MHT-CET 2024 Question Paper - Physics

4th May 2024 (Shift – I)

1. According to the law of equipartition of energy the molar specific heat of a diatomic gas at constant volume where the molecule has one additional vibrational mode is

(A) $\frac{9}{2}R$ (B) $\frac{5}{2}R$

(C) $\frac{3}{2}R$ (D) $\frac{7}{2}R$

2. A parallel plate air capacitor, with plate separation 'd' has a capacitance of 9pF. The space between the plates is now filled with two dielectrics, the first having $K_1 = 3$ and thickness $d_1 = d/3$, while the 2nd has $K_2 = 6$ and thickness $d_2 = 2d/3$. The capacitance of the new capacitor is

(A) 3.8pF (B) 20.25pF

(C) 40.5pF (D) 45pF

3. The collector supply voltage is 6 V and a voltage drop across a resistor of 600Ω in the collector circuit is 0.6 V, in a circuit of transistor connected in common emitter mode. If the current gain is 20 then the base current is

(A) 0.25 mA (B) 0.05 mA

(C) 0.12 mA (D) 0.02 mA

4. The velocity of particle executing S.H.M. varies with displacement (x) as $4V^2 = 50 - x^2$. The time period of oscillation is $\frac{x}{7}$ second. The value of 'x' is (Take $\pi = \frac{22}{7}$)

(A) 22 (B) 44

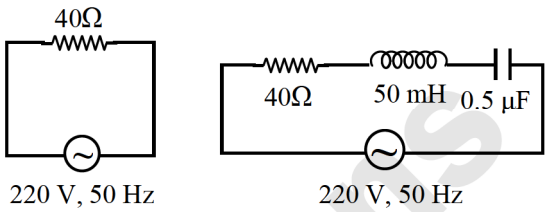
(C) 66 (D) 88

5. For a projectile, the maximum height and horizontal range are same. The angle of projection 'θ' of the projectile is

(A) $\tan^{-1}\left(\frac{1}{2}\right)$ (B) $\tan^{-1}(2)$

(C) $\tan^{-1}\left(\frac{1}{4}\right)$ (D) $\tan^{-1}(4)$

6. For the given figure, choose the correct option.



(a) (b)

(A) The r.m.s. current in circuit (b) can never be greater than that in circuit (a)

(B) The r.m.s. current in circuit (a) is always equal to that in circuit (b)

(C) The r.m.s. current in circuit (b) can be greater than in circuit (a)

(D) At resonance, current in (b) is less than that in circuit (a)

7. A disc and a ring both have same mass and radius. The ratio of moment of inertia of the disc about its diameter to that of a ring about a tangent in its plane is

(A) 1:2 (B) 1:4 (C) 1:6 (D) 1:8

8. Two waves $Y_1 = 0.25 \sin 316t$ and $Y_2 = 0.25 \sin 310t$ are propagating along the same direction. The number of beats produced per second are

(A) $\frac{\pi}{3}$ (B) $\frac{3}{\pi}$ (C) $\frac{2}{\pi}$ (D) $\frac{\pi}{2}$

9. In a meter bridge experiment, the balance point is obtained if the gaps are closed by 2 Ω and 3 Ω. A shunt of X Ω is added to 3 Ω resistor to shift the null point by 22.5 cm. The value of 'x' is

(A) 1 Ω (B) 2 Ω (C) 3 Ω (D) 4 Ω

10. Water rises up to height 'x' in a capillary tube immersed vertically in water. When the whole arrangement is taken to a depth 'd' in a mine, the water level rises up to height 'Y'. If 'R' is the radius of earth then the ratio $\frac{Y}{X}$ is

(A) $\left(1-\frac{d}{R}\right)^{-1}$ (B) $\left(1-\frac{d}{R}\right)$

(C) $\left(1+\frac{d}{R}\right)^{-1}$ (D) $\left(1+\frac{d}{R}\right)$

Target Publications

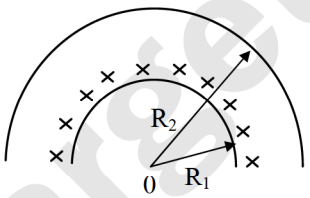
11. In an equilateral prism the ray undergoes minimum deviation when it is incident at an angle of 50°. The angle of minimum deviation is
(A) 50° (B) 40°
(C) 25° (D) 20°

12. A rotating body has angular momentum 'L'. If its frequency is doubled and kinetic energy is halved, its angular momentum will be
(A) $\frac{L}{4}$ (B) $\frac{L}{2}$
(C) 2 L (D) 4 L

13. The distance between two consecutive points with phase difference of 60° in wave of frequency 500 Hz is 0.6 m. The velocity with which wave is travelling is
(A) 1.8 km / s (B) 9 km / s
(C) 3.6 km / s (D) 2.7 km / s

