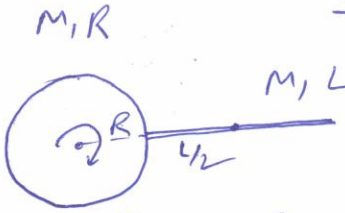
FLT-2

1.



$$I = MR^2 + \left[\frac{ML^2}{12} + M\left(\frac{L}{2}+R\right)^2\right]$$

$$I = MR^2 + \frac{ML^2}{12} + M\frac{L^2}{4} + MR^2 + 2\cdot M\cdot\frac{L}{2}\cdot R$$

$$I = 2MR^2 + ML^2\left(\frac{1+3}{12}\right) + MLR$$

$$I = 2MR^2 + \frac{ML^2}{3} + MLR$$

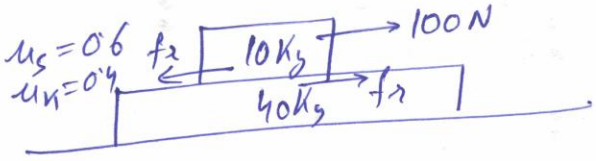
$$= \frac{M}{12}\left[2R^2 + \frac{L^2}{3} + LR\right]12$$

$$= \frac{M}{3}\left[6R^2 + L^2 + 3LR\right]$$

2. $\frac{SS}{R} = \frac{2\phi}{80}$

$R = 220\Omega$

3.



Together $a = \frac{100}{50} = 2 m/s^2$

f_1 Req. $100 - f_1 = 10\times 2$

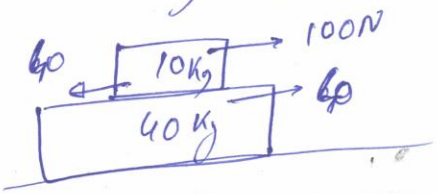
$f_1 = 100 - 20$

$= 80N.$

f_1 available $f_{max} = \mu N = 0.6\times 10\times 10$

$= 60N$

So freq < available so they will not move together.

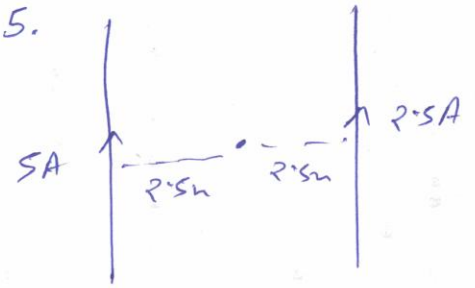


$a_{slab} = \frac{60}{40} = 1 m/s^2$

4. In Common base amplifier the phase difference between the input signal voltage & output voltage is . 0.

& in Common Emitter it is π.

5.



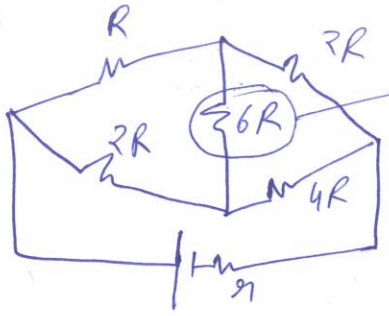
$$\frac{\mu_0 I_1}{2\pi r} - \frac{\mu_0 I_2}{2\pi r}$$

$$= \frac{\mu_0}{2\pi(2.5)}(2.5) = \frac{\mu_0}{2\pi}$$

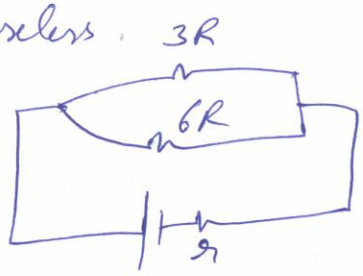
6. $\Delta\phi = \frac{2\pi}{\lambda}\cdot\frac{\lambda}{6} = \pi/3$

$I = I_0\cos^2\left(\frac{\pi}{6}\right) = I_0\left(\frac{3}{4}\right)$

$\frac{I}{I_0} = 3/4.$

7. 

balanced wheat stone bridge.
useless.



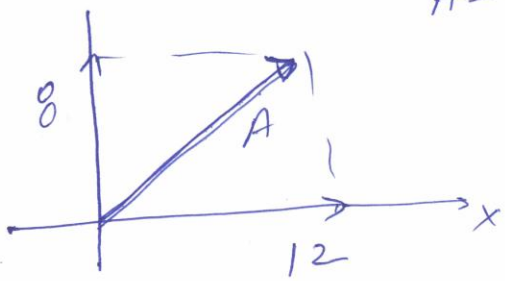
$2R = r$

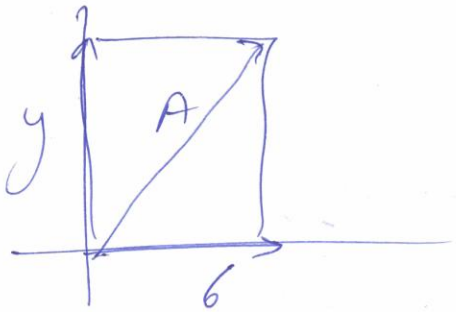
$2R = 4$

$R = 2\Omega$

8

$$A = \sqrt{64+144} = \sqrt{208}$$





$$\sqrt{36+y^2} = \sqrt{208}$$

$$y^2 = 208-36 = 172$$

$$y = \sqrt{172} = 13.11\text{m}$$

(9)

