MHT-CET 2022 Question Paper

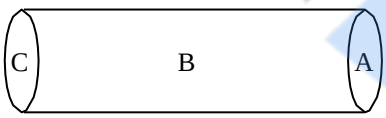
6th August 2022 (Shift – I)

1. Three isolated metal spheres A, B, C have radius R, 2R, 3R respectively, and same charge Q. U_A, U_B and U_C be the energy density just outside the surface of the spheres. The relation between U_A, U_B and U_C is
   (A) $U_A > U_B < U_C$ (B) $U_A > U_B > U_C$
   (C) $U_A < U_B < U_C$ (D) $U_A < U_B > U_C$

2. In an adiabatic expansion of a gas initial and final temperatures are T_1 and T_2 respectively then the change in internal energy of the gas is [R = gas constant, γ = adiabatic ratio]
   (A) $R(T_1 - T_2)$ (B) $\frac{R}{\gamma - 1}(T_1 - T_2)$
   (C) $\frac{R}{\gamma - 1}(T_2 - T_1)$ (D) zero

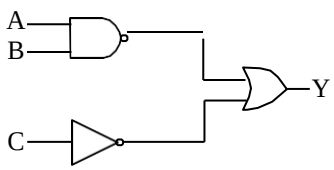
3. In which thermodynamic process, there is no exchange of heat between the system and surroundings?
   (A) Isothermal (B) Adiabatic
   (C) Isochoric (D) Isobaric

4. A hollow cylinder has a charge q coulomb within it. It ϕ is the electric flux associated with the curved surface B, the flux linked with the plane surface A will be



   (A) $\frac{\phi}{3}$ (B) $\frac{q}{\epsilon_0} - \phi$
   (C) $\frac{1}{2}\left(\frac{q}{\epsilon_0} - \phi\right)$ (D) $\frac{q}{2\epsilon_0}$

5. The output Y when all the three inputs A, B, C are first low and then high will be respectively



   (A) 0, 1 (B) 1, 0
   (C) 1, 1 (D) 0, 0

6. In metre bridge experiment, null point is obtained at 20 cm from left end of the wire, when resistance X is balanced against another resistance Y (X < Y). To balance a resistance 4 X against Y, the new position of the null point from the same end will be
   (A) 80 cm (B) 60 cm
   (C) 40 cm (D) 50 cm

7. The work done by a force on body of mass 5 kg to accelerate it in the direction of force from rest to 20 m/s^2 in 10 second is
   (A) 2×10^3 J (B) 4×10^3 J
   (C) 10^{-3} J (D) 10^3 J

8. A diffraction pattern is obtained by making blue light incident on a narrow slit. If blue light is replaced by red light then
   (A) there is no change in diffraction pattern.
   (B) diffraction bands become broader.
   (C) diffraction bands disappear.
   (D) diffraction bands become narrower.

9. In a p-type semiconductor,
   (A) electrons are minority carriers and pentavalent atoms are dopants.
   (B) electrons are majority carries and pentavalent atoms are dopants.
   (C) holes are majority carriers and trivalent atoms are dopants.
   (D) holes are minority carriers and trivalent atoms are dopants.

10. Two thin lenses have a combined power of + 9D. When they are separated by a distance of 20 cm, then their equivalent power becomes $+\frac{27}{5}$ D. Their individual power (in dioptre) is respectively
    (A) 3, 6 (B) 1, 8
    (C) 2, 7 (D) 4, 5

11. In hydrogen atom, radius of the smallest orbit of the elctron is a_0, the radius of the third orbit is
    (A) $9\,a_0$ (B) $\frac{a_0}{9}$
    (C) $3\,a_0$ (D) $6\,a_0$

12. Which one of the following statements is 'NOT' true about the angle of contant of a liquid?
    (A) Any increase in the temperature of the liquid does not decrease its angle of contact.
    (B) Angle of contact depends upon the nature of liquid and solid in contact.
    (C) If an impurity is added in the liquid then it's angle of contact changes.
    (D) At a given temperature, the angle of contact is constant for a solid-liquid surface.

