MH CET 2018

(QUESTION WITH ANSWER)

PHYSICS

1. The path length of oscillation of simple pendulum of length 1 meter is 16 cm. Its maximum velocity is ($g = \pi^2$ m/s^2)

(1) 2π cm/s

(2) 4π cm/s

(3) 8π cm/s

(4) 16π cm/s

Ans. (3)

Sol. Path length = 16 cm

$\therefore$ Amplitude a = 8 cm

Period $T = 2\pi\sqrt{\frac{l}{g}}$

$= 2\pi\sqrt{\frac{1}{\pi^2}}$

$= 2\pi \times \frac{1}{\pi} = 2s$

Maximum velocity Vmax = $a\omega$

$= a \times \frac{2\pi}{T}$

$= 8 \times \frac{2\pi}{2}$

$= 8\pi$ cm/s

2. A vessel completely filled with water has holes 'A' and 'B' at depths 'h' and '3h' form the top respectively. Hole 'A' is a square of side 'L' and 'B' is circle of radius 'r'. The water flowing out per second from both the holes is same. Then 'L' is equal to

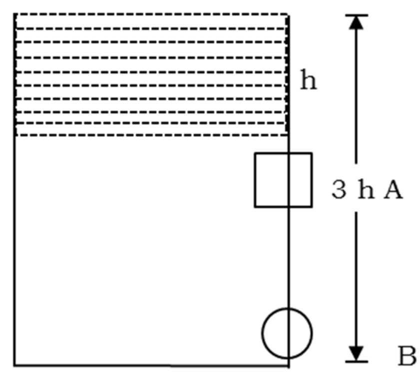
(1) $r^{\frac{1}{2}}(\pi)^{\frac{1}{2}}(3)^{\frac{1}{2}}$

(2) $r.(\pi)^{\frac{1}{4}}(3)^{\frac{1}{4}}$

(3) $r.(\pi)^{\frac{1}{2}}(3)^{\frac{1}{4}}$

(4) $r^{\frac{1}{2}}(\pi)^{\frac{1}{3}}(3)^{\frac{1}{2}}$

Ans. (3)



Sol.

$A_1V_1 = A_2V_2$

$L^2\sqrt{2gh} = \pi r^2\sqrt{6gh}$

$L^4 gh = \pi^2\sqrt{6gh}$

$L = \pi^{\frac{1}{2}}(r)(3)^{\frac{1}{4}}$

$L = (r)(\pi)^{\frac{1}{2}}(3)^{\frac{1}{4}}$

3. A transistor is used as a common emitter amplifier with a load resistance $2K\Omega$. The input resistance is 150Ω. Base current is changed by $20\mu A$ which results in a change in collector current by 1.5 mA. The voltage gain of the amplifier is

(1) 900

(2) 1000

(3) 1100

(4) 1200

Ans. (2)

Sol. Voltage gain $= \frac{V_0}{V_1} = \frac{R_0 \times I_C}{R_i \times I_B}$

$= \frac{2000 \times 1.5 \times 10^{-3}}{150 \times 20 \times 10^{-6}} = \frac{3}{3000 \times 10^{-6}}$

$= \frac{1}{(1000)^{-1}} = 1000$

4. A disk has mass 'M' and radius 'R'. how much tangential force should be applied to the rim of the disc so as to rotate with angular velocity 'ω' in time '*t*'

(1) $\frac{MR\omega}{4t}$

(2) $\frac{MR\omega}{2t}$

(3) $\frac{MR\omega}{t}$

(4) $MR\omega t$

Ans. (2)

Sol. $\tau = I\alpha$

$F \times R = \frac{MR^2}{2} \times \frac{\omega}{t}$

$F = \frac{MR}{2} \times \frac{\omega}{t}$

5. A circular coil carrying current 'I' has radius 'R' and magnetic field at the centre is 'B'. At what distance from the centre along the axis of the same coil, the magnetic field will be $\frac{B}{8}$?

(1) $R\sqrt{2}$

(2) $R\sqrt{3}$

(3) 2R

(4) 3R

Ans. (2)

Sol. $B = \frac{\mu_0 n I a^2}{\left(a^2 + x^2\right)^{3/2}} = \frac{\mu_0 n I a^2}{a^3} = \frac{\mu_0 n I}{a}$

$\frac{B}{8} = \frac{\mu_0 n I a^2}{\left(a^2 + x^2\right)^{3/2}}$

$\frac{\mu_0 n I}{8a} = \frac{8 \times \mu_0 n I a^2}{\left(a^2 + x^2\right)^{3/2}}$

$\frac{1}{8a^3} = \frac{1}{\left(a^2 + x^2\right)^{3/2}}$

$\frac{1}{2a} = \frac{1}{\left(a^2 + x^2\right)/2}$

$4a^2 = a^2 + x^2$

$x^2 = 3a^2$

$x = \sqrt{3}$

6. Two light waves of intensities 'I_1' and 'I_2' having same frequency pass through same medium at a time in same direction and interfere. The sum of the minimum and maximum intensities is