14. A square loop of area 25 cm^2 has a resistance of 10Ω. The loop is placed in uniform magnetic field of magnitude 40 T. The plane of loop is perpendicular to the magnetic field. The work done in pulling the loop out of the magnetic field slowly and uniformly in 1 second, will be
(A) 2.5×10^{-3} J (B) 1.0×10^{-3} J
(C) 1.0×10^{-4} J (D) 5×10^{-3} J

15. The electric potential at the centre of two concentric half rings of radii R_1 and R_2, having same linear charge density 'λ' is
(ε_0 – permittivity of free space)



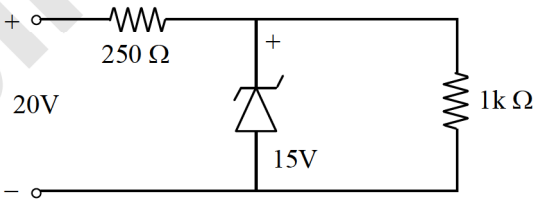
(A) $\frac{2\lambda}{\varepsilon_0}$ (B) $\frac{\lambda}{2\varepsilon_0}$
(C) $\frac{\lambda}{4\varepsilon_0}$ (D) $\frac{\lambda}{\varepsilon_0}$

16. Which of the following person is in an inertial frame of reference?
(A) A pilot in an aeroplane which is taking off.
(B) A child revolving in a merry-go-round.
(C) A driver in a bus which is moving with constant velocity.
(D) A man in a train which is slowing down to stop.

17. A charged particle of charge 'q' is accelerated by a potential difference 'V' enters a region of uniform magnetic field 'B' at right angles to the direction of field. The charged particle completes semicircle of radius 'r' inside magnetic field. The mass of the charged particle is
(A) $\frac{r^2qB^2}{2V}$ (B) $\frac{r^2q^2B^2}{\sqrt{2}V}$
(C) $\frac{qrB}{2V}$ (D) $\frac{q^2r^2B^2}{V}$

18. A simple pendulum of length l_1 has time period T_1. Another simple pendulum of length $l_2 (l_1 > l_2)$ has time period T_2. Then the time period of the pendulum of length $(l_1 - l_2)$ will be
(A) $T_1 - T_2$ (B) $\sqrt{\frac{T_1}{T_2}}$
(C) $\sqrt{T_1^2 - T_2^2}$ (D) $\sqrt{\frac{T_2}{T_1}}$

19. A zener diode, having breakdown voltage 15 V is used in a voltage regulator circuit as shown. The current through the zener diode is



(A) 20 mA (B) 5 mA
(C) 10 mA (D) 15 mA

20. If 'R' is the radius of Earth and 'g' is acceleration due to gravity on Earth's surface, then mean density of Earth is
(A) $\frac{4\pi G}{3gR}$ (B) $\frac{3\pi R}{4gG}$
(C) $\frac{3g}{4\pi RG}$ (D) $\frac{\pi RG}{12\ g}$

21. In LCR series circuit if the frequency is increased, the impedance of the circuit
(A) increases
(B) decreases
(C) either increases or decreases
(D) first decreases then become minimum and then increases.

22. A potentiometer wire of length 1 m is connected in series with 495 Ω resistance and 2 V battery. If 0.2 mV / cm is the potential gradient, then the resistance of the potentiometer wire is
(A) 8 Ω (B) 7 Ω
(C) 6 Ω (D) 5 Ω

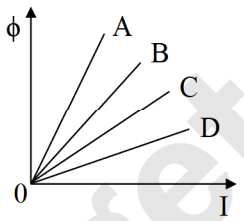
Target Publications

23. A carnot engine, whose efficiency is 40% takes heat from a source maintained at temperature 600 K. It is desired to have an efficiency 60%, then the intake temperature for the same exhaust (sink) temperature should be
(A) 1800 K (B) 1200 K
(C) 900 K (D) 600 K

24. A person is observing a bacteria through a compound microscope. For better analysis and to improve the resolving power he should
(A) increase the wavelength of light.
(B) increase the refractive index of the medium between the object and objective lens.
(C) decrease the focal length of the eye-piece.
(D) decrease the diameter of the objective lens.