13. Two coils P and S have a mutual inductance of 3×10^{-3} H. If the current in the coil, P is I = 20 sin (50 πt), then the maximum value of the e.m.f. induced in coil S is
(A) 6.28 V (B) 12.56 V
(C) 15.70 V (D) 3.14 V

14. A metal wire of density 'ρ' floats on water surface horizontally. If it is NOT to sink in water, then maximum radius of wire is
(T = surface tension of water, g = gravitational acceleration)
(A) $\sqrt{\frac{\pi\rho g}{T}}$ (B) $\frac{T}{\pi\rho g}$
(C) $\frac{\pi\rho g}{T}$ (D) $\sqrt{\frac{2T}{\pi\rho g}}$

15. A mass tied to a string is whirled in a horizontal circular path with a constant angular velocity and its angular momentum is L. If the string is now halved, keeping angular velocity same, then the angular momentum will be
(A) L (B) $\frac{L}{4}$
(C) 2L (D) $\frac{L}{2}$

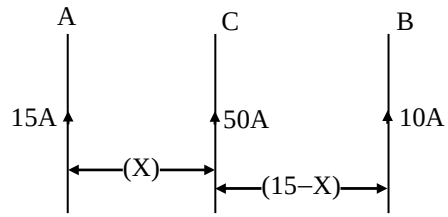
16. A galvanometer of resistance G has voltage range V_g. Resistance required to convert it to read voltage up to V is
(A) $\left(\frac{V-V_g}{V}\right).G$ (B) $G\cdot\left[\frac{V}{V_g}-1\right]$
(C) $\frac{G\cdot V_g}{V}-G$ (D) $\left(\frac{V+V_g}{V}\right).G$

17. In LCR series resonance circuit, choose the wrong statement.
(A) Resonance occurs at $X_L = X_C$.
(B) At resonance, current has a maximum value.
(C) At resonance, circuit is purely inductive.
(D) At resonance, impedance is minimum.

18. An electron jumps from the 4th orbit to the 2nd orbit of hydrogen atom. Given the Rydberg's constant $R = 10^7 m^{-1}$. The frequency in Hz of the emitted radiation is ($c = 3 \times 10^8$ m/s)
(A) $\frac{9}{16}\times10^{15}$ (B) $\frac{3}{16}\times10^{5}$
(C) $\frac{3}{16}\times10^{15}$ (D) $\frac{9}{16}\times10^{5}$

19. Two point charges q_1 and q_2 are 'l' distance apart. If one of the charges is doubled and distance between them is halved, the magnitude of force becomes n times, where n is
(A) 16 (B) 8
(C) 1 (D) 2

20. Three long straight and parallel wires carrying currents are arranged as shown



The wire C which carries a current of 50A is so placed that it experiences no force. The distance of wire C from wire A is
(A) 7 cm (B) 9 cm
(C) 3 cm (D) 5 cm

21. A photon of energy 'E' ejects photoelectrons from a metal surface whose work function is W_0. If this electron enters into uniform magnetic field of induction 'B' in a direction perpendicular to field and describes a circular path of radius 'r', then radius is given by
(A) $\frac{\sqrt{2m(E-W_0)}}{eB}$ (B) $\sqrt{\frac{2e(E-W_0)}{mB}}$
(C) $\sqrt{\frac{2m(E-W_0)}{eB}}$ (D) $\sqrt{2m(E-W_0)eB}$

22. A satellite of mass 'm' is revolving around the earth of mass 'M' in an orbit of radius 'r'. The angular momentum of the satellite about the centre of orbit will be
(A) $\sqrt{GMmr}$ (B) $\sqrt{GMm^2r}$
(C) $\sqrt{mvr}$ (D) $\sqrt{GMm}$

23. The coefficient of linear expansion of brass and steel rod are 'α_1' and 'α_2' respectively. Lengths of brass and steel rods are 'l_1' and 'l_2' respectively. If ($l_2 - l_1$) is maintained same at all temperatures, which one of the following relation is correct?
(A) $\alpha_1 l_2 = \alpha_2 l_1$ (B) $l_1\alpha_1 = l_2\alpha_2$
(C) $\alpha_1 l_2^2 = \alpha_2 l_1^2$ (D) $\alpha_1^2 l_2 = \alpha_2^2 l_1$

24. Consider the following statements about interference of light.
A – When crest of one wave coincides with crest of another wave at a point, this point is a point of destructive interference.
B – Two coherent sources emit wave of same frequency with constant phase difference.
Choose the correct option from the following.
(A) Both statements A and B are wrong.
(B) Statement B is correct while statement A is wrong.
(C) Statement A is correct while statement B is wrong.
(D) Both statements A and B are correct.