(1) $(I_1 + I_2)$

(2) $2(I_1 + I_2)$

(3) $\left(\sqrt{I_1} + \sqrt{I_2}\right)$

(4) $\left(\sqrt{I_1} - \sqrt{I_2}\right)$

Ans. (2)

Sol. $I_{max} = (a_1 + a_2)^2$

$I_{min} = (a_1 - a_2)^2$

$I_{max} + I_{min} = a_1^2 + a_2^2 + a_1^2 + a_2^2$

$= 2\left(a_1^2 + a_2^2\right)$

$= 2(I_1 + I_2)$

7. An alternating voltage $e = 20\sqrt{2}\sin(100t)$ volt is connected to capacitor through a.c. ammeter. The reading of ammeter is

(1) $5\,mA$

(2) $10\,mA$

(3) $15\,mA$

(4) $20\,mA$

Ans. (4)

Sol. $e = e_0 \sin \omega t$

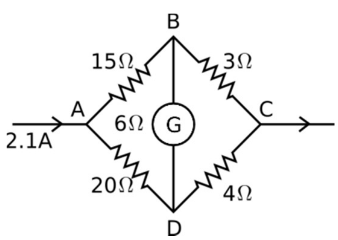
$E_0 = 200\sqrt{2}V,\ \omega = 100$

$I_{rms} = \frac{V_{rms}}{X_c} = \frac{V_0 \omega C}{\sqrt{2}}$

$= \frac{200\sqrt{2} \times 100 \times 10^{-6}}{\sqrt{2}}$

$= 2 \times 10^{-2} = 20\,mA$

8. In the following network, the current flowing through $15\,\Omega$ resistance is



(1) 0.8 A

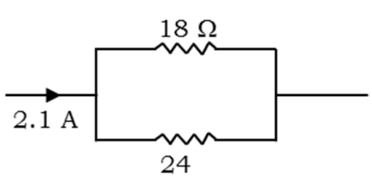
(2) 1.0 A

(3) 1.2 A

(4) 1.4 A

Ans. (3)

Sol.



$I_1 + I_2 = 2.1\,A$

$18I_1 = 24I_2$

$3I_1 = 4I_2 = 4(2.1 - I_1)$

$7I_1 = 8.4 - 4I_1$

$7I_1 = 8.4$

$I_1 = \frac{8.4}{7} = 1.2\,A$

9. The angle made by incident ray of light with the reflecting surface is called

(1) Glancing angle

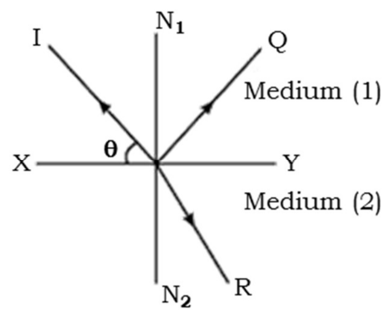
(2) Angle of incidence

(3) Angle of deviation

(4) Angle or refraction

Ans. (1)

Sol.



10. In non uniform circular motion, the ratio of tangential to radial acceleration is (r = radius of circle, v = speed of the particle, α = angular acceleration)

(1) $\frac{\alpha^2 r^2}{v}$

(2) $\frac{\alpha^2 r}{v^2}$

(3) $\frac{\alpha r^2}{v^2}$

(4) $\frac{v^2}{r^2 \alpha}$

Ans. (3)

Sol. Tangential acceleration $= \alpha r$

Radial acceleration $= \frac{v^2}{r}$

Ratio $= \frac{\alpha a}{v^2 / r} = \frac{\alpha r^2}{v^2}$

11. If numerical aperture of a microscope is increased then its

(1) Resolving power remains constant

(2) Resolving power becomes zero

(3) Limit of resolution is decreased

(4) Limit of resolution is increased

Ans. (3)

Sol. $d = \frac{\lambda}{2\mu \sin\alpha} = \frac{\lambda}{2\,N.A}$

N.A limit of resolution is decrease(d).

12. In amplitude modulation

(1) Amplitude remains constant but frequency change

(2) Both amplitude and frequency do not change

(3) Both amplitude and frequency change

(4) Amplitude of the carrier wave changes according to information signal

Ans. (4)

Sol. In amplitude modulation amplitude of the carrier wave changes according to information signal

13. If M_z = magnetization of a paramagnetic sample, B = external magnetic field, T = absolute temperature, C = curie constant then according to Curie's law in magnetism, the correct relation is

(1) $M_z = \frac{T}{CB}$

(2) $M_z = \frac{CB}{T}$

(3) $C = \frac{M_z B}{T}$

(4) $C = \frac{T^2}{M_z B}$

Ans. (2)

Sol. $M_z = \frac{M_{ext}}{V}$

$M_z = \frac{CB}{T}$ ....(paramagnetic)

Where, C = C Curie constant.

