PART : PHYSICS

1. A car is moving with velocity v_1 from point A to B & with velocity v_2 from B to C. Then the average velocity from A to C is v_{avg}. (AB = BC).

(1) $v_{avg} = \frac{v_1 + v_2}{2}$ (2) $\frac{1}{v_{avg}} = \frac{1}{v_1} + \frac{1}{v_2}$ (3) $v_{avg} = \frac{v_1 v_2}{v_1 + v_2}$ (4) $\frac{2}{v_{avg}} = \frac{1}{v_1} + \frac{1}{v_2}$

Ans. (4)

Sol. $v_{avg} = \frac{x}{\frac{x/2}{v_1} + \frac{x/2}{v_2}} = \frac{2v_1v_2}{v_1+v_2} \Rightarrow \frac{2}{v_{avg}} = \frac{1}{v_1} + \frac{1}{v_2}$

2. Two stones A & B are projected from same speed with different projection angle 60° & 30° respectively on horizontal plane. If maximum heights achieved for both stones in projectile motion are h_1 & h_2. Then the value of h_1/h_2 is :

(1) 1 (2) 3 (3) 4 (4) 2

Ans. (3)

Sol. $\frac{h_1}{h_2} = \frac{\frac{u^2 \sin^2 60^\circ}{2g}}{\frac{u^2 \sin^2 30}{2g}} = \frac{\left[\frac{\sqrt{3}}{2}\right]^2}{\left[\frac{1}{2}\right]^2} = \frac{3/4}{1/4} = 3$

3. A satellite revolves around the earth at height 'R' from its surface. Find out the time period of its rotation Given: Radius of earth = R & $\pi^2 = g$

(1) $\sqrt{2}.R^{\frac{1}{2}}$ (2) $2\sqrt{2}.R^{\frac{1}{2}}$ (3) $4R^{\frac{1}{2}}$ (4) $4\sqrt{2}.R^{\frac{1}{2}}$

Ans. (4)

Sol. $\therefore V = \sqrt{\frac{GM}{R+h}} = \sqrt{\frac{GM}{R+R}} = \sqrt{\frac{GM}{2R}}$

$\therefore T = \frac{2\pi[2R]}{V_0} = \frac{4\pi R}{\sqrt{GM}} \times \sqrt{2R} = \left(\frac{4\sqrt{2}\pi}{\sqrt{GM}}\right) \times R^{3/2} = \frac{4\sqrt{2}\pi}{\sqrt{gR^2}} R^{\frac{3}{2}}$

$T = 4\sqrt{2}.R^{\frac{1}{2}}$

4. Two sound waves of same intensity are superimposed at points A and B. The phase difference between them is 60° and 90° respectively. The net resultant intensity at points A and B are I_A and I_B respectively. Then the value of I_A/I_B is :

(1) 3/2 (2) 2/3 (3) 5/2 (4) 1/2

Ans. (1)

Sol. We know $I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

$I_A = I + I + 2I\cos60° = 3I$

Similarly $I_B = I + I + 2I\cos90° = 2I$

$\therefore \frac{I_A}{I_B} = \frac{3}{2}$

5. **Statement-1** : Rotation of earth affects the acceleration due to gravity.

Statement-2 : At poles, effect of rotation of earth on acceleration due to gravity is maximum and equator, it is minimum.

(1) Statement-1 and statement-2 both are correct

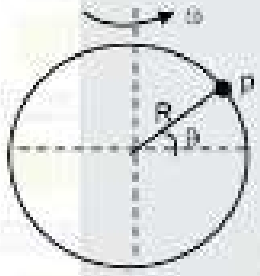
(2) Statement-1 and statement-2 both are incorrect

(3) Statement-1 is correct but statement-2 is incorrect

(4) Statement-1 is incorrect and statement-2 is correct

Ans. (3)

Sol.



