Subject: Answer key of physics mid year exam for third Secondary- G.S and L.S
Academic year: 2010-2011

I- 1) No friction with air ⟹ M.E is conserved (0^+)

$M.E_A = M.E_B$

$M.E_B = K.E_B + G.P.E_B$

$M.E_B = \frac{m_1 V_1^2}{2} = 1.25J$ (1/2)

$M.E_A = K.E_A + G.P.E_A \Longrightarrow$

$1.25 = m_1 gL + \frac{m_A V_A^2}{2}$ (0^+) ⟹

$V_A = 3m/s$ (1/2)

2) L.M is conserved ⟹ $\overrightarrow{p_f} = \overrightarrow{p_i}$

$m_1\overrightarrow{V_1} + m_2\overrightarrow{V_2} = m_1\overrightarrow{V'_1} + m_2\overrightarrow{V'_2} \Longrightarrow$

$m_1\overrightarrow{V'_1} + 0.4(2\vec{i}) = 0.1(5\vec{i}) + 0 \Longrightarrow$

$\overrightarrow{V'_1} = -3\vec{i}$ (1/2) (V'_1 in m/s)

$K.E_f = \frac{m_1 {V'_1}^2}{2} + \frac{m_2 {V'_2}^2}{2} = 1.25J$

$K.E_i = \frac{m_1 V_1^2}{2} + \frac{m_2 V_2^2}{2} = 1.25J$

$K.E_f = K.E_i$ ⟹ Elastic collision (1)

3) $\overrightarrow{V'_1} = -3\vec{i}$ ⟹ Deviation to left (0^+)

M.E is conserved $M.E_B = M.E_{B'}$

$\frac{m_1 {V'_1}^2}{2} = m_1 gh \Longrightarrow$

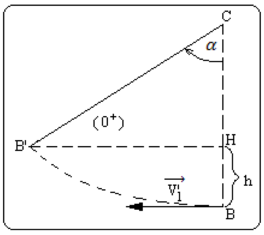
h = 0.45m (0^+)

h = CB- CH =

h = L-Lcos α (0^+)

0.45= 0.8-0.8cos α

⟹ α =64° (1/2)



4) a) $\Delta M.E = W_{\vec{f}} \Longrightarrow \quad 0 - \frac{m_2 {V'_2}^2}{2} = -f.d$ (0^+)

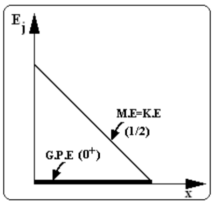
f=0.16N (1/2)

b) G.P.E =0 (0^+)

M.E – $M.E_0$ = -f.x

M.E = -0.16x + 0.8 (0^+)

K.E =M.E (0^+)



II-1)

$M.E = \frac{1}{2}mV^2 + \frac{1}{2}Kx^2 = K.E + E_{.P.E}$ (0^+)

2) $\frac{d(M.E)}{dt} = 0 \Longrightarrow x'' + \frac{K}{m}x = 0$ (0^+)

$\Longrightarrow x'' + \omega_0^2 x = 0 \qquad \omega_0 = \sqrt{\frac{K}{m}}$ (0^+) ,

$T = \frac{2\pi}{\omega_0} = 2\pi\sqrt{\frac{m}{K}}$ (0^+)

3) $\omega_0 = \sqrt{\frac{50}{0.5}}$ =10rd/s (0^+)

$x = x_m \sin(\omega_0 t + \varphi)$

$\frac{1}{2}mv_0^2 = \frac{1}{2}Kx_m^2 \Longrightarrow x_m = 0.2m$ (1/2)

$V = \omega_0 x_m \cos(\omega_0 t\varphi) \qquad V_0 = \omega_0 x_m \cos(\varphi) > 0$

$t = o, x = 0 \Longrightarrow 0 = x_m \sin(\varphi) \Longrightarrow$

$sin\varphi = 0 \Longrightarrow \varphi = 0 \;\; or \; \varphi = \pi$

$\varphi = 0 \Longrightarrow V_0 > 0$ accepted (0^+)