14. An electron of stationary hydrogen atom jumps from 4th energy level to ground level. The velocity that the photon acquired as result of electron transition will be (h = Planck's constant, R = Rydberg's constant, m = mass of photon)

(1) $\frac{9Rh}{16m}$

(2) $\frac{11hR}{16m}$

(3) $\frac{13hR}{16m}$

(4) $\frac{15hR}{16m}$

Ans. (4)

Sol. $\frac{1}{\lambda} = R\left(\frac{1}{P^2} - \frac{1}{n^2}\right)$

$\frac{1}{\lambda} = R\left[\frac{1}{1} - \frac{1}{16}\right]$

$\frac{1}{\lambda} = \frac{15 - R}{16}$

$\lambda = \frac{16}{15R}$

$P = \frac{h}{\lambda}$

$mv = \frac{h}{\lambda}$

$V = \frac{h}{m\lambda} = \frac{15hR}{m16}$

$V = \frac{15hR}{16m}$

15. 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 proportional to (T = surface tension of water, g = gravitational accleration)

(1) $\sqrt{\frac{T}{\pi\rho g}}$

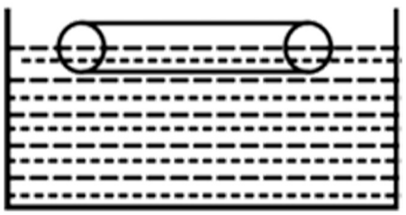
(2) $\sqrt{\frac{\pi\rho g}{T}}$

(3) $\frac{T}{\pi\rho g}$

(4) $\frac{\pi\rho g}{T}$

Ans. (1)

Sol.



$mg = T \cdot l$

$\pi r^2 \rho g = Tl$

$r^2 = \frac{T}{\pi\rho g}$

$r = \sqrt{\frac{T}{\pi\rho g}}$

16. A sphere of mass '*m*' moving with velocity '*v*' collides head - on another sphere of same mass which is a at rest. The ratio of final velocity of second sphere to the initial velocity of the first sphere is (e is coefficient of restitution and collision is inelastic)

(1) $\frac{e-1}{2}$

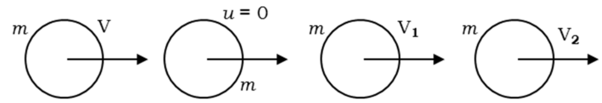
(2) $\frac{e}{2}$

(3) $\frac{e+1}{2}$

(4) e

Ans. (3)

Sol.



$mV + 0 = mV_1 + mV_2$

$V_1 + V_2 = V$

$e = \frac{V_2 - V_1}{u_1 - u_2}$

$e = \frac{V_2 - V_1}{V - 0}$

$eV = V_2 - V_1$

$eV + V = 2V$

$V_2 = \frac{V(e+1)}{2}$

$\frac{V_2}{V} = \frac{e+1}{2}$

17. For a particle performing linear S.H.M., its average speed over one oscillation is (a = amplitude of S.H.M., n = frequency of oscillation)

(1) 2 an

(2) 4 an

(3) 6 an

(4) 8 an

Ans. (2)

Sol. Distance travelled in one oscillation is 4 an and time is period is T velocity $= \frac{4a}{T} = 4an$

18. An ideal transformer converts 220 V a.c. to 3.3 kV a.c. to transmit a power of 4.4 kW If primary coil has 600 turns, then alternating current in secondary coil is

(1) $\frac{1}{3}$A

(2) $\frac{4}{3}$A

(3) $\frac{5}{3}$A

(4) $\frac{7}{3}$A

Ans. (2)

Sol. $V_{in} = 220\,V \quad V_{out} = 3.3 \times 10^3\,V$

Power = 4.4 kW

$N_P = 600 \quad R_{out}$

$P = V_{in} \times R_{in}$

$$R_{in} = \frac{4.4 \times 1000}{220} = \frac{44 \times 10}{22} = 20\,A$$

$$\frac{e_s}{e_p} = \frac{R_p}{R_s}$$

$$R_s = R_p = \frac{e_p}{e_s} = \frac{20 \times 220}{3.3 \times 1000} = \frac{44}{33} = \frac{4}{3}A$$

19. A conducting wire has length 'L_1' and diameter 'd_1'. After stretching the same wire length becomes 'L_2' and diameter 'd_2'. The ratio of resistance before and after stretching is

(1) $d_2^4 : d_1^4$

(2) $d_1^4 : d_2^4$

(3) $d_2^2 : d_1^2$

(4) $d_1^2 : d_2^2$

Ans. (2)

