PHYSICS

1. Two bodies with initial velocity 40 m/s and 60 m/s are projected at angle 60° and 30° respectively. Find the ratio of their range.

Ans. $\frac{4}{9}$

Sol. $\frac{R_1}{R_2} = \frac{u_1^2 \sin 2\theta_1}{u_2^2 \sin 2\theta_2}$

$= \left(\frac{40}{60}\right)^2 \frac{\sin 60}{\sin 20}$

$= \frac{4}{9} \times 1$

$= \frac{4}{9}$

2. Mass of Proton is 6×10^{-24} g and mass of electron is 9.1×10^{-28} g. If they are having same wavelength find the ratio of their momentum.

Ans. 1 : 1

Sol. $\lambda \propto \frac{1}{P}$

$\frac{\lambda_1}{\lambda_2} = \frac{P_2}{P_1}$

$\frac{P_1}{P_2} = \frac{\lambda_1}{\lambda_2} = 1:1$

3. In the circuit, inductance of the inductor is 7.5 mH, capacitance is 12 μF. If the maximum charge stored in the capacitor is 27 μC then find the maximum current in the circuit.

Ans. 0.09 A

Sol. $\frac{q_{max}^2}{2C} = \frac{1}{2} L (I_{max})^2$

$\frac{\left(27 \times 10^{-6}\right)^2}{2 \times 12 \times 10^{-6}} = \frac{1}{2} \times 7.5 \times 10^{-3} \times I_{max}^2$

$I_{max}^2 = 0.81 \times 10^{-2}\ A$

$I_{max} = 0.09\ A$

4. What is the dimensional formula of $\left(\frac{1}{\mu_0 \varepsilon_0}\right)$?

Ans. $[L^2T^{-2}]$

Sol. $\frac{1}{\mu_0 \varepsilon_0} = C^2$

Dimensional formula = $[L^2T^{-2}]$

5. If the momentum of a body is increased by 50%, find the percentage change in its kinetics energy.

Ans. 125%

Sol. $p' = 1.5\ p$

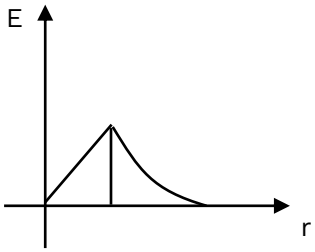
$$k = \frac{p^2}{2m}$$

$$k' = \frac{(p')^2}{2m} = \frac{(1.5p)^2}{2m} = 2.25\frac{p^2}{2m} = 2.25k$$

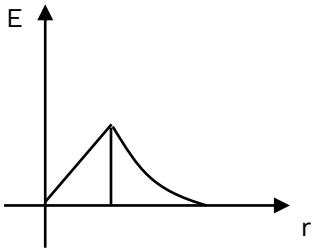
$$\frac{\Delta k}{k} \times 100\% = \frac{1.25}{1} \times 100\% = 125\%$$

6. Identify the graph which represents the relationship between Electric field and r for an insulating sphere. Where r is distance from the center of sphere.

Ans.



Sol. $E_{in} = \frac{kQr}{R^3}$ $\qquad$ $E_{at} = \frac{kQ}{R^2}$



7. In a conducting wire of cross section area 25 mm^2, current flowing is 2 A. If the number of electrons flowing per unit volume is 2×10^{28}, find the drift velocity.

Ans. 0.025

Sol. $I = neAv_d$

$2 = (2 \times 10^{28}) \times (1.6 \times 10^{-19}) \times (25 \times 10^{-6})\ v_d$

$$v_d = \frac{2}{2 \times 1.6 \times 25 \times 10^3} = \frac{1}{40 \times 10^3} = 2.5 \times 10^{-5}\ m/s$$

$= 0.025$ mm/s

8. Moment of inertia for a semi-circular ring of mass M and radius R is given by $\frac{MR^2}{x}$. Find the value of x.

Ans. 1

Sol. $I = MR^2$

So, x = 1

9. Statement -1: Potential energy of a revolving satellite is half of the total energy of the satellite.
Statement -2: kinetic energy of a revolving satellite is half of the total energy of the satellite.

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

Ans. (4)

Sol. P.E. + K.E. = T.E.

$$|K.E.| = |T.E.| = \frac{|P.E.|}{2}$$

10. Two forces of magnitude F_1 and F_2 are perpendicular to each other. Find the magnitude of resultant force.

Ans. $\sqrt{F_1^2 + F_2^2}$

Sol. $F_R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

11. A particle of mass 500 gm having velocity $\vec{v} = 2t\,\hat{i} + 3t^2\hat{j}$ and force acting on the particle is $\vec{F} = \hat{i} + xt\,\hat{j}$. Find the value of x.

