

1. If a simple pendulum completes 200 oscillation in 100 sec. Least count of watch is 1 sec., length of simple pendulum is 100 cm and it's least count is 1 mm then find max. possible percentage error in measuring acceleration due to gravity.

- (1) 3.2 (2) 5.2 (3) 2.1 (4) 4.1

Ans. (3)

Sol. $T = 2\pi\sqrt{\frac{\ell}{g}}$

$$T^2 = 4\pi^2\left(\frac{\ell}{g}\right)$$

$$g = 4\pi^2\left(\frac{\ell}{T^2}\right)$$

$$\frac{\Delta g}{g} = \frac{\Delta \ell}{\ell} + 2\frac{\Delta T}{T}$$

$$\frac{\Delta g}{g} \times 100 = \frac{0.1\text{cm}}{100\text{cm}} \times 100\% + 2\left(\frac{1\text{sec}}{100\text{sec}}\right) \times 100\%$$

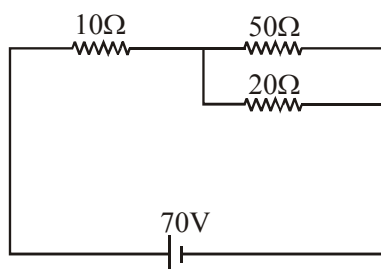
$$\frac{\Delta g}{g} \times 100 = 2.1\%$$

2. A girl is looking at the distant rectangular window, she finds window to be blurred & non-uniformly curved. What eye defect she may have?

- (1) Myopia & Astigmatism (2) Myopia & Hypermetropia
 (3) Astigmatism (4) Hypermetropia & Astigmatism

Ans. (1)

3. In the circuit shown evaluate potential difference across 10Ω in volts?



Ans. 70.00

Sol. $R_{eq} = 10 + \frac{10 \times 20}{50 \times 20}$
 $= \frac{170}{7} \Omega$

$I = \frac{V}{R_{eq}} = \frac{170}{170} \times 7 = 7 \text{ amp}$

$V_{10\Omega} = IR$
 $= 7 \times 10 = 70 \text{ v}$

4. A satellite revolves in a circular orbit of radius R around earth with time period T. Find its time period if it starts revolving in radius 9R?

- (1) 3T (2) 6T (3) 9T (4) 27T

Ans. (4)

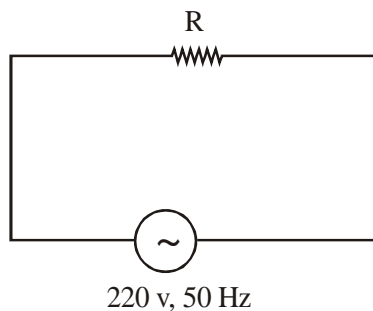
Sol. $T^2 \propto R^3$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = 9^3$

$\therefore \frac{T_2}{T_1} = 27$

5. AC circuit diagram is shown. Find time taken to reach its current from i_{rms} to i_{max} .



- (1) 10 milli sec. (2) 1 milli sec. (3) 2.5 milli sec. (4) 5 milli sec.

Ans. (3)

Sol. $i = i_{max} \sin(\omega t + \theta)$

at $t = 0$, $i = i_{rms}$

$i_{rms} = \sqrt{2} (i_{rms}) \sin \theta$

$\theta = \frac{\pi}{4}$

$$i = i_{\max} \sin \left(\omega t + \frac{\pi}{4} \right)$$

at $t = t_1$, $i = i_{\max}$

$$i_{\max} = i_{\max} \sin \left(\omega t_1 + \frac{\pi}{4} \right)$$

$$\omega t_1 + \frac{\pi}{4} = \frac{\pi}{2}$$

$$\omega t_1 + \frac{\pi}{4}$$

$$\frac{2\pi}{T} t_1 = \frac{\pi}{4}$$

$$t_1 = \frac{T}{8}$$

$$t_1 = \frac{1}{8} \left(\frac{1}{f} \right) = \frac{1}{8} \left(\frac{1}{50} \right)$$

$$t_1 = \frac{1000}{400} \text{ m sec} = 2.5 \text{ m sec}$$

6. In LCR circuit L and C are constant and R is increased then:
- (1) Quality factor and resonant frequency both are unchanged.
 - (2) Quality factor is increased.
 - (3) Band width is increased.
 - (4) Quality factor remains unchanged

Ans. (3)