Sol. $$\frac{R_1}{R_2} = \frac{L_1}{L_2} \times \frac{A_2}{l_2} = \frac{L_1}{L_2} \times \frac{\frac{\pi d^2}{4}}{\frac{\pi d_1^2}{4}}$$

$$R_1 = \frac{\rho l l}{[A l]} = \frac{l^2}{V}$$

$X_1 : X_2$

$$L - 1\frac{\pi d_1^2}{4} = L_2 \frac{\pi d_2^2}{4}$$

$$\frac{L_1}{L_2} = \frac{d_2^2}{d_1^2}$$

20. The molar specific heat of an ideal gas at constant pressure and constant volume is 'C_P' and 'C_V' respectively. If 'R' is the universal gas constant and the ratio of 'C_P' to 'C_V' is 'γ' then 'C_v' =

(1) $\frac{1-\gamma}{1+\gamma}$

(2) $\frac{1+\gamma}{1-\gamma}$

(3) $\frac{\gamma-1}{R}$

(4) $\frac{R}{\gamma-1}$

Ans. (4)

Sol. $C_P - C_V = R,\ \frac{C_P}{C_V} = \gamma \Rightarrow \gamma C_V$

$\gamma C_V - C_V = R$

$$C_V = \frac{R}{(\gamma - 1)}$$

21. In a capillary tube having area of cross-section 'A', water rises to a height 'h'. If cross-sectional area is reduced to '$\frac{A}{9}$', the rise of water in the capillary tube is

(1) 4 h

(2) 3 h

(3) 2 h

(4) h

Ans. (2)

Sol. rh = constant

$r_1 h_1 = r_2 h_2 \qquad A_1 = \pi r_1^2$

$\frac{r_1}{r_2} = \frac{h_1}{h_2} \qquad A_2 = \pi r_2^2$

$3 = \frac{h_2}{h_1} = \frac{h_2}{h_1} \qquad \frac{\pi r_1^2}{9} = \pi r_2^2$

$h_2 = 3h_1 = 3h \qquad \frac{r_1^2}{r_2^2} = 9 \Rightarrow \frac{r_1}{r_2} = 3$

22. With forward biased mode, the $p-n$ junction diode

(1) Is one in which width of depletion layer increases

(2) Is one in which potential barrier increases

(3) Acts as closed switch

(4) Acts as open switch

Ans. (3)

Sol. Acts as closed switch

23. An alternating electric field of frequency 'v' is applied across the dees (radius R) of a cyclotron to accelerate protons (mass m). The operating magnetic field 'B' used and K.E. of the proton beam produced by it are respectively (e = charge on proton)

(1) $\frac{2\pi m v}{e}, 2\pi^2 m v^2 R^2$

(2) $\frac{2\pi^2 m v}{e^2}, 4\pi^2 m v^2 R^2$

(3) $\frac{\pi m v}{e}, \pi^2 m v^2 R$

(4) $\frac{2\pi^2 m^2 v^2}{e}, 2\pi^2 m^2 v^2 R^2$

Ans. (1)

Sol. $t = 1/V \qquad R = \frac{mv}{eB} = \frac{P}{eB}$

$B = \frac{2\pi m}{\rho} v \qquad P = eBR = e \times \frac{2\pi m u}{e} R$

$= 2\pi m v R$

$K.E. = \frac{P^2}{2m} = \frac{(2\pi m v R)^2}{2m}$

$= 2\pi^2 m v^2 R$

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

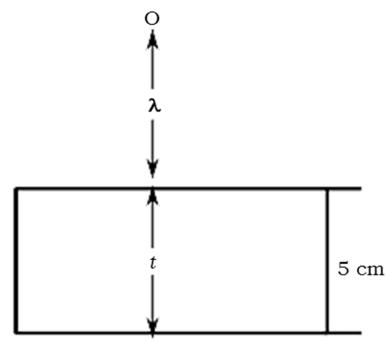
(1) 4 cm

(2) 8 cm

(3) 12 cm

(4) 16 cm

Ans. (2)



Sol.

$V = \frac{5}{t}$

$t = \frac{5}{V} \quad \frac{x}{c} = \frac{5\mu}{c}$

$x = 5\mu = 5 \times 1.6$

$x = 8\,cm$

25. A string is vibrating in its fifth overtone between two rigid supports 2.4 m apar. The distance between successive node and antinode is

(1) 0.1 m

(2) 0.2 m

(3) 0.6 m

(4) 0.8 m

Ans. (2)

Sol. Fifth overtone

$2.4 = 6n$

$A = 0.4m$

$\frac{\lambda}{2} = 0.4$

$\lambda = 0.8$

$\frac{\lambda}{4} = \frac{0.8}{4}$

$= 0.2$

26. If $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}$, $\vec{B} = \hat{i} - 3\hat{j} + 5\hat{k}$ and $\vec{C} = 2\hat{i} + \hat{j} - 4\hat{k}$ form a right angled triangle the out of the following which one is satisfied?