Ans. 3t

Sol. $\vec{v} = 2t\,\hat{i} + 3t^2\hat{j}$, m = 500 gm = $\frac{1}{2}$ kg

$\vec{F} = \hat{i} + xt\hat{j}$

$\vec{a} = 2\hat{i} + 6t\hat{j}$

$\vec{F} = \frac{1}{2}(2\hat{i} + 6t\hat{j})$

$= \hat{i} + 3t\hat{j}$

X = 3t

12. Magnetic field at the center of a long solenoid is 1.6×10^3 T. If there are 8 turns in 1 cm of length, then find the value of current flowing through the solenoid.

Ans. $\frac{1}{2\pi} \times 10^7$ A

Sol. $B = \mu_0 ni$

$$i = \frac{B}{\mu_0 n} = \frac{1.6 \times 10^3}{4\pi \times 10^{-7} \times 800} = \frac{16 \times 10^7}{32\pi}$$

$$= \frac{1}{2\pi} \times 10^7 \text{ A}$$

13. Weigh of a particle at the surface of earth is 400 N. Find its weight at $\frac{R}{2}$ depth. (R = radius of earth)

Ans. 200

Sol. $g^1 = g_0\left(1 - \frac{d}{R_e}\right)$

$$= g_0\left(1 - \frac{1}{2}\right) = \frac{g_0}{2}$$

$W^1 = W/2 = 200N.$

14. In a nuclear reaction,

$X^{242} \rightarrow Y^{121} + Y^{121}$

Binding energy/Nucleon of X = 7.6 MeV

Binding energy/Nucleon of Y = 8.1 MeV

Then find the Q – value of reaction.

Ans. 121 MeV

Sol. Q – value = $\sum B \cdot E_P - \sum B.E_R$

15. A wire of young modulus, Y = 7×10^{11} is stretched. The strain developed in the wire is 0.04%. Find the energy stored per unit volume.

Ans. 56×10^3 J

Sol. $\frac{U}{V} = \frac{1}{2} \times Y \times (\text{strain})^2$

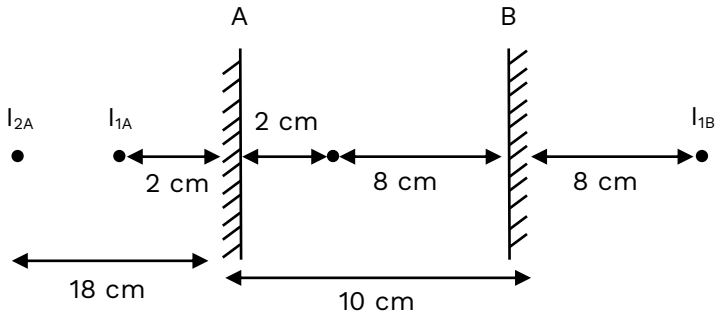
$= \frac{1}{2}(7 \times 10^{11})(16 \times 10^{-8})$

$= 56 \times 10^3$ J

16. Two plane mirrors A & B separated by 10 cm are placed in front of each other. A point object is placed at 2 cm from mirror A. Find the distance of 2nd closest image from mirror A.

Ans. 18 cm

Sol.



17. Sound wave is travelling through a 40 cm long pipe at fundamental frequency. Given that velocity is sound air is 340m/s then find the frequency of wave.

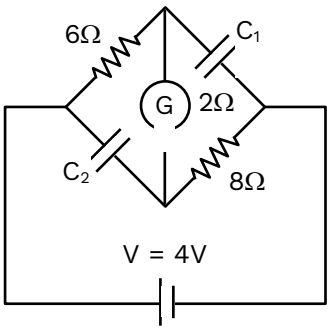
Ans. 425 Hz

Sol. $\ell = \frac{\lambda}{2} \Rightarrow \lambda = 2\ell = 80$ cm ...(1)

$V = f\lambda$

$f = \frac{v}{\lambda} = \frac{340 \times 100}{80} = 425$ Hz

18.

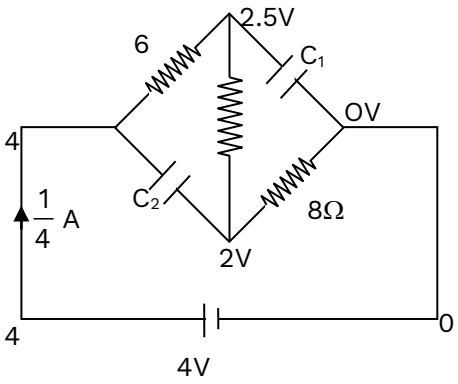


Find the ratio of potential difference across capacitor C_1 and C_2 in steady state in the given figure.