25. Two rods of same length & material transfer a given amount of heat in 12 s when they are joined end to end. But when they are joined length wise parallel to each other they will transfer same amount of heat in same condition in time
(A) 24 s (B) 3 s
(C) 1.5 s (D) 48 s

26. A graph of magnetic flux (ϕ) versus current (I) is shown for four inductors A, B, C, D. Smaller value of self inductance is for inductor



(A) D (B) C (C) B (D) A

27. An insulated container contains a monoatomic gas of molar mass ' m '. The container is moving with velocity ' V '. If it is stopped suddenly, the change in temperature is (R = gas constant)
(A) $\frac{mV^2}{5R}$ (B) $\frac{mV^2}{3R}$
(C) $\frac{mV^2}{7R}$ (D) $\frac{mV^2}{9R}$

28. A ray of light is incident normally on a glass slab to thickness 5 cm and refractive index 1.6. The time taken to travel by a ray from source of light to surface of slab is same as to travel through glass slab. The distance of source from the surface is
(A) 5 cm (B) 8 cm
(C) 12 cm (D) 24 cm

29. The magnetic moments associated with two closely wound circular coils A and B of radius $r_A = 10$ cm and $r_B = 20$ cm respectively are equal if $(N_A, I_A$ and N_B, I_B are number of turns and current of A and B respectively)
(A) $2\,N_A I_A = N_B I_B$ (B) $N_A = 2\,N_B$
(C) $N_A I_A = 4\,N_B I_B$ (D) $4\,N_A I_A = N_B I_B$

30. Focal length of objective of an astronomical telescope is 1.5 m. Under normal adjustment, length of telescope is 1.56 m. Focal length of the eyepiece is
(A) 0.06 m (B) 1.04 m
(C) 2.34 m (D) 3.06 m

31. The surface of water in a water tank of cross section area $750\ cm^2$ on the top of a house is 'h' m above the tap level. The speed of water coming out through the tap of cross section area $500\ mm^2$ is 30 cm/s. At that instant $\frac{dh}{dt}$ is $x \times 10^{-3}$ m/s. The value of 'x' will be
(A) 2 (B) 3
(C) 4 (D) 6

32. A string A has twice the length, twice the diameter, twice the tension and twice the density of another string B. The overtone of A which will have the same fundamental frequency as that of B is
(A) first (B) second
(C) third (D) fourth

33. An inductor of inductance $2\mu H$ is connected in series with a resistance, a variable capacitor and an a.c. source of frequency 5 kHz. The value of capacitance for which maximum current is drawn into the circuit is $\frac{1}{x}F$, where the value of 'x' is (Take $\pi^2 = 10$)
(A) 500 (B) 1000
(C) 2000 (D) 4000

34. Three identical polaroids P_1, P_2 and P_3 are placed one after another. The pass axis of P_2 and P_3 are inclined at an angle 60° and 90° with respect to axis of P_1. The source has an intensity I_0. The intensity of transmitted light through P_3 is $\left(\cos 60° = 0.5, \cos 30° = \frac{\sqrt{3}}{2}\right)$
(A) $\frac{I_0}{8}$ (B) $\frac{3I_0}{16}$
(C) $\frac{3I_0}{32}$ (D) $\frac{I_0}{32}$

Target Publications

35. A semiconductor device X is connected in series with a battery and a resistor. The current of 10 mA is found to pass through the circuit. If the terminals of X are connected in reverse manner, the current drops to almost zero. X may be
(A) a zener diode
(B) a p-n junction diode
(C) an intrinsic semiconductor
(D) an extrinsic semiconductor

36. A solid cylinder of mass M and radius R is rotating about its geometrical axis. A solid sphere of the same mass and same radius is also rotating about its diameter with an angular speed half that of the cylinder. The ratio of the kinetic energy of rotation of the sphere to that of the cylinder will be
(A) 1 : 4 (B) 1 : 5
(C) 2 : 3 (D) 3 : 2

37. A circular coil of resistance R, area A, number of turns 'N' is rotated about its vertical diameter with angular speed 'ω' in a uniform magnetic field of magnitude 'B'. The average power dissipated in a complete cycle is
(A) $\frac{N^2 A^2 B^2\omega^2}{2R}$ (B) $\frac{BNA\omega}{R}$
(C) $\frac{N^2AB}{2R\omega^2}$ (D) $\frac{BA\omega}{2NR}$

38. The excess pressure inside a spherical drop of water A is four times that of another drop B. Then the ratio of mass of drop A to that of drop B is
(A) 1 : 4 (B) 1 : 8
(C) 1 : 16 (D) 1 : 64

39. A parallel plate capacitor has plate area 40 cm^2 and plate separation 2 mm. The space between the plates is filled with a dielectric medium of thickness 1 mm and dielectric constant 5. The capacitance of the system is (ϵ_0 = permitity of vacuum)
(A) $24\,\epsilon_0$ F (B) $\frac{3}{10}\epsilon_0$ F
(C) $\frac{10}{3}\epsilon_0$ F (D) $10\,\epsilon_0$ F