(1) $\vec{A} = \vec{B} + \vec{C}$ and $A^2 = B^2 + C^2$

(2) $\vec{A} = \vec{B} + \vec{C}$ and $B^2 = A^2 + C^2$

(3) $\vec{B} = \vec{A} + \vec{C}$ and $B^2 = A^2 + C^2$

(4) $\vec{B} = \vec{A} + \vec{C}$ and $A^2 = B^2 + C^2$

Ans. (3)

Sol. $|A| = \sqrt{9+4+1} = \sqrt{14}$

$|B| = \sqrt{1+9+25} = \sqrt{35}$

$|C| = \sqrt{4+1+16} = \sqrt{21}$

$B^2 = A^2 + C^2$

27. A square frame ABCD is formed by four identical rods each of mass 'm' and length 'l'. This frame is in X – Y plane such that side AB coincides with X-axis and side AD along Y-axis. The moment of inertia of the frame about X-axis is

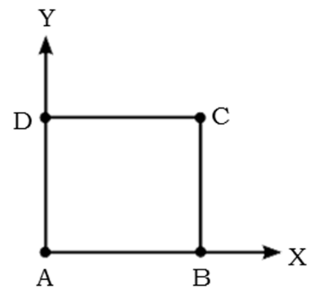
(1) $\frac{5ml^2}{3}$

(2) $\frac{2ml^2}{3}$

(3) $\frac{4ml^2}{3}$

(4) $\frac{ml^2}{12}$

Ans. (1)



Sol.

$$\frac{ml^2}{3} + \frac{ml^2}{3} + ml^2$$

$$I = \frac{5}{3}ml^2$$

28. A unit vector is represented as $\left(0.8\hat{i} + b\hat{j} + 0.4\hat{k}\right)$. Hence the value of '$b$' must be

(1) 0.4

(2) $\sqrt{0.6}$

(3) 0.2

(4) $\sqrt{0.2}$

Ans. (4)

Sol. $\sqrt{(0.8)^2 + (b)^2 + (0.4)^2} = 1$

$\sqrt{64 + b^2 + 0.16} = 1$

$\sqrt{0.80 + b^2} = 1$

$0.8 + b^2 = 1$

$b^2 = 0.2$

$b = \sqrt{0.2}$

29. Magnetic susceptibility for a paramagnetic and diamagnetic material is respectively

(1) Small, positive and small, positive

(2) Large, positive and small, negative

(3) Small, positive and small, negative

(4) Large, negative and large, positive

Ans. (3)

Sol. $B = (1+\chi)H$

$\chi =$ For paramagnetic positive and small

$\chi =$ For diamagnetic positive and small

30. A mass is suspended from a vertical spring which is executing S.H.M. of frequency 5 Hz. The spring is unstretched at the highest point of oscillation. Maximum speed of the mass is [acceleration due to gravity g = 10 m/s²]

(1) $2\pi \, m/s$

(2) $\pi \, m/s$

(3) $\frac{1}{2\pi} m/s$

(4) $\frac{1}{\pi} m/s$

Ans. (4)

Sol. $T = 2\pi\sqrt{\frac{m}{k}}$

$n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$25 = \frac{1}{4\pi^2}\frac{k}{m}$

$k = 100\pi^2 m$

$kA = mg$

$A = \frac{mg}{k}$

$V_{max} = \omega A$

$= \frac{2\pi}{T} A$

$= 2\pi n A$

$= \frac{2\pi 5 \times mg}{k}$

$V_{max} = \frac{10\pi \times m \times 10}{100\pi^2 m} = \frac{1}{\pi}$

31. The moment of inertia of a ring about an axis passing through the centre and perpendicular to its plane is 'I'. It is rotating with angular velocity 'ω'. Another identical ring is gently placed on it so that their centres coincide. If both the rings are rotating about the same axis then loss in kinetic energy is

(1) $\frac{I\omega^2}{2}$

(2) $\frac{I\omega^2}{4}$

(3) $\frac{I\omega^2}{6}$

(4) $\frac{I\omega^2}{8}$

Ans. (2)

Sol. $I_1\omega_1 = I_2\omega_2$

$I\omega = 2I\omega_1$

$\omega_1 = \frac{\omega}{2}$

Now $KE = \frac{1}{2}I\omega^2$

$= \frac{1}{2}2I\left(\frac{\omega}{2}\right)^2$

$= \frac{I\omega^2}{4}$

Change in $KE = \frac{1}{2}I\omega^2 - \frac{I\omega^2}{4} = \frac{I\omega^2}{4}$

32. A bomb at rest explodes into 3 parts of same mass. The momentum of two parts is $3P\hat{i}$ and $2P\hat{j}$ respectively. The magnitude of momentum of the third part is

(1) P

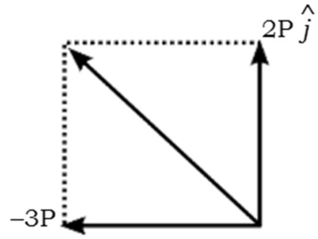
(2) $\sqrt{5}\,P$

(3) $\sqrt{11}\,P$

(4) $\sqrt{13}\,P$

Ans. (4)

Sol.