25. Two satellites A and B rotate round a planet's orbit having radius 4R and R respectively. If the speed of satellite A is 3 V then speed of satellite B is

(A) $\frac{3V}{2}$ (B) 6V

(C) $\frac{4V}{2}$ (D) 12V

26. An equation of a simple harmonic progressive wave is given by y = A sin (100 πt – 3x). The distance between two particles having a phase difference of $(\pi/3)^c$ in metre is

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{18}$

(C) $\frac{\pi}{9}$ (D) $\frac{\pi}{6}$

27. A wall is hit elastically and normally by 'n' balls per second. All the balls have the same mass 'm' and are moving with the same velocity 'u'. the force exerted by the balls on the wall is

(A) 2mnu (B) $\frac{1}{2}mnu^2$

(C) mnu (D) $2mnu^2$

28. A magnetizing field of 1000 A/m produces a magnetic flux of 2.4×10^{-5} Wb in an iron bar of cross-sectional area 0.3 cm^2. The magnetic permeability of the iron bar in SI unit is

(A) 2.5×10^{-4} (B) 8×10^{-4}

(C) 5×10^{-4} (D) 4×10^{-4}

29. For a particular sound wave propagating in air, a path difference between two points is 0.54 m which is equivalent to phase difference of $(1.8\ \pi)^c$. If the velocity of sound wave in air is 330 m/s, the frequency of this wave is

(A) 110 Hz. (B) 367 Hz.

(C) 550 Hz. (D) 660 Hz.

30. To a bird in air, a fish in water appears to be at 30 cm from the surface. If refractive index of water with respect to air is $\frac{4}{3}$, the real distance of bird from the surface is

(A) 30cm (B) 50cm

(C) 40cm (D) 60cm

31. With an alternating voltage source of frequency 'f', inductor 'L', capacitor 'C' and resistance 'R' are connected in series. The voltage leads the current by 45°. The value of 'L' is (tan 45° = 1)

(A) $\left(\frac{1-2\pi fCR}{4\pi^2 f^2 C}\right)$ (B) $\left(\frac{4\pi^2 f^2 C}{1-2\pi fCR}\right)$

(C) $\left(\frac{1+2\pi fCR}{4\pi^2 f^2 C}\right)$ (D) $\left(\frac{4\pi^2 f^2 C}{1+2\pi fCR}\right)$

32. If 'N' is the number of turns in a circular coil, the value of its self-inductance varies as

(A) N^0 (B) N^3

(C) N^2 (D) N^1

33. Four identical condensers are connected in parallel and then in series equivalent capacitance in series to that in parallel combination is

(A) 16 : 1 (B) 4 : 1

(C) 1 : 4 (D) 1 : 16

34. If 'V' is velocity and 'a' is acceleration of a particle executing linear simple harmonic motion. Which one of the following statements is correct?

(A) when 'a' is maximum, v is maximum.

(B) when 'a' is maximum, v is zero.

(C) when 'a' is zero, v is zero.

(D) 'a' is zero for any value of 'v'.

35. For a particle performing S.H.M. the equation $\left(\frac{d^2x}{dt^2}\right) + a\ x = 0$. Then the time period of the motion will be

(A) $2\pi a$ (B) $\frac{2\pi}{\sqrt{\propto}}$

(C) $\frac{2\pi}{\propto}$ (D) $2\pi\sqrt{\propto}$

36. Two spheres 'S_1' and 'S_2' have same radii but temperatures are 'T_1' and 'T_2' respectively. Their emissive power is same and emissivity is in the ratio 1 : 4. Then the ratio 'T_1' to 'T_2' is

(A) 1 : 2 (B) 2 : 1

(C) $\sqrt{2}$: 1 (D) 1 : $\sqrt{2}$

37. A photoelectric surface is illuminated successively by monochromatic light of wavelength '(λ)' and '$\left(\frac{\lambda}{2}\right)$'. If the maximum kinetic energy of the emitted photoelectrons in the first case is one-third that in the second case, the work function of the surface of the material is (c = speed of light, h = Planck's constant.)