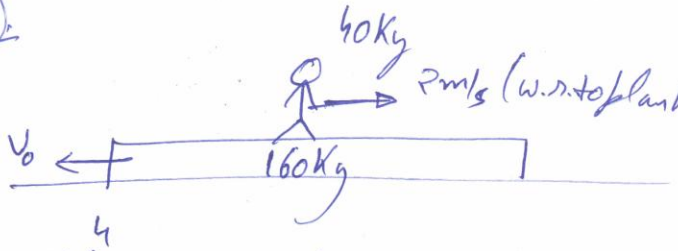
$$V(x) = \frac{20}{x^2-4} = 20(x^2-4)^{-1}$$

$$E = -\frac{dv}{dx} = -\left[20(-1)(x^2-4)^{-2}(-2x)\right]$$

$$E = \frac{20.2x}{(x^2-4)^2} \quad \text{at } x = 4\mu m$$

$$E = \frac{20.2.4}{(16-4)^2} = \frac{160}{144} = \frac{10}{9} \text{ volt/}\mu m \text{ along } +x\text{ dir}$$

10.



$160 \cdot V_0 = 40(2 - V_0)$

$4V_0 = 2 - V_0$

$5V_0 = 2$

$[V_0 = 2/5 \text{ m/s}]$ $\quad 2 - \frac{2}{5} = \frac{8}{5}$

11. $x = 2\times10^{-2}\cos(\pi t)$

motion starts from extreme position so maximum speed occurs at $t = T/4$

$\omega = \pi$

$T = 2\pi/\omega = 2s$

$t = \frac{T}{4} = \frac{2}{4} = \frac{1}{2}s.$

12. $-\frac{dT}{dt} = k(T - T_0)$

$\frac{2}{4} = k(60 - 30)$

$\frac{2}{t} = k(50 - 30)$

Divide

$\frac{2}{4}\cdot\frac{t}{2} = \frac{30}{20}$

$t = 6$ min

13. (C) $V = V_0 + gt + ft^2$

$t = 0 \quad x = 0$

$\int_0^x dx = \int_0^t (V_0 + gt + ft^2)\,dt$

$x = \left(V_0 t + \frac{gt^2}{2} + \frac{ft^3}{3}\right)_0^1$

$= V_0 + \frac{g}{2} + \frac{f}{3}$

14. (a) $y \to$ mod $\Rightarrow$ Press

$1\frac{N}{m^2} = \frac{10^5 \text{ dyne}}{10^4 \text{ cm}^2} = 10 \text{ dyne/cm}^2$

15.

$\lambda/2 = \ell$

$\lambda = 2\ell$

$f = \frac{v}{2\ell} = 390 \text{ Hz}$

$\lambda/4 = 3\ell/4$

$\lambda = 3\ell$

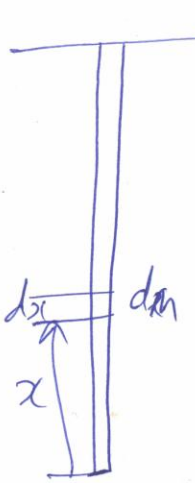
$f' = \frac{v}{\lambda} = \frac{v}{3\ell} = \frac{1}{3}\times 2\times 390 = 260 \text{ Hz}$

(16) b

(17) C

(18) D

(19)



$g_{eff} = 3g/2$

$\mu = \mu_0 \sqrt{x}$

$\mu\, dx = dm$

$$\int_0^x \mu_0 \sqrt{x}\, dx = \int_0^M dm$$

$$\frac{\mu_0 x^{3/2}}{3/2} = m_x$$

$$\frac{2}{3}\mu_0 x^{3/2} = m_x$$

$T_x = m_x g$

$= \frac{2}{3}\mu_0 x^{3/2} \frac{3g}{2}$

$v_x = \sqrt{\frac{T_x}{\mu_x}}$

$$\frac{dx}{dt} = \sqrt{\frac{\frac{2}{3}\mu_0 x^{3/2}\frac{3g}{2}}{\mu_0 x^{3/2}}} = \sqrt{\frac{2}{3}\sqrt{g}\cdot x}$$