$g_\theta = g_0[1 - \omega^2 R\cos^2\theta]$

6. If force $\vec{F} = -p\hat{k}$ is acting at point having position vector $\vec{r} = (2\hat{i} - 3\hat{j})$. The torque about origin is given by $p[a\hat{i} + b\hat{j}]$. If $\frac{a}{b} = \frac{x}{2}$, then the value of x is :

(1) 1 (2) 2 (3) 3 (4) 4

Ans. (3)

Sol. $\vec{\tau} = \vec{r} \times \vec{F}$

$= (2\hat{i} - 3\hat{j}) \times [-p\hat{k}] = [2\hat{j} + 3\hat{i}]$

Comparing with $p[a\hat{i} + b\hat{j}]$

$a = 3$ & $b = 2$

$\therefore \frac{a}{b} = \frac{3}{2} = \frac{x}{2} \quad \therefore x = 3$

7. A gaseous mixture contains 2 mole of oxygen and 4 moles Neon gases, at same temperature T. Ignore all vibrational degree of freedoms of gas molecules. Then the internal energy of gas at given temperature is :

(1) 5RT (2) 11RT (3) $\frac{5}{2}$ RT (4) $\frac{7}{2}$ RT

Ans. (2)

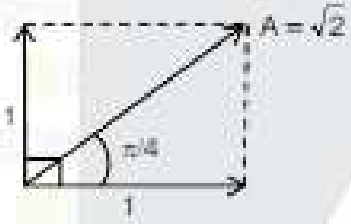
Sol. $V = \frac{5}{2} \times 2 \times RT + \frac{3}{2} \times 4 \times RT = 11RT$

8. Displacement of a particle in SHM is given by $y = (\sin\omega t + \cos\omega t)$, where ω is angular frequency & t is time then the amplitude of particle is

(1) 1m (2) $\sqrt{2}$ m (3) 2 m (4) $\sqrt{3}$ m

Ans. (2)

Sol.



Phasor diagram

$y = \sin\omega t + \sin\left(\omega t + \frac{\pi}{2}\right) = \sqrt{2}\sin\left[\omega t + \frac{\pi}{4}\right]$

9. Maximum load of 1400 kg can be lifted by a lift. 2000 N friction force is also acting on lift when its is moving with constant velocity 3 m/s in upward direction. Then the power of external force applied on lift is :

(1) 16 kw (2) 32 kw (3) 28 kw (4) 48 kw

Ans. (4)

Sol. F = Mg + f

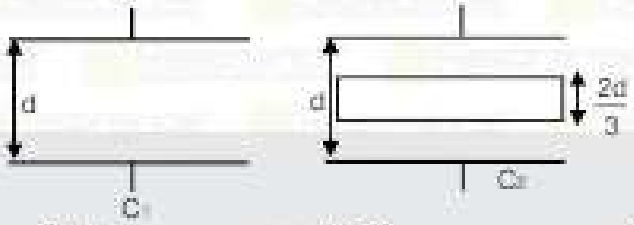
= 14000 + 2000

= 16000

Power = FV

= 48 kw

10. Two plates of a capacitor are placed at distance d, capacitance is C_1. If a conducting sheet of thickness $\frac{2}{3}d$ is inserted in between the capacitor plates, capacitance becomes C_2. Then the value of $\frac{C_2}{C_1}$ is :



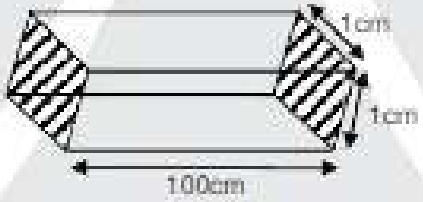
(1) 2 (2) 4 (3) 3 (4) 5

Ans. (3)

Sol. $C_1 = \frac{A\epsilon_0}{d}$

$C_2 = \frac{A\epsilon_0}{(d-1)+\frac{1}{K}} = \frac{A\epsilon_0}{\left(d-\frac{2d}{3}\right)+\frac{2d}{3(\infty)}} = \frac{3A\epsilon_0}{d} \quad \therefore \frac{C_2}{C_1} = 3$