$\sqrt{9P^2 + 4P^2} = \sqrt{13}\,P$

33. In a photocell, frequency of incident radiation is increased by keeping other factors constant $(\nu > \nu_0)$, the stopping potential

(1) Decreases

(2) Increases

(3) Becomes zero

(4) First decreases and then increases

Ans. (2)

Sol. $eV_0 = h\nu - h\nu_0$

$eV_0 = h(\nu - \nu_0)$

$V_0 = \frac{h}{e}(\nu - \nu_0)$

Stopping potential directly proportional to frequency of incident radiation ν increases.

34. A mass attached to one end of a string crosses top-most point on a vertical circle with critical speed. Its centripetal acceleration when string becomes horizontal will be (g = gravitational acceleration)

(1) g

(2) $3g$

(3) $4g$

(4) $6g$

Ans. (2)

Sol. $v = \sqrt{3rg}$

Centripetal acceleration $= \frac{v^2}{r} = \frac{3rg}{r} = 3g$

35. The expression for electric field intensity at a point outside uniformly charged thin plane sheet is (d is the distance of point from plane sheet)

(1) Iindependent of d

(2) Directly proportional to $\sqrt{d}$

(3) Directly proportional to d

(4) Directly proportional to $\frac{1}{\sqrt{d}}$

Ans. (1)

Sol. Electric field intensity outside sheet is $\frac{\sigma}{2\varepsilon_0}$

So it is independent of d.

36. When source of sound moves towards a stationary observer, the wavelength of sound received by him

(1) Decreases while frequency increases

(2) Remains the same whereas frequency increases

(3) Increases and frequency also increases

(4) Decreases while frequency remains the same

Ans. (1)

Sol. $n_a = n\left[\frac{v \pm v_0}{v \pm v_s}\right]$

$v_0 = 0$

$n_a = n\left[\frac{v}{v - v_s}\right]$

So frequency increases, wavelength decreases.

37. The deflection in galvanometer falls to $\left(\frac{1}{4}\right)^{th}$ when it is shunted by $3\,\Omega$. If additional shunt of $2\,\Omega$ is connected to earlier shunt, the deflection in galvanometer falls to

(1) $\frac{1}{2}$

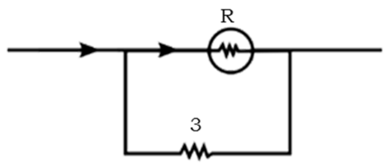
(2) $\left(\frac{1}{3}\right)^{\text{rd}}$

(3) $\left(\frac{1}{4}\right)^{\text{th}}$

(4) $\left(\frac{1}{8.5}\right)^{\text{th}}$

Ans. (4)

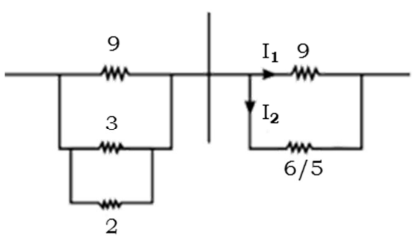
Sol.



$$I - \frac{I}{4} = \frac{3I}{4}$$

$$\frac{RI}{4} = \frac{3I}{4} \times 3$$

$$R = 9\,\Omega$$



$$I = I_1 + I_2$$

$$9I_1 = \frac{6}{5}I_2$$

$$\frac{15}{2}I_1 = I_2$$

$$I = I_1 + \frac{15}{2}I_1 = \frac{17}{2}I_1$$

$$I_1 = \frac{2I}{17}$$

$$\frac{I}{17/2} = \frac{I}{8.5}$$

38. A body is thrown from the surface of the earth with velocity 'u' m/s. The maximum height in m above the surface of the earth upto which it will reach is (R = radius of earth, g = acceleration due to gravity)

(1) $\frac{u^2 R}{2gR - u^2}$

(2) $\frac{2u^2 R}{gR - u^2}$

(3) $\frac{u^2 R^2}{2gR - u^2}$

(4) $\frac{u^2 R}{gR - u^2}$

Ans. (4)