$\varphi = \pi \Longrightarrow V_0 < 0$ rejected (0^+)

$\Longrightarrow x = 0.2\sin(10t)$ (0^+) $(x \; in \; m, t \; in \; s)$

4) a) $S = S_0 + \Delta S = S_0 + L.x = S_0 + 0.25x$ (0^+)

$\emptyset = B.S.\cos(180°) = -B(S_0 + 0.25x)$ (0^+)

$\emptyset = -0.4(S_0 + 0.25x)$ (0^+)

b) $e = -\frac{d\emptyset}{dt} = BLx'$ = BLV (1/2)

$e_0 = B.L.V_0 = 0.2V$ (1/2)

c) $I_0 = \frac{e_0}{R} = 0$ very large R (1/2)

d) when R = 5Ω ⟹ $I_0 = \frac{0.2}{5} = 0.04$ A (1/2)

The induced current I_0 acts in such a way to oppose the cause producing it⟹ The electromagnetic force $\overrightarrow{F_0}$ is opposite in direction to $\overrightarrow{V_0}$

In magnitude: $F_0 = I_0.B.L.\sin(\widehat{\overrightarrow{I_0}, \vec{B}})$

$F_0 = 4 \times 10^{-3}N$ (1/2)

The electromagnetic force $\overrightarrow{F_{em}}$ *acting on MN is opposite to $\vec{V}$ in direction ⟹ it damps the oscillations*

⟹ the oscillation of MN is damped.

In order to produce S.H.M, we must exert on MN a driving force $\vec{F}$ opposite to $\overrightarrow{F_{em}}$. (0^+)

The oscillation of MN is called driven oscillation.(0^+)

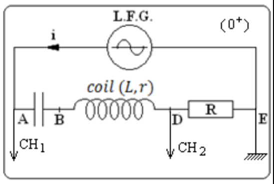
III- 1)

a) $U_{m_1} = 2 \times 3 = 6V$ (0^+), U_{m_2}=2×1 (0^+)

$U_{m_1} > U_{m_2}$ ⟹curve C_1 represents u_G (0^+)

b) U_{m_2}= R. I_m ⟹

$I_m = 0.1A$ (0^+)



$\varphi = 2\pi\frac{d}{D} = \frac{\pi}{3}$ rd (0^+)

u_G cuts t-axis before u_R

⟹ u_G leads i (0^+)

T= 6×2 =12mS = 0.012S (0^+)

ω = $\frac{2\pi}{T} = \frac{500\pi}{3}$ rd/s (0^+)

u = 6 sin ($\frac{500\pi}{3}$ t) (0^+) , i= 0.1 sin($\frac{500\pi}{3}$ t - $\frac{\pi}{3}$) (0^+)

c) P_{av}= U.I.cos(φ)= 0.15 ω (1/2)

P_{av}= (R+r) I^2 ⟹ r =10Ω (1/2)

2)

a) current resonance (0^+) $LC\omega_0{}^2=1 \Longrightarrow L= 0.05H$ (1/2)

b) $U_m= (R+r)\, I_m{}' \Longrightarrow I_m{}' =0.2A$ (0^+)

$i'=0.2\sin(200\pi t)$ (0^+)

c) $u_C = \frac{q}{C} = \frac{1}{C}\int i.dt = \frac{0.2}{50\times10^{-6}}\int sin(200\,\pi t\,)$

$u_C= -6.28\cos(200\,\pi t)$ (0^+)

$u_{coil} = ri+ L\frac{di}{dt} = 2\sin(200\pi t)+ 6.28\cos(200\pi t)$

$u_{coil} = U_{m(r,L)}\sin(\omega t + \varphi') \Longrightarrow$

Calc. $\tan\varphi'= \frac{L\omega}{r} =3.14 \Longrightarrow$

$\varphi' = 1.26rd=72°$ (1/2)