Sol. $\omega = \frac{1}{\sqrt{LC}}$, $Q = \frac{1}{R} \sqrt{\frac{L}{C}}$, Band width = $\frac{R}{L}$

7. In YDSE setup, distance between slits is 0.5 mm & separation between slits plane & screen is 0.5 m. Find the distance between 1st maxima & 3rd maxima if light used has wave length 5890 Å.
- (1) 1178×10^{-6} m (2) 1178×10^{-7} m (3) 1178×10^{-8} m (4) 5890×10^{-7} m

Ans. (1)

Sol. Distance between 1st & 3rd maxima will be 3β .

$$\therefore 2 \times \frac{\lambda D}{d} = 2 \times 5890 \times 10^{-10} \times \frac{0.5}{0.5 \times 10^{-3}}$$

$$= 11780 \times 10^{-7} \text{ m}$$

8. A closed current carrying loop is placed in uniform magnetic field. Then in equilibrium shape of wire will be :
- (1) straight
 - (2) unchanged
 - (3) circular and plane perpendicular to magnetic field
 - (4) Circular and plane parallel to magnetic field

Ans. (3)

9. A muon particle (mass = $207 m_e$) revolves around hydrogen nucleus. Find its ionisation energy.?
 [m_e = mass of electron]

- (1) 13.6 eV (2) 27.2 eV (3) 13.6×207 eV (4) 331.8 eV

Ans. (Bonus)

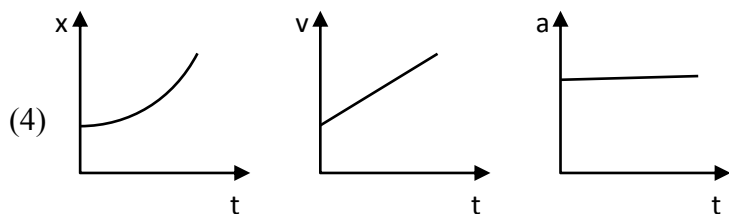
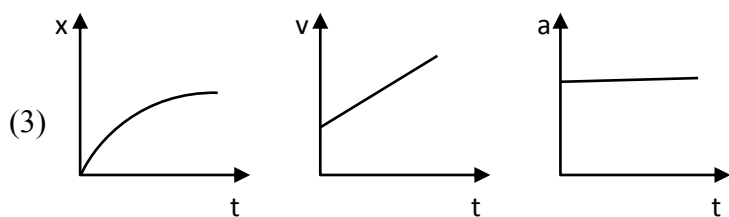
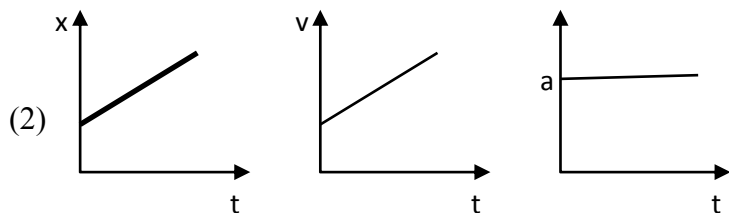
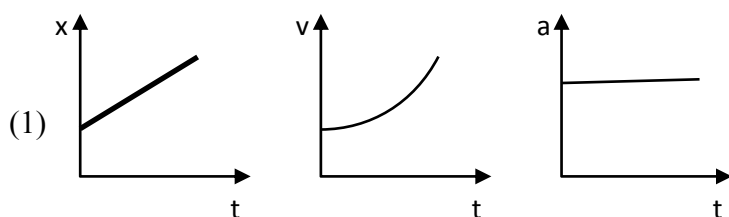
Sol. $E_n = -13.6 \times \frac{\mu}{m_e} \text{ eV}$

$$\mu = \frac{(1836m_e)(207m_e)}{(1836 + 207)m_e}$$

$$= \frac{1836 \times 207}{2043} = 186 m_e.$$

\therefore Ionisation energy = 13.6×186 eV

10. An object is moving with constant acceleration. Choose the correct option.



Ans. (4)

Sol. $a = \text{constant}$

$$v \propto t$$

$$x \propto t^2$$

11. A ring of mass M is rotating with constant angular velocity ω about axis of rotation passing through centre and perpendicular to the plane of ring. Two particles each of mass m are placed gently diametrically at opposite position. Find new angular velocity.

