PHYSICS

1. When a particle is projected with same initial speed at an angle of projection 15°, its range is found to be 50 m. Find out its range when it is thrown at an angle of 45° with same initial speed.

Ans. 100m

Sol. $R = \frac{u^2 \sin 2\theta}{g} \Rightarrow \theta = 15°$

$R = \frac{u^2}{g} \sin 30° = 50$

$\frac{u^2}{g} = 100\text{m}$

For $\theta = 45°$

$R = \frac{u^2}{g} \sin 90° = 100\text{m}$

2. A block of mass 'm' is projected with velocity v_0 towards another block of mass '2m' at rest. The mass 'm' collides with '2m' mass and sticks to it. Find out the new velocity of system.

Ans. $\frac{V_0}{3}$

Sol. $P_i = P_f$

$mv_0 = (m + 2m)V_f \Rightarrow V_f = \frac{V_0}{3}$

3. A particle weighs 200 N on the surface of earth. Find its weight at the depth $\frac{Re}{2}$.

Ans. 100 N

Sol. mg = 200

$g' = g\left(1 - \frac{d}{Re}\right), d = \frac{Re}{2}$

$g' = g\left(1 - \frac{1}{2}\right) = g/2$

New weight = mg' = m 9/2 = 100 Newtons

4. The quantity 'p' is given by $p = \frac{a^3 b^2}{c\sqrt{d}}$ and % errors in a, b, c, d are 1%, 2%, 3%, 4% respectively. Find total error in 'p'.

Ans. 12%

Sol. $p = \frac{a^3b^2}{c\sqrt{d}} = a^3b^2c^{-1}d^{-\frac{1}{2}}$

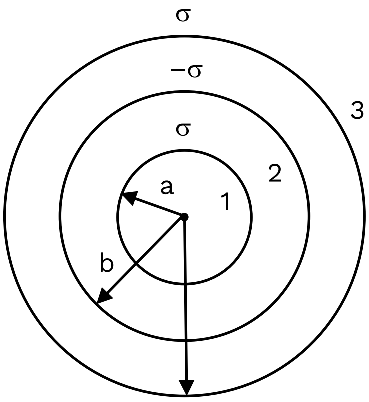
$\frac{\Delta p}{p} = 3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{1}{2}\frac{\Delta d}{d}$

$= 3(1) + 2(2) + 3 + \frac{1}{2}(4)$

= 3 + 4 + 3 + 2

= 12%

5. Figure shows 3 metallic sphere with radius a = 2 cm, b = 3 cm and the radius of sphere 3 is unknown. If potential of inner sphere and outer sphere in same find the radius of 3 sphere.



Ans. 5 cm

Sol. $V_1 = \frac{kq_1}{a} + \frac{kq_2}{b} + \frac{kq_3}{c}$

$= \sigma k 4\pi(a - b + c)$

$V_3 = \frac{kq_1}{C} + \frac{kq_2}{C} + \frac{kq_3}{C} = k\sigma 4\pi\frac{(a^2 - b^2 + c^2)}{C}$

$V_1 + V_3 \Rightarrow a - b + c = \frac{a^2 - b^2 + c^2}{C}$

$ac - bc + c^2 = a^2 - b^2 + c^2$

$(a - b)c = (a - b)(a + b)$

$c = a + b = 5$ cm

6. The equation of progressive wave is y = 5 sin(6t + 0.03x). Find the speed of wave in m/s. (Here x is in cm and t is in second)

Ans. 2

Sol. $V = \frac{\omega}{K}$

7. De-Broglie wavelength of gas molecules at T = 300 k is λ. Find the de-Broglie wavelength of its molecules at T = 600k.

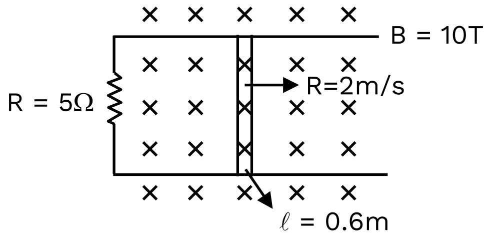
Ans. $\frac{\lambda}{\sqrt{2}}$

Sol. $\lambda = \frac{h}{\sqrt{3mkT}}$

$\lambda \times \frac{1}{T}$

$\frac{\lambda_2}{\lambda_1} = \frac{\sqrt{T_1}}{\sqrt{T_2}} \Rightarrow \lambda_2 = \frac{\lambda}{\sqrt{2}}$

