q_2$

2. $W_1 + Q_1 = Q_2 + W_2$

3. $W_1 = W_2$

4. $Q_1 - W_1 = Q_2 - W_2$

51. Which is correct in the case of vander Waals adsorption?

1. High temperature, low pressure

2. Low temperature, high pressure

3. Low temperature, low pressure

4. High temperature, high pressure

52. The first order reaction,
$$2N_2O_{(g)} \rightarrow 2N_{2\,(g)} + O_{2\,(g)},$$
has a rate constant equal to 0.76 s^{-1} at 1000 K. How long will it take for the concentration of N_2O to decrease to 42% of its initial concentration?

1. 3.1 s

2. 0.18 s

3. 1.1 s

4. 2.4 s

53. When a silver cup is plated with silver by passing 965 Coulombs of electricity, the amount of silver deposited is

1. 10.787 g

2. 107. 87 g

3. 1.0787 g

4. 0.10787 g

54. Which of the following analytical methods would you choose to investigate whether a compound is a monomer, dimer or trimer?

1. NMR spectroscopy

2. ESI-MS

3. IR spectroscopy

4. Elemental analysis

55. The higher calorific value of fuel occurs when water vapour

1. present in products of combustion is condensed to the initial temperature of the fuel

2. present in the products of combustion is not condensed to the initial temperature of the fuel

3. is not formed during the combustion of fuel

4. is formed during the combustion of fuel