Sol. $\frac{GMm}{R} + \frac{1}{2}mu^2 = 0 + -\frac{GMm}{(R+h)}$

$$\frac{GM}{R+h} = \frac{Gm}{R} - \frac{u^2}{2}$$

$$\frac{GM}{(R+h)} = \frac{2Gm - Ru^2}{2R}$$

$$\frac{R+h}{GM} = \frac{2R}{2GM - Ru^2}$$

$$h = \frac{2GMR}{2GM - Ru^2} - R$$

$$= \frac{2GMR - 2GMR + R^2u^2}{2GM - Ru^2}$$

$$= \frac{R^2u^2}{2GM - Ru^2} = \frac{Ru^2}{2gR - u^2}$$

39. A series combination of N_1 capacitors (each of capacity C_1) is charged to potential difference '3V'. Another parallel combination of N_2 capacitors (each of capacity C_2) is charged to potential difference 'V'. The total energy stored in both the combination is same. The value of C_1 in terms of C_2 is

(1) $\frac{C_2 N_1 N_2}{9}$

(2) $\frac{C_2 N_1^2 N_2^2}{9}$

(3) $\frac{C_2 N_1}{9 N_2}$

(4) $\frac{C_2N_2}{9N_1}$

Ans. (1)

Sol. $C_{eq} = \frac{C_1}{N_1}$ V = 3V

$E = \frac{1}{2}CV^2$

$= \frac{1}{2}\frac{C_1}{N_1}9V^2$

$= \frac{9}{2}\frac{C_1}{N_1}V^2$

$C_{eq} = N_2C_2$ V = V

$E = \frac{1}{2}CV^2 = \frac{1}{2}C_2N_2V^2$

$= \frac{9}{2}\frac{C_1}{N_1}V^2 = \frac{C_2N_2V^2}{2}$

$C_1 = C_2 \frac{N_2N_1}{9}$

40. Heat energy is incident on the surface at the rate of 1000 J/min. If coefficient of absorption is 0.8 and coefficient of reflection is 0.1 then heat energy transmitted by the surface in 5 minute is

(1) 100 J

(2) 500 J

(3) 700 J

(4) 900 J

Ans. (2)

Sol. Q_i = 1000 J/m

1 = r + a + t

t = 1 – 0.1 – 0.8 = 0.1

$Q_t = 0.1 \times 1000 \times 5$

= 500 J

41. Two metal wires 'P' and 'Q' of same length and material are stretched by same load. Their masses are in the ratio $m_1 : m_2$. The ratio of elongations of wire 'P' to that of 'Q' is

(1) $m_1^2 : m_2^2$

(2) $m_2^2 : m_1^2$

(3) $m_2 : m_1$

(4) $m_1 : m_2$

Ans. (3)

Sol. $m_1 : m_2$

$Y = \frac{Fl}{A\Delta l}$

$\Delta l = \frac{Fl}{YA}$

$m = \rho V = \rho \times A \times l$

A α m

$\frac{\Delta l_1}{\Delta l_2} = \frac{A_2}{A_1} = \frac{m_2}{m_1}$

42. Let $x = \left[\frac{a^2b^2}{c}\right]$ be the physical quantity. If the percentage error in the measurement of physical quantities a, b and c is 2, 3 and 4 percent respectively then percentage error in the measurement of x is

(1) 7%

(2) 14%

(3) 21%

(4) 28%

Ans. (2)

Sol. $\frac{\Delta x}{x} = 2\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c}$

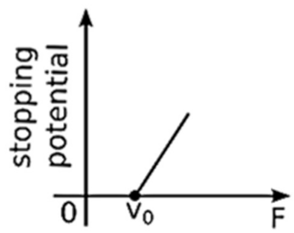
$\frac{\Delta x}{y} = 2 \times 2 + 2 \times 3 + 4$

$= 4 + 6 + 4$

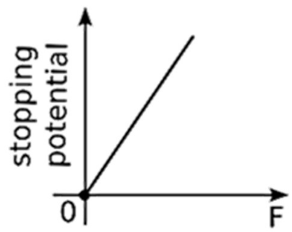
$\frac{\Delta x}{x} = 14\%$

43. Following graphs show the variation of stopping potential corresponding to the frequency of incident radiation (F) for a given metal. The correct variation is shown is graph (υ_0 = Threshold frequency)

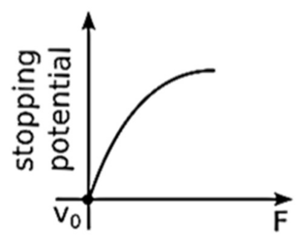
(1)



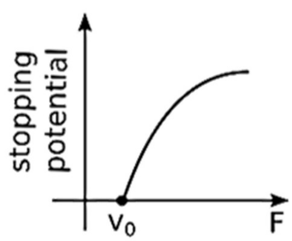
(2)



(3)

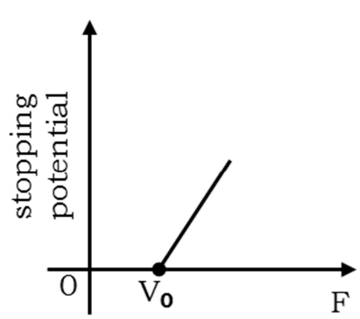


(4)



Ans. (1)

Sol.