(1) $\left(\frac{M+2m}{M}\right)\omega$ (2) $\left(\frac{M\omega}{M+2m}\right)$ (3) $\left(\frac{M-2m}{M}\right)\omega$ (4) $\left(\frac{m\omega}{M+2m}\right)$

Ans. (3)

Sol. Using angular momentum conservation

$$L_i = MR^2\omega$$

$$L_f = (MR^2 + 2mR^2)\omega'$$

$$\omega' = \left(\frac{M\omega}{M+2m}\right)$$

12. Electromagnetic wave is propagating in x direction. Magnetic field in space is given by $\vec{B} = 2 \times 10^{-8}(\text{T})\hat{k}$. What will be the value and direction of electric field.

(1) $0.6 \hat{j}$ (2) $6 \hat{j}$ (3) $0.6 \hat{k}$ (4) $6 \hat{k}$

Ans. (2)

Sol. $E = CB$

$$E = 3 \times 10^8 \times 2 \times 10^{-8}$$

$$E = 6$$

direction of \vec{v} is $\vec{E} \times \vec{B}$

$$\hat{i} = \hat{j} \times \hat{k}$$

$$\text{so } \vec{E} = 6\hat{j}$$

13. A machine starting from Rest delivers constant Power 'P'. Then distance travelled by it in time 't' is proportional to:-

(1) $t^{-3/2}$ (2) $t^{1/2}$ (3) $t^{3/2}$ (4) $t^{-1/2}$

Ans. (3)

Sol. $P = Fv$

$$P = mav$$

$$P \int dt = m \int v dv$$

$$m \frac{v^2}{2} = Pt$$

$$v = \left(\frac{2Pt}{m} \right)^{1/2}$$

$$\frac{dx}{dt} = \left(\frac{2Pt}{m} \right)^{1/2}$$

$$x = \left(\frac{2P}{m} \right)^{1/2} \frac{t^{3/2}}{\frac{3}{2}}$$

$$x \propto t^{3/2}$$

- 14.** An object is performing SHM with time period 2 sec. If time taken by it to move from mean position to half of amplitude is $\frac{1}{K}$ sec. Then value of K is.

- (1) 3 (2) 6 (3) 4 (4) 2

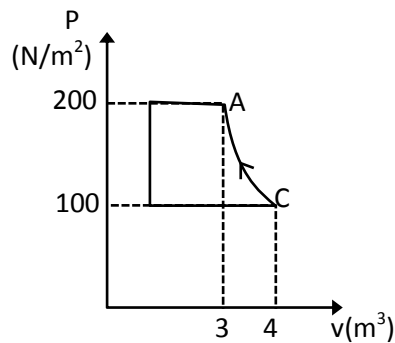
Ans. (2)

Sol. from 0 to $\frac{A}{2}$

$$\text{time} = \frac{T}{12} \text{ sec}$$

$$\frac{2}{12} = \frac{1}{6} \text{ sec}$$

- 15.** In given P-V graph process CA is adiabatic. Find work done in process CA if gas is diatomic ($\gamma = 1.4$):

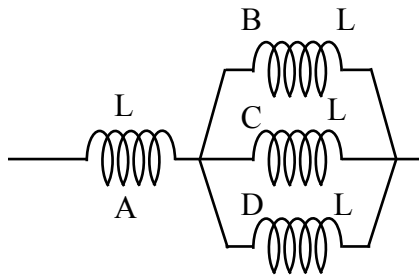


- (1) -400 J (2) -500 J (3) 200 (4) 400

Ans. (2)

Sol.
$$W = \frac{nR\Delta T}{1-\gamma} = \frac{P_2V_2 - P_1V_1}{1-\gamma} = \frac{200 \times 3 - 4 \times 100}{1-1.4} = -500 \text{ J}$$

16. Four identical solenoids are connected as shown in figure



If magnetic field in A is 3T, evaluate magnetic field in C

- (1) 1T (2) 9T (3) 12T (4) 6T

Ans. (1)

Sol. $B_A = \mu_0 nI = 3T$

$$B_C = \mu_0 n \frac{I}{3}$$

$$B_C = 1T$$

17. In a wire $V = 5.0V$, $I = 2.00A$, $L = 10.0$ cm and diameter $d = 5.00$ mm. Evaluate $\frac{\Delta\rho}{\rho} \times 100$?