11. A cuboid is given as shown in figure. Resistivity of material $\rho = 3 \times 10^{-7}\Omega$-m. Then the electrical resistance of cuboid between sketched cross-section is :

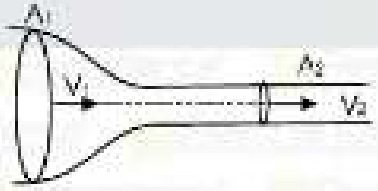


(1) $2 \times 10^{-2}\Omega$ (2) $1 \times 10^{-2}\Omega$ (3) $3 \times 10^{-2}\Omega$ (4) $3 \times 10^{-5}\Omega$

Ans. (3)

Sol. $R = \rho\frac{\ell}{A} = 3\times10^{-7} \times \frac{1}{(10^{-4})} = 3 \times 10^{-2}\Omega$

12. Water is flowing in a pipe of non-uniform cross-sectional area as shown in figure. Then velocity V_2 will be:



Given that $A_1 = 2cm^2$, $A_2 = 10mm^2$, $V_1 = 4cm/sec$

(1) 20 cm/sec. (2) 40 cm/sec. (3) 80 cm/sec. (4) 100 cm/sec.

Ans. (3)

Sol. $A_1V_1 = A_2V_2$

$2 \times 4 = (10\times10^{-2})V_2$

$V_2 = 80$ cm/sec

13. A bar magnet falls in a large conducting tube

Statement-1 : acceleration of bar magnet equal to g.

Statement-1 : acceleration of bar magnet greater then g.

(1) Statement-1 and statement-2 both are correct

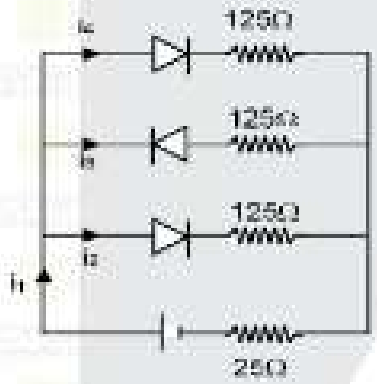
(2) Statement-1 and statement-2 both are incorrect

(3) Statement-1 is correct but statement-2 is incorrect

(4) Statement-1 is incorrect and statement-2 is correct

Ans. **(2)**

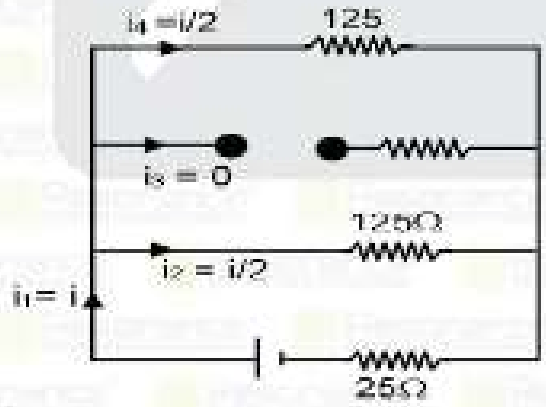
14.



(1) $\frac{i_1}{i_2} = 2$ (2) $\frac{i_2}{i_4} = 1$ (3) $\frac{i_2}{i_3} = 1$ (4) $\frac{i_3}{i_4} = 2$

Ans. **(1)**

Sol.



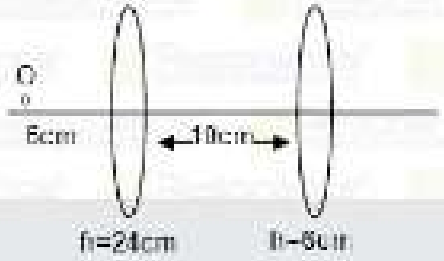
$i_2 = i$

$i_3 = i_4 = i/2$

$i_1 = 0$

$\therefore \frac{i_2}{i_4} = 2$

15. Two convex lens of focal length $f_1 = 24cm$ and $f_2 = 6cm$ are placed co-axially in air. A object is placed at distance of 6 cm from first convex lens. Find the distance between object and final image formed.