$$\int_0^{\ell} \frac{dx}{\sqrt{x}} = \frac{2}{3}\sqrt{g}\int_0^t dt$$

$$\left(\frac{x^{-1/2+1}}{-1/2}\right)_0^{\ell} = \frac{2}{3}\sqrt{g}\cdot t$$

$$2\sqrt{\ell} = \sqrt{\frac{3}{3}}\sqrt{g}\cdot t$$

$t = 3\sqrt{\ell/g}$

$t =$

$$\frac{dx}{dt} = \sqrt{\frac{2g}{3}} \cdot \sqrt{x}$$

$$\int_0^{\ell} x^{-1/2}\, dx = \sqrt{\frac{2g}{3}} \int_0^{t} dt$$

$$\int_0^{\ell} x^{-1/2}\, dx = \sqrt{\frac{2g}{3}} \int_0^{t} dt$$

$$\frac{x^{1/2}}{1/2} = \sqrt{\frac{2g}{3}} \cdot t$$

$$2\sqrt{\ell} = \sqrt{\frac{2g}{3}} \cdot t$$

(20)

$$5(40\hat{i} + 50\hat{j} - 25\hat{k})$$

$$= 1(200\hat{i} + 70\hat{j} + 15\hat{k}) + 4\vec{v}$$

$$4\vec{v} = 180\hat{j} - 140\hat{k}$$

$$\vec{v} = 45\hat{j} - 35\hat{k}$$

(21) $t = \sqrt{\frac{2\ell}{g}}$

(22) Same

(23)

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\frac{V_s}{80} = \frac{3000}{1000}$$

$$V_s = 240 \text{ volt}$$

per turn $\frac{240}{3000} = 0.08$ volt per turn.

24. $a = \frac{qE}{m}$

(25.) $r \propto n^2$

26. Thermal stress

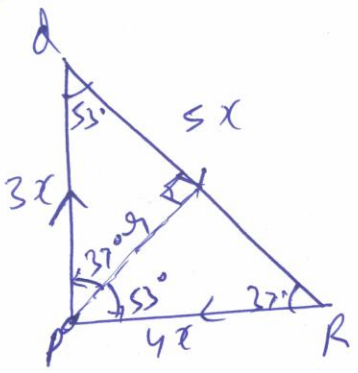
$$\frac{F}{A} = Y\alpha\Delta T = \frac{mg}{A}$$

$$10^{11} \times 10^{-5} \times 10 = m \times 10$$

$$\alpha\Delta T = \Delta l = \frac{Fl}{YA} = \frac{mgl}{YA}$$

$$YA\alpha\Delta T = mg$$

27. (d)



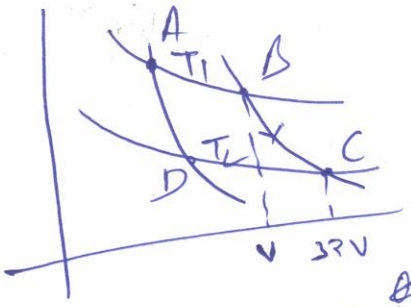
$$r = 4x \cdot \cos 53^\circ$$

$$= 4x \cdot \frac{3}{5} = \frac{12x}{5}$$

$$B_P = \frac{\mu_0 I}{4\pi\left(\frac{12x}{5}\right)} \left[\sin 37^\circ + \sin 53^\circ\right]$$

$$= \frac{\mu_0 I}{4\pi\left(\frac{12x}{5}\right)} \left(\frac{7}{5}\right] = \frac{7\mu_0 I}{48\pi x}$$

(29) (C) (30)



$PV^\gamma = C$

$\frac{nRT}{V} \cdot V^\gamma = C$

$T \cdot V^{\gamma-1} = C$

$\gamma = 7/5 = 1.4$

$\gamma - 1 = 2/5 = 0.4$

$T_1 (V)^{4/5} = T_2 (32V)^{2/5}$

$\frac{T_1}{T_2} = (32)^{2/5} = 4$

$\eta = 1 - \frac{T_2}{T_1}$

$= 1 - \frac{1}{4} = 3/4$

(31) $\varepsilon_{net} = \frac{\varepsilon/r_1 + \varepsilon_2/r_2}{1/r_1 + 1/r_2} = \frac{6/2 + 4/2}{1/2 + 1/2} =$ 5 volt