- (1) 3.9% (2) 1.9% (3) 2.9% (4) 3%

Ans. (1)

Sol.
$$\frac{\Delta\rho}{\rho} = \frac{\Delta R}{R} + \frac{\Delta\ell}{\ell} + \frac{2\Delta d}{d}$$

$$\frac{\Delta\rho}{\rho} = \frac{\Delta V}{V} + \frac{\Delta I}{I} + \frac{\Delta\ell}{\ell} + \frac{2\Delta d}{d}$$

$$\frac{\Delta\rho}{\rho} \% = \left(\frac{0.1}{5} + \frac{0.01}{2} + \frac{0.1}{10} + 2 \times \frac{0.01}{5} \right) \times 100$$

$$= 2 + 0.5 + 1 + 0.4 = 3.9\%$$

18. A is forming B and C independently if $A \rightarrow B$ with half life = $T_{1/2}(B)$ and if $A \rightarrow C$ with half life $T_{1/2}(C)$ then what will be overall half life:

(1) $\frac{T_{1/2}(B) \times T_{1/2}(C)}{T_{1/2}(B) + T_{1/2}(C)}$ (2) $\frac{T_{1/2}(B) + T_{1/2}(C)}{T_{1/2}(B) \times T_{1/2}(C)}$

(3) $\frac{T_{1/2}(B) \times T_{1/2}(C)}{T_{1/2}(B) - T_{1/2}(C)}$ (4) $\frac{T_{1/2}(B) + T_{1/2}(C)}{T_{1/2}(B) - T_{1/2}(C)}$

Ans. (1)

Sol.
$$-\frac{dN_A}{dt} = \lambda_B N_A + \lambda_C N_A$$

$$= (\lambda_B + \lambda_C) N_A = \lambda_{eq} N_A$$

$$\lambda_{eq} = \lambda_B + \lambda_C$$

$$\frac{\ln 2}{T_{eq}} = \frac{\ln 2}{T_{1/2B}} + \frac{\ln 2}{T_{1/2C}} \Rightarrow \frac{1}{T_{eq}} = \frac{1}{T_{1/2B}} + \frac{1}{T_{1/2C}}$$

$$T_{eq} = \frac{T_{1/2B} \times T_{1/2C}}{T_{1/2B} + T_{1/2C}}$$

- 19.** Two wires A and B of same material having elongation 2 mm and 4 mm respectively on applying 2N take. If radius of B is four times the radius of A and ratio of length of A is to B in the form of $\frac{1}{x}$ then the value of x is

Ans. 32.00

Sol.
$$\frac{F}{A} = Y \frac{\Delta L}{L}$$

$$\frac{F}{\pi r_A^2} = Y \frac{\Delta L_A}{L_A} \quad \text{----- (i)}$$

$$\frac{F}{\pi r_B^2} = Y \frac{\Delta L_B}{L_B} \quad \text{----- (ii)}$$

$$\left(\frac{r_B}{r_A}\right)^2 = \frac{\Delta L_A}{\Delta L_B} \times \frac{L_A}{L_B} \quad r_B = 4r_A$$

$$16 = \frac{2}{4} \times \frac{L_B}{L_A} \quad \frac{r_B}{r_A} = 4$$

$$\frac{L_B}{L_A} = 32$$

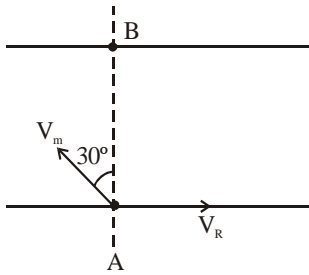
$$\frac{a}{b} = \frac{1}{32}$$

$$x = 32$$

- 20.** A man is swimming in a river at an angle 120° with river flow. Speed of man in still water is 10m/s. If he reaches the other bank exactly opposite to origin point, find speed of flow of river (in m/s)

Ans. 5.00

Sol.



Net speed perpendicular to line.

AB must be zero.

$$\therefore v_m \sin 30 = V_R$$

$$\therefore v_r = 5 \text{ m/s}$$

21. If ratio of de-Broglie wavelength of particle and electron is 2 : 1 and ratio of their velocity is 4 : 1. Then

- (1) mass of particle is 8 times that of electron
- (2) mass of electron is 8 times that of particle
- (3) mass of electron is 16 times that of particle
- (4) mass of particle is 16 times that of electron

Ans. (2)

Sol.
$$\frac{\lambda_p}{\lambda_e} = \frac{\frac{h}{m_p v_p}}{\frac{h}{m_e v_e}} \Rightarrow \frac{2}{1} = \frac{m_e v_e}{m_p v_p} = \frac{m_e}{m_p} \times \frac{1}{4}$$

$$\frac{m_e}{m_p} = 8$$

22. In the millikan oil drop experiment radius of drop is $r = 2 \text{ mm}$ and density $\rho = 3 \text{ gm/cm}^3$. If the applied electric field is $E = 3.55 \times 10^5 \text{ N/C}$. Find excess electrons.