(A) $\frac{hc}{3\lambda}$ (B) $\frac{hc}{2\lambda}$

(C) $\frac{2hc}{\lambda}$ (D) $\frac{hc}{\lambda}$

38. Air column in two identical tubes is vibrating. Tube A has one end closed and tube B has both ends open. Neglecting end correction, the ratio of the fundamental frequency of air column in tube A to that in tube B is

(A) 2 : 1 (B) 4 : 1

(C) 1 : 4 (D) 1 : 2

39. A string is vibrating in its fifth overtone between two rigid supports 2.4 m apart. The distance between successive node and antinode is
(A) 0.2 m (B) 0.6 m
(C) 0.8 m (D) 0.1 m

40. The maximum speed of a particle in S.H.M. is V. The average speed is
(A) $\frac{3V}{\pi}$ (B) $\frac{4V}{\pi}$
(C) $\frac{V}{\pi}$ (D) $\frac{2V}{\pi}$

41. A liquid drop having surface energy 'E' is spread into 216 droplets of the same size. The final surface energy of the droplets is
(A) 3 E (B) 8 E
(C) 2 E (D) 6 E

42. A light wave of wavelength 'λ' is incident on a slit of width 'd'. The resulting diffraction pattern is observed on a screen at a distance 'D'. If linear width of the principal maximum is equal to the width of the slit, then the distance D is
(A) $\frac{2\lambda^2}{d}$ (B) $\frac{d}{\lambda}$
(C) $\frac{d^2}{2\lambda}$ (D) $\frac{2\lambda}{d}$

43. A transistor is used as a common emitter amplifier with a load resistance 2kΩ. The input resistance is 150Ω. Base current is changed by 20μA which results in a change in collector current by 1.5 mA. The voltage gain of the amplifier is
(A) 1100 (B) 1200
(C) 900 (D) 1000

44. A 4 kg mass and a 1 kg mass are moving with equal energies. The ratio of the magnitude of their linear momenta is
(A) 1 : 2 (B) 2 : 1
(C) 1 : 1 (D) 4 : 1

45. The ratio of the speed of sound in helium gas to that in nitrogen gas at same temperature is
($\gamma_{He} = \frac{5}{3}$, $\gamma_{N2} = \frac{7}{5}$, $M_{He} = 4$, $M_{N_2} = 28$)
(A) $\frac{5}{\sqrt{3}}$ (B) $\sqrt{\frac{7}{5}}$
(C) $\sqrt{\frac{2}{7}}$ (D) $\sqrt{\frac{5}{3}}$

46. A van is moving with a speed of 108 km/hr on a level road where the coefficient of friction between the tyres and the road is 0.5. For the safe driving of the van, the minimum radius of curvature of the road shall be (Acceleration due to gravity, g = 10 m/s^2)
(A) 180 m (B) 120 m
(C) 80 m (D) 40 m

47. Two long parallel wires seperated by distance 'd' carry currents I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of the wire is increased to three times and its direction is made opposite. The distance between the wires is doubled. The magnitude of force between them is
(A) $\frac{F}{2}$ (B) $\frac{3F}{2}$ (C) $\frac{2F}{3}$ (D) 3F

48. A metal disc of radius 'R' rotates with an angular velocity 'ω' about an axis perpendicular to its plane passing through its centre in a magnetic field of induction 'B' acting perpendicular to the plane of the disc. The induced e.m.f. between the rim and axis of the disc is (magnitude only)
(A) $\frac{B\omega R}{2}$ (B) $\frac{B\omega^2 R^2}{2}$
(C) $\frac{B\omega R^2}{2}$ (D) $\frac{B\omega^2 R}{2}$

49. The relative angular speed of hour hand and second hand of a clock is (in rad/s)
(A) $\frac{421\pi}{11600}$ (B) $\frac{119\pi}{15600}$
(C) $\frac{719\pi}{21600}$ (D) $\frac{311\pi}{578}$

50. A condenser of capacity 'C' is charged to a potential difference of 'V_1'. The plates of the condenser are then connected to an ideal inductor of inductance 'L'. The current through an inductor when the potential difference across the condenser reduces to 'V_2' is
(A) $\frac{C\left(V_1^2 - V_2^2\right)}{L}$ (B) $\frac{C\left(V_1^2 + V_2^2\right)}{L}$
(C) $\left[\frac{C\left(V_1^2 - V_2^2\right)}{L}\right]^{\frac{1}{2}}$ (D) $\left[\frac{C\left(V_1 - V_2\right)^2}{L}\right]^{\frac{1}{2}}$