Ans. 1.25

Sol. Current $I = \frac{V}{R} = \frac{4}{16} = \frac{1}{4}A$

$$\frac{V_{C_1}}{V_{C_2}} = \frac{2.5}{2} = 1.25$$



19. An air bubble having volume 1 cm^3 at depth 40 m inside water, on coming to the surface has volume:

Ans. 5 cm^3

Sol. $P_1V_1 = P_2V_2$

$$(10^5 + \rho gh) \times \left(1 \times 10^{-6}\right) = (10^5) \times V_2$$

$$\left[10^5 + (10^3 \times 10 \times 40)\right] \times 10^{-6} = 10^5 V_2$$

$5 \times 10^5 \times 10^{-6} = 10^5\ V_2$

$V_2 = 5\ cm^3$

20. An engine horns a whistle of frequency 400 Hz. If the speed of engine is 10 m/s, then find the frequency of sound received by passenger sitting in last boggie of the train. (Length of train is 500 m).

Ans. 400 Hz

Sol. Velocity of source and receiver is same, therefore, frequency received will be same as frequency at source.

Frequency receiver = 400Hz

21. The height of antenna is 98 m. The radius of earth is 6400 km. The area up to which it will transmit signal is-

Ans. $38424 \times 10^5\ m^2$

Sol. Distance covered by the signal from antenna

$$d = \sqrt{2Rh}$$

Area covered = $\pi d^2 = 2\pi Rh$

$= 2 \times \pi \times 6400 \times 10^3 \times 98$

$= 2 \times \frac{22}{7} \times 64 \times 10^5 \times 98$

$= 38424 \times 10^5\ m^2$

22. If mass, radius of cross-section and height of a cylinder are (0.4 ± 0.01) g, (6 ± 0.03) m and (8 ± 0.04) m. The maximum percentage of error in the measurement of density of cylinder is:

Ans. 4%

Sol. $d = \frac{m}{Ah}$

$$\frac{\Delta d}{d} = \frac{\Delta m}{m} + 2\frac{\Delta r}{r} + \frac{\Delta h}{h}$$

$$= \frac{0.01}{0.4} + 2\left(\frac{0.03}{6}\right) + \frac{0.04}{8}$$

$$= \frac{1}{40} + \frac{1}{100} + \frac{1}{200}$$

$$= \frac{5+2+1}{200} = \frac{8}{200} = \frac{4}{100}$$

$$\frac{\Delta d}{d} \times 100 = \frac{4}{100} \times 100 = 4\%$$

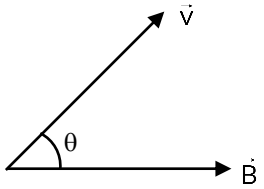
23. A charge particle moves at an angle with magnetic field in a region of uniform magnetic field intensity. The path traced by it will be:

(1) Circular (2) Straight Line

(3) Cycloid (4) Helical

Ans. (4)

Sol.



Path will be helical.

24. **Statement -1:** If heat is given to a gas, its temperature must increase.
Statement -2: If positive work is done, volume of gas must increase.

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

Ans. (3)

25. An electric dipole with dipole moment 5 μCm is placed in a region with uniform electric field 600 N/C at angle 90° with the direction of field. The torque experienced by the dipole (in milli Newton – metre) is equal to _____.

Ans. 3

Sol. $\tau = PE \sin\theta$

$= 5 \times 10^{-6} \times 600 \times \sin 90°$

$= 3 \times 10^{-3}$ N – m

$\tau = 3$ mN - m

26. Secondary mirror is used in telescope to:

(1) Remove spherical aberration

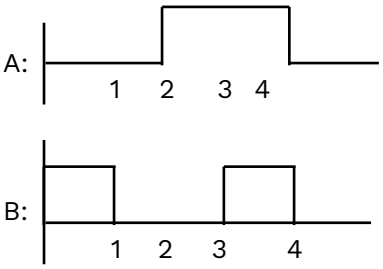
(2) Remove chromatic aberration

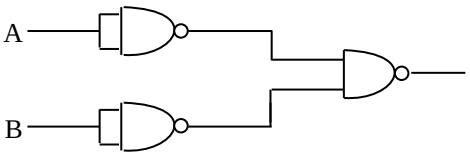
(3) Both of the above

(4) None of these

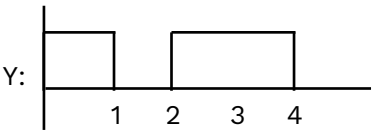
Ans. (1)

27. Wave form of input signal A and B are shown in the figure. Find the output wave form.





Ans.



Sol. $\overline{(\bar{A}\cdot\bar{B})} = A + B$

28. Non-magnetic core in the galvanometer is used to:
(1) Reduce Eddy current
(2) Increase sensitivity of G.
(3) Produce radial magnetic field
(4) None of these

Ans. (2)