- (1) 1.769×10^{10} (2) 1.567×10^{10} (3) 1.769×10^{12} (4) 1.567×10^{12}

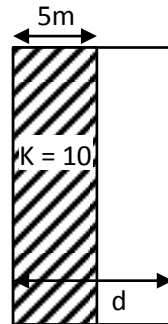
Ans. (1)

Sol. $mg = qE$

$$q = \frac{mg}{E}$$

$$N = \frac{mg}{eE} = \frac{3 \times 10^{-3} \times 10 \times \frac{4}{3} \pi \times 8 \times 10^{-9}}{10^{-6} \times 3.55 \times 10^5 \times 1.6 \times 10^{-19}} = 1.769 \times 10^{10}$$

- 23.** A partially filled capacitor has half of its space filled with dielectric of relative permittivity 10. Equivalent capacitance if area of plates is 100 m^2 and distance between plates is 10 m is given as $x \text{ pF}$. Find x ? ($\epsilon_0 = 8.85 \times 10^{-12}$)



Ans. 161.00

Sol. $C_2 = \frac{\epsilon_0 \times 100}{5} = 20\epsilon_0$

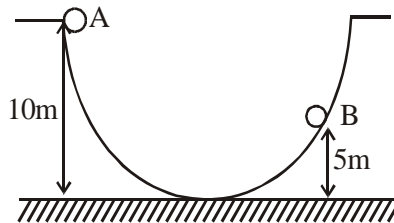
$$C_1 = 10 \times \frac{\epsilon_0 \times 100}{5} = 200\epsilon_0$$

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

$$C_{eq} = \frac{4000 \epsilon_0}{220}$$

$$= 160.90 \times 10^{-12} = 161 \text{ pF}$$

- 24.** A ball is released from point A. Evaluate its velocity (m/s) when it reaches to point B (assume frictionless surface):



Ans. 10.00

Sol. $mg(5) = \frac{1}{2}mv^2$

$$V = 10 \text{ m/s.}$$

- 25.** Initially a body of mass 10 kg is moving along x -axis with velocity $10\sqrt{3} \text{ m/s}$. It collides with another body of mass 20 kg and comes to rest. The 20 kg mass object disintegrates in 2 parts each of mass 10 kg . One part moves along y -axis with velocity 10 m/s and another at 30° with x -axis. Evaluate the velocity of the object which moves at angle 30° with x -axis.

Ans. 20.00

Sol. $|\vec{v}| = 20 \text{ m/s}$

$$10 \times 10 \sqrt{3} \hat{i} = 10 \times 10 \hat{j} + 10 \vec{v}$$

$$\frac{100\sqrt{3}\hat{i} - 100\hat{j}}{10} = \vec{v}$$

$$\vec{v} = 10\sqrt{3}\hat{i} - 10\hat{j}$$

- 26.** A bullet of mass 0.1 kg initially moving with a velocity 10 m/sec and then passes through a wooden block and comes to rest with uniform deceleration by travelling 50cm. If the force exerted by wooden block on bullet is x newton, then find x.

Ans. 10.00

Sol. $v^2 = u^2 + 2as$

$$0 = 100 + 2(-a)\left(\frac{1}{2}\right)$$

$$a = 100 \text{ m/s}^2$$

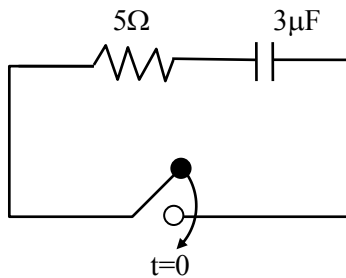
$$F = ma = (0.1)(100)$$

$$F = 10 \text{ N}$$

- 27.** A capacitor of capacitance $3 \mu\text{F}$ has charge 30 nC is connected to a resistance of 5Ω . If current in circuit just after closing the switch is x A. Then x is :

Ans. 2.00

Sol.



$$q = Qe^{-\frac{t}{RC}}$$

$$I = \frac{Q}{RC} e^{-\frac{t}{RC}}$$

$$I(t=0) = \frac{Q}{RC} = \frac{30}{5 \times 3} = 2\text{A}$$

28. Coming soon.

29. Coming soon.

30. Coming soon.