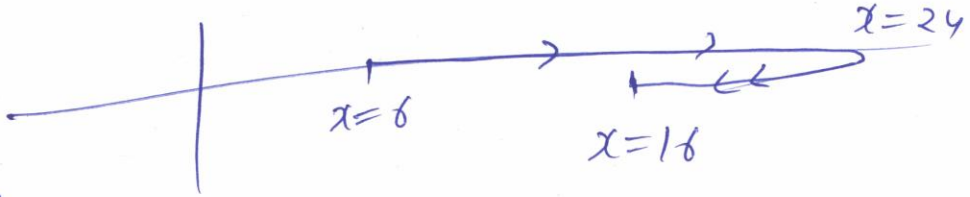
(32) $x = 6 + 12t - 2t^2$ $\quad v = 12 - 4t$

at $t=0$ $x = 6m$ $\quad v = 0$ at $t = 3s$

so at $t = 3$

$x = 6 + 36 - 2 \times 9 = 6 + 18 =$ 24m

at $t = 5$ $\quad x = 6 + 60 - 2 \times 25 = 16m$



So Distance $= (24-6) + (24-16)$

$= 18 + 8 =$ 26m

(33) $R_i = 333\Omega$

$R_{out} = 5000\Omega$

$\Delta I_B = 15\mu A = 15\times10^{-6} A$

$\Delta I_C = 10^{-3} A$

$\beta = \frac{\Delta I_C}{\Delta I_\Delta} = \frac{10^{-3}}{15\times10^{-6}} = \frac{1000}{15}$

$A_R = \frac{R_{out}}{R_{in}} = \frac{5000}{333}$

$A_V = \beta . A_R = \frac{1000}{15} \times \frac{5000}{333}$

(34) through one face $\Rightarrow 9/16 E_0$

(35) D

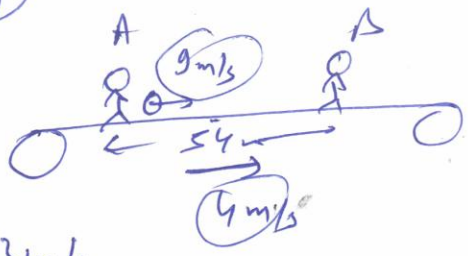
(36) $P_{air} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$P_{liq} = \left(\frac{\mu}{\mu_e} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{P_{air}}{P_{liq}} = \frac{(1.5-1)}{\left(\frac{1.5}{1.25}-1\right)} = \frac{0.5\times1.25}{0.25} = 2.5$

(37) D

(38)



13 m/s

(39) $\omega_m = \frac{2\pi}{60}$ rad/min

$\omega_s = \frac{2\pi}{1}$ rad/min

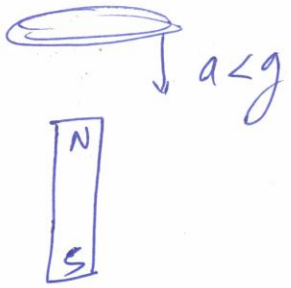
$\frac{\omega_m}{\omega_s} = \frac{1}{60}$

(40) $C_V = \frac{2\times\frac{3R}{2} + 3\times\frac{5R}{2}}{5}$

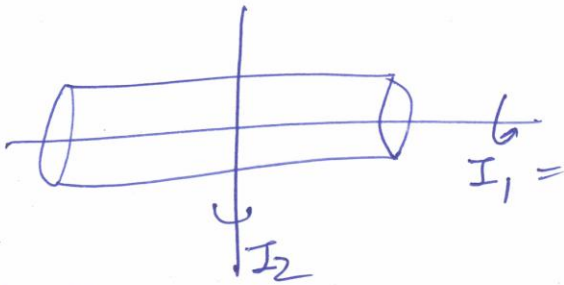
$= \frac{3R + 7.5R}{5}$

$= \frac{10.5R}{5} = 2.1R$

41



(42)



$I_1 = \frac{MR^2}{2}$

$I_1 = I_2$

$\frac{1}{4}MR^2 + \frac{ML^2}{12}$

$\frac{MR^2}{2} = \frac{MR^2}{4} + \frac{ML^2}{12}$

$\frac{MR^2}{4} = \frac{ML^2}{12}$

$R = L/\sqrt{3}$

(43) $B_0 = \frac{\mu_0 I}{2\pi}$

$B' = 3\left(\frac{\mu_0 I}{2\pi/3}\right) = 9B_0$

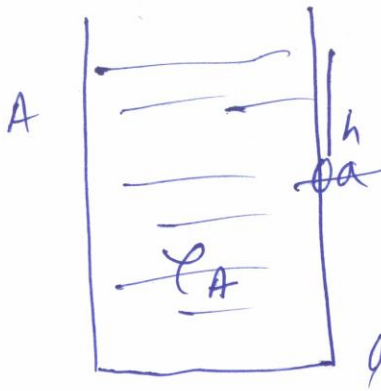
(45) 21 ys $\Rightarrow$ 4 half lives

$1\left(\frac{1}{2}\right)^4 = \frac{1}{16}g$

$= \frac{1000}{16}mg$

$= 62.5mg$

(44)



$a\sqrt{2gh}\,\rho_A$

$= 2a\sqrt{2gh}\,\rho_B$

$\frac{\rho_A}{\rho_B} = \frac{2}{1}$