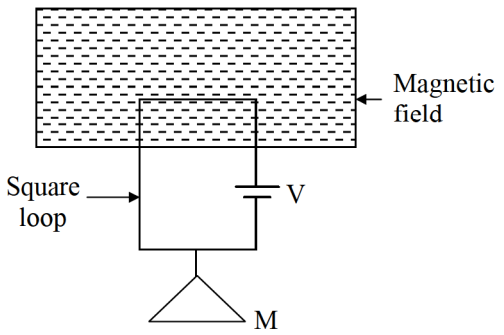
40. The height 'h' above the Earth's surface at which the value of acceleration due to gravity (g) becomes $\left(\frac{g}{3}\right)$ is
(R = radius of the Earth)
(A) $\left(\sqrt{3}+1\right)R$ (B) $\left(\sqrt{3}-1\right)R$
(C) $\sqrt{3}R$ (D) $3\sqrt{R}$

41. In an isobaric process of an ideal gas, the ratio of work done by the system to the heat supplied $\left(\frac{W}{Q}\right)$ is
(A) $\frac{1}{\gamma-1}$ (B) γ
(C) $\frac{\gamma}{\gamma-1}$ (D) $\frac{\gamma-1}{\gamma}$

42. The threshold frequency of a metal is 'F_0'. When light of frequency $2\,F_0$ is incident on the metal plate, the maximum velocity of photoelectron is 'V_1'. When the frequency of incident radiation is increased to '$5\,F_0$', the maximum velocity of photoelectrons emitted is 'V_2'. The ratio of V_1 to V_2 is
(A) $\frac{1}{8}$ (B) $\frac{1}{16}$
(C) $\frac{1}{4}$ (D) $\frac{1}{2}$

43. A charged particle is moving in a uniform magnetic field in a circular path with radius 'R'. When the energy of the particle is doubled, then the new radius will be
(A) $\frac{R}{\sqrt{2}}$ (B) 2R
(C) $\frac{R}{2}$ (D) $\sqrt{2}R$

44. A massless square loop of wire of resistance 'R' supporting a mass 'M' hangs vertically with one of its sides in a uniform magnetic field 'B' directed outwards in the shaded region. A d.c. voltage 'V' is applied to the loop. For what value of 'V' the magnetic force will exactly balance the weight of the supporting mass 'M'? (side of loop = L, g = acceleration due to gravity)



(A) $\frac{Mg}{LBR}$ (B) $\frac{LB}{MgR}$
(C) $\frac{MgR}{LB}$ (D) $\frac{LR}{MgB}$

Target Publications

45. A sphere is at temperature 600K. In an external environment of 200 K, its cooling rate is 'R'. When the temperature of the sphere falls to 400 K, then cooling rate 'R' will become

(A) $\frac{3}{16}R$ (B) $\frac{9}{16}R$

(C) $\frac{16}{9}R$ (D) $\frac{16}{3}R$

46. A progressive wave of frequency 400 Hz is travelling with a velocity 336 m/s. How far apart are the two points which are 60° out of phase?

(A) 0.14 m (B) 0.21 m

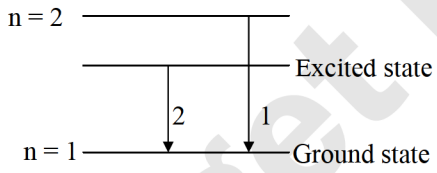
(C) 0.24 m (D) 0.28 m

47. Two bodies A and B of equal mass are suspended from two separate massless springs of spring constants K_1 and K_2 respectively. The two bodies oscillate vertically such that their maximum velocities are equal. The ratio of the amplitude of B to that of A is

(A) $\frac{K_1}{K_2}$ (B) $\frac{K_2}{K_1}$

(C) $\sqrt{\frac{K_1}{K_2}}$ (D) $\sqrt{\frac{K_2}{K_1}}$

48. For hydrogen atom, 'λ_1' and 'λ_2' are the wavelengths corresponding to the transitions 1 and 2 respectively as shown in figure. The ratio of 'λ_1' and 'λ_2' is $\frac{x}{32}$. The value of 'x' is



(A) 3 (B) 9

(C) 27 (D) 81

49. A metallic sphere 'A' isolated from ground is charged to +50μC. This sphere is brought in contact with other isolated metallic sphere 'B' of half the radius of sphere 'A'. Then the charge on the two isolated spheres A & B are in the ratio

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

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

50. For a photosensitive material, work function is 'W_0' and stopping potential is 'V'. The wavelength of incident radiation is (h = Planck's constant, c = velocity of light, e = electronic charge)

(A) $\frac{h^2c^2}{W_0 + eV}$ (B) $\frac{hc}{W_0}$

(C) $\frac{hcV}{W_0}$ (D) $\frac{hc}{W_0 + eV}$

Target Publications