8. Find out the force required to be applied on the wire to keep it moving with constant velocity.



Ans. 14.4 N

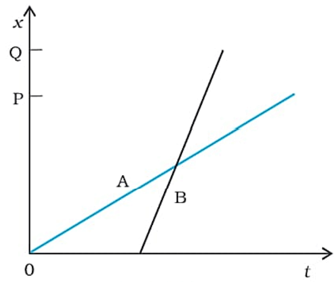
Sol. induced emf = $vB\ell$

$i = \frac{vB\ell}{R}$

$F = i\ell B = \frac{vB^2\ell^2}{R} = \frac{2 \times 0.6 \times 0.6}{5} \times 100$

= 14.4

9. The position-time (x-t) graphs for two children A and B returning from their school O to their homes P and Q respectively are shown in Fig. Choose the correct entries in the brackets below:



(1) (A) lives closer to the school than (B)
(2) (A) starts from the school earlier than (B)
(3) (A) walks faster than (B)
(4) A and B reach home at the (same) time
(5) (A) overtakes (B) on the road (once)

Ans. (1,2)

10. **Statement 1:** If number of turns increases in moving coil galvanometer, then current sensitivity increases.
Statement 2: If number of turns increases in moving coil galvanometer, then voltage sensitivity increases.
(1) TT (2) FF (3) TF (4) FT

Ans. (3)

11. Find the ratio of orbital velocity of planet A of mass M and planet B of mass 3M orbiting in orbit of radius R and 3R respectively.

Ans. 1 : 1

Sol. Orbital velocity = $\sqrt{\frac{4M}{R}}$

$$V_0 \propto \sqrt{\frac{M}{R}}$$

$$\frac{(V_0)_1}{(V_0)_2} = \frac{\sqrt{M/R}}{\sqrt{3M/3R}} = 1:1$$

12. Initial pressure of a monoatomic gas is P_0. If it is compressed adiabatically and isothermally respectively to $\frac{1}{8}$ times of initial volume, them find the ratio of final pressure in both processes.

Ans. 4

Sol. For adiabatic process

$$V = \frac{5}{3}$$

$$P_1V_1 = P_2V_2^{\frac{5}{3}}$$

$$P_2 = P_1\left(\frac{V_1}{V_2}\right)^{\frac{5}{3}}$$

$$P_2 = 32P_0$$

For isothermal process $\Rightarrow$

$$P_1V_1 = P_2^1V_2$$

$$P_1^2 = P_1\left(\frac{V_1}{V_2}\right) = 8P_0$$

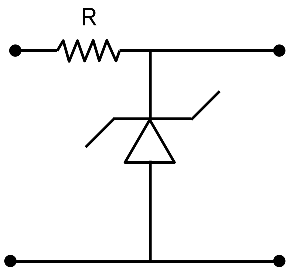
$$\frac{P_2}{P_1} = \frac{32P_0}{8P_0} = 4$$

13. **Statement 1:** Power radiated is maximum in LCR series circuit in resonance condition.
Statement 2: Power radiated is maximum in pure resistive circuit because current and voltage are in same phase.

(1) TT (2) FF (3) TF (4) FT

Ans. (1)

14. Break down voltage of Zener diode in reverse biased is 8V. Unregulated voltage fluctuates between 2V to 10V. Find the value of resistance to be connected for safe condition. (Given: Power consumed in Zener diode is 9W.)



Ans. $\frac{16}{9}\Omega$

Sol. P = 9W

$I = \frac{P}{V} = \frac{9}{8}A$ (from zener)

$V_R = 2V$

$R = \frac{V_R}{I} = \frac{2}{9/8} = \frac{16}{9}\Omega$

15. Angular momentum of an electron revolving in first orbit of hydrogen atom is L. Find the angular momentum of electron in second orbit.

Ans. 2L

Sol. $L_1 = \frac{nh}{2\pi} = \frac{h}{2\pi} = L$

$L_2 = \frac{nh}{2\pi} = 2L$

16. Earth shrinks to 1/64 times of its initial volume. Time period of Earth rotation is found to be $\frac{24}{x}$ hrs. Find the value of x.