44. In compound microscope, the focal length and aperture of the objective used is respectively

(1) large and large

(2) large and small

(3) short and large

(4) short and small

Ans. (2)

Sol. In compounds microscope, the focal length and aperture of the objective used is respectively large and small.

45. The energy of an electron having de-Broglie wavelength 'λ'is (h = Planck's constant, m= mass of electron)

(1) $\frac{h}{2m\lambda}$

(2) $\frac{h^2}{2m\lambda^2}$

(3) $\frac{h^2}{2m^2\lambda^2}$

(4) $\frac{h^2}{2m^2\lambda}$

Ans. (2)

Sol. $\lambda = \frac{h}{\sqrt{2mK.E}}$

$\lambda^2 = \frac{h^2}{2m(K.E)}$

$(K.E) = \frac{h^2}{2m\lambda^2}$

46. 'n' number of waves are produced on a string in 0.5 second. Now the tension in the string is doubled (Assume length and radius constant), the number of waves produced in 0.5 second for same harmonic will be

(1) n

(2) $\sqrt{2}n$

(3) $\frac{n}{\sqrt{2}}$

(4) $\frac{n}{\sqrt{5}}$

Ans. (2)

Sol. $n = \frac{1}{2L}\sqrt{\frac{T}{m}}$

$n' = \frac{1}{2L}\sqrt{\frac{2T}{m}}$

$= \sqrt{2}\frac{1}{2L}\sqrt{\frac{T}{m}}$

$n' = \sqrt{2}n$

47. The increase in energy of a metal bar of length 'L' and cross-sectional area 'A' when compressed with a load 'M' along its length is (Y = Young's modulus of the material of metal bar)

(1) $\frac{FL}{2AY}$

(2) $\frac{F^2L}{2AY}$

(3) $\frac{FL}{AY}$

(4) $\frac{F^2L^2}{2AY}$

Ans. (3)

Sol. $y = \frac{FL}{Al}$

$l = \frac{FL}{Ay}$

48. The ratio of magnetic fields due to a bar magnet at the two axial points P_1 and P_2 which are separated from each other by 10 cm is 25 : 2 Point P_1 is situated at 10 cm from the centre of the magnet. Magnetic length of the bar magnet is (Points P_1 and P_2 are on the same side of magnet and distance of P_2 from the centre is greater than distance of P_1 form the centre of magnet)

(1) 5 cm

(2) 10 cm

(3) 15 cm

(4) 20 cm

Ans. (1)

Sol. $\frac{B_1}{B_2} = \frac{25}{2}$

$$\frac{\frac{\mu_0}{4\pi}\frac{Md_1}{(d_1^2 - l^2)^2}}{\frac{\mu_0}{4\pi}\frac{Md_2}{(d_2^2 - l^2)}} = \frac{25}{2}$$

$$\frac{d_1}{d_2} \times \frac{(d_2^2 - l^2)^2}{(d_1^2 - l^2)^2} = \frac{25}{2}$$

$d_1 = 10$ cm, $d_2 = 20$ cm

$$\frac{10}{20} \times \left(\frac{20^2 - l^2}{10^2 - l^2}\right) = \frac{25}{2}$$

$400 - l^2 = 5(100 - l^2)$

$4l^2 = 100 \Rightarrow l^2 = 25$

$l = 5$ cm

49. A satellite is revolving in a circular orbit at a height 'h' above the surface of the earth of radius 'R'. The speed of the satellite in its orbit is one - fourth the escape velocity from the surface of the earth. The relation between 'h' and 'R' is

(1) h = 2R

(2) h = 3R

(3) h = 5R

(4) h = 7R

Ans. (4)

Sol. $\upsilon_c = \frac{1}{4}\upsilon_e$

$$\sqrt{\frac{GM}{(R+h)}} = \frac{1}{4}\sqrt{\frac{2GM}{(R+h)}}$$

$$\frac{GM}{(R+h)} = \frac{1}{16} \times \frac{2GM}{(R+h)}$$

R + h = 8(R)

R + h = 8R

7R = h

50. A pipe closed at one end has length 83 cm. The number of possible natural oscillations of air column whose frequencies lie below 1000Hz are (velocity of sound in air = 332 m/s)

(1) 3

(2) 4

(3) 5

(4) 6

Ans. (3)

Sol. $n = \frac{V}{4L} = \frac{332}{4 \times 83 \times 10^{-2}}$

$n = 100$

$n_1 = 300$

$n_2 = 500$

$n_3 = 700$

$n_5 = 900$