(1) 15 cm (2) 20 cm (3) 25 cm (4) 35 cm

Ans. (3)

Sol. For 1st lens

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{v}-\frac{1}{-6}=\frac{1}{24}$$

$$\frac{1}{v}=\frac{1}{24}-\frac{1}{6}$$

$v = -8$ cm

For 2nd lens

$$\frac{1}{v}-\frac{1}{4}=\frac{1}{f}$$

$$\frac{1}{v}-\frac{1}{-18}=\frac{1}{6}$$

$$\frac{1}{v}=\frac{1}{6}-\frac{1}{18}$$

$$=\frac{3-1}{18}$$

$v = 9$ cm

$\therefore$ Distance between the object O and final image $l_2 = (9 + 10 + 6)$ cm $= 25$ cm

16. Frequency of signal wave is 3 kH_z & frequency of carrier wave is 1.5 mH_z what will be the band width of modulating signal.

(1) 3 kH_z (2) 6 kH_z (3) 9 kH_z (4) 12 kH_z

Ans. (2)

Sol. band width $= 2$ fm $= 2 \times 3 = 6$ kHz

17. Two wires of same length are stretched along their length with same stretching force. The ratio of cross-sectional area of wires is 1/3 and ratio of young's modulus is 1/4. Then the ratio of their elongations will be.

(1) 6 (2) 12 (3) 1 (4) 3

Ans. (2)

Sol. $\frac{F}{A} = Y\left(\frac{\Delta L}{L}\right)$

$\frac{\Delta L_1}{\Delta L_2} = \frac{A_2}{A_1} \times \frac{Y_2}{Y_1} = \frac{3}{1} \times \frac{4}{1} = 12$

18. An electron is revolving around about a fixed uniformly charged long wire of linear charge density $\lambda = 2 \times 10^{-6}$ C/m. Then the speed of revolution of electron will be : (mass of electron 9×10^{-31} kg).

(1) 4×10^{16} m/s (2) 2×10^{16} m/s (3) 8×10^{16} m/s (4) 10^{16} m/s

Ans. (2)

Sol. $\frac{mv^2}{r} = \frac{2K\lambda}{r}$

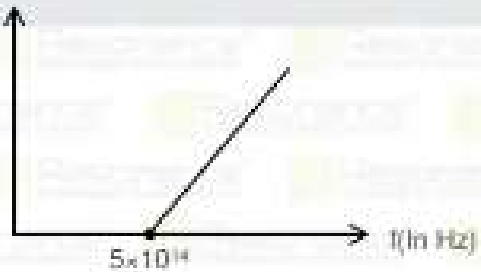
$V = \sqrt{\frac{2K\lambda}{m}} = \sqrt{\frac{2 \times 9 \times 10^9 \times 2 \times 10^{-6}}{9 \times 10^{-31}}}$

$V = 2 \times 10^{16}$ m/s

19. **Assertion :** Fan rotates for same time even if switch is turned off.
Reason : Fan has Inertial property
(1) Assertion is correct and reason incorrect
(2) Assertion is incorrect and reason is correct
(3) Both are correct and Reason is **NOT** the correct explanation of assertion
(4) Both correct and Reason is the correct explanation of assertion

Ans. (4)

20. Graph between stopping potential and frequency in photo electric effect is



Work function of emitter plate will be.
(1) 10×10^{-20} J (2) 20×10^{-20} J (3) 30×10^{-20} J (4) 40×10^{-20} J

Ans. (3)

Sol. $W = h\nu_0 = 6 \times 10^{-34} \times 5 \times 10^{14}$

$W = 30 \times 10^{-20}$ Joule