Ans. 1.5 Hrs

Sol. $V' = \frac{V}{64}$

$R' = \frac{R}{4}$

$I_1W_1 = I_2W_2$

$\frac{2}{5}MR^2W_1 = \frac{2}{5}M(R')^2W_2$

$W_2 = 16W_1$

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

$\frac{T_1}{T_2} = \frac{W_2}{W_1}$

$T_2 = \frac{24}{16}$ hrs

17. Intensity of incident light is $32Wm^{-2}$. 3 polaroid were placed such that axis of first and third polaroid are perpendicular to each other. Find the angle between axis of first and second polaroid if intensity of emerging light is $3Wm^{-2}$.

Ans. 30°

Sol. $I = \frac{I_0}{2}\cos^2\theta \times \cos^2(90-\theta)$

$3 = \frac{32}{2} \times \cos^2\theta \sin^2\theta$

$3 = 4 \times 4\sin^2\theta \cos^2\theta$

$(\sin 2\theta)^2 = \frac{3}{4}$

$\sin 2\theta = \frac{\sqrt{3}}{2}$

$\theta = 30°$

18. 10 resistors of resistance 10Ω each are arranged such that the circuit has maximum or minimum resistance. Find the ratio of maximum and minimum resistance.

Ans. 100

Sol. Maximum resistance when connected in sense $\Rightarrow$ 10 × 10 = 100Ω

Minimum resistance when connected in parallel $\Rightarrow \frac{10}{10} = 1\Omega$

$\frac{R_{max}}{R_{min}} = \frac{100}{1} = 100$

19. Radioactive nuclei A decays by a reaction in which its half life is 12 minutes. In another independent reaction the half life is 3 minutes. If both reactions take place together then find the effective half life.

Ans. 2.4 min.

Sol. $\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}$

$\frac{1}{t} = \frac{1}{3} + \frac{1}{12} = \frac{5}{12}$

t = 2.4 min.

20. In an AM wave, amplitude of modulating wave = 3 units and amplitude of carrier wave = 15 units. Find the ratio of maximum of minimum intensity $\frac{I_{max}}{I_{min}}$.

Ans. 2.25

Sol. $A_{max} = A_C + A_m$

$A_{min} = A_C - A_m$

$$\left(\frac{I_{max}}{I_{min}}\right) = \left(\frac{A_C + A_m}{A_c - A_m}\right)^2$$

$$= \left(\frac{18}{12}\right)^2$$

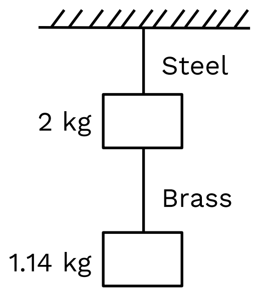
= 2.25

21. Match the column

Column-I	**Column-II** **Degree of freedom**
(A) Monoatomic	(P) $F_T = 3, F_R = 2, F_V = 1$
(B) Diatomic	(Q) $F_T = 3, F_R = 0, F_V = 0$
(C) Triatomic linear	(R) $F_T = 3, F_R = 3, F_V = 3$
(D) Triatomic non linear	(S) $F_T = 3, F_R = 2, F_V = 4$

Ans. (A)-Q; (B)-P; (C)–S:(D)-R

22. Two wires of radius 0.1 cm, one made of steel and the other made of brass are loaded as shown in Fig. The unloaded length of steel wire is 1.6 m. Compute the elongation of the steel wire. ($Y_S = 2 \times 10^{11}$ Nm^{-2})



Ans. 0.08 mm

Sol. $\frac{T}{A} = Y\frac{\Delta\ell}{\ell}$

$$\Delta\ell = \frac{T\ell}{YA} = \frac{3.14 \times g \times 1.6}{2 \times 10^{11} \times \pi \times 10^{-6}}$$

23. **Statement 1:** In a reservoir of water at the same level pressure remains the same.
Statement 2: When pressure is applied on closed vessel it is equally transmitted throughout the water.

(1) TT (2) FF (3) TF (4) FT

Ans. (1)

24. Decay constant for a radioactive nuclei is given to be 2×10^3. If molar mass of sample is 60 gm then activity of 0.3μg sample is equal to (in disintegration/seconds)

Ans. 6.023×10^{18}

25. A solenoid having 60 turns and length 15 cm produces magnetic field of 2.4×10^{-3}T, find the current in the solenoid.

Ans. $\frac{30}{2\pi}$

26. A point sized object is placed 4 cm from the double convex lens of focal length 8 cm. The change in the position of image, when the object is moved 2 cm towards the lens, is:

Ans. $\frac{16}{3}$cm