$U_{m(r,L)}= I_m{}'\sqrt{r^2 + (L\omega)^2}$

$u_{coil} = 6.6\sin(200\pi t+1.26)$ (0^+)

IV-1)

a) $a = \frac{mx+M(0)}{m+M}= \frac{mx}{m+M} = \frac{x}{4}$ (0^+)

b) $I = I_{rod} + I_m = \frac{ML^2}{12} + mx^2= \frac{1}{20} +0.2x^2$ (0^+)

c) i) K.E +G.P.E = M.E = $\frac{I\theta'^2}{2}$ - mgh (0^+) ,

h= $x\cos\theta$

M.E = $\frac{I\theta'^2}{2}$ – 0.2(10)($x\cos\theta$) $\Longrightarrow$

M.E = $(\frac{1}{40} + 0.1x^2)\,\theta'^2$ - $2x\cos\theta$

M.E = $(\frac{1}{40} + 0.1x^2)\,\theta'^2$ - $2x + x\theta^2$ (1/2)

ii) No friction $\Longrightarrow$ M.E is conserved $\Longrightarrow$

$\frac{dM.E}{dt} = 0$ (0^+) ,x = constant $\Longrightarrow$

$\theta'' + (\frac{x}{\frac{1}{40}+0.1x^2})\,\theta = 0$ (0^+)

Or $\theta'' + \frac{(M+m).g.a}{I}\theta = 0$

Similar to $\theta'' + \omega_0{}^2\theta = 0$

$\Longrightarrow \omega_0 = \sqrt{\frac{x}{\frac{1}{40}+0.1x^2}}$ (0^+)

$T_0 = \frac{2\pi}{\omega_0} = 2\pi\sqrt{\frac{\frac{1}{40}+0.1x^2}{x}} = 2\pi\sqrt{\frac{1}{40} + \frac{x}{10}}$ (1/2)

iii) T_0 is min $\Longrightarrow \frac{1}{40x} + \frac{x}{10}$ is min $\Longrightarrow$

$\frac{1}{40x} = \frac{x}{10}$ (using derivative or other method)

$\Longrightarrow x=0.5m$ (1/2)

$T_{0(min)} =2S$ (0^+) , $\pi^2=10$

iv) $2.5 = 2\pi\sqrt{\frac{1}{40x} + \frac{x}{10}} \Longrightarrow$

$4x^2 - 6.25x + 1 = 0$ (0^+)

$\Longrightarrow x =0.16m < \frac{1}{2}$ (accepted) (1/2)

$x =1.38m$ (rejected) (0^+)

2)

a) P.E= $T.E_{P.E}$ + G.P.E $=\frac{1}{20}c\theta^2 - mg\frac{L}{2}\cos\theta$ (1/2)

P.E $=\frac{1}{2}\,C.\theta^2 - \cos\theta = \frac{1}{2}\,C.\theta^2 + \frac{1}{2}\theta^2 - 1$

P.E $=\frac{1}{2}\,(C+1)\theta^2 - 1$ (0^+)

b) M.E = K.E +P.E $= \frac{1}{2}I\cdot\theta'^2 + \frac{1}{2}(C+1)\theta^2 - 1$

M.E $= \frac{1}{20}\theta'^2 + \frac{1}{2}(1+C)\theta^2 - 1$ (1/2)

No friction $\Longrightarrow$ M.E is conserved $\Longrightarrow \frac{dM.E}{dt} = 0$

$\Longrightarrow \theta'' + 10(1+C)\theta = 0$ (1/2)

Similar to $\theta'' + \omega_0{}^2\theta = 0$

$c)$ $\Longrightarrow \omega_0 = \sqrt{10(1+C)}$ (0^+)

$\Longrightarrow T_0 = \frac{2\pi}{\omega_0} = 2\pi\sqrt{\frac{1}{10(1+C)}}$ (1/2)

$d)$ $1.8 = 2\pi\sqrt{\frac{1}{10(1+C)}}$ $\Longrightarrow$ C= 0.23 S.I (1/2)