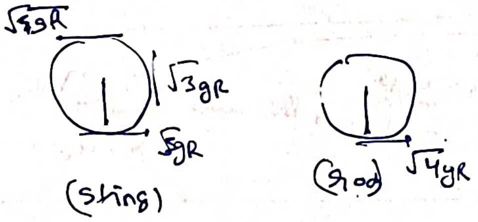
JEE Formula's

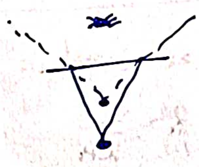
$\frac{\Delta l}{l} = \alpha \Delta T$, $\frac{\Delta A}{A} = \beta \Delta T$, $\frac{\Delta V}{V} = \gamma \Delta T$ ~ $\alpha = \frac{\beta}{2} = \frac{\gamma}{3}$

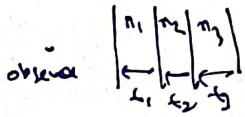
Apparent depth $d' = \frac{d}{n_{relative}}$ ~ $n_{relative} = \frac{n_i \text{ (RI incidence)}}{n_r \text{ (RI refraction medium)}}$

· apparent shift = $d\left(1 - \frac{1}{n_{rel}}\right)$



for composite slab: apparent depth $= \frac{t_1}{n_{1rel}} + \frac{t_2}{n_{2rel}} + \frac{t_3}{n_{3rel}} + \dots$





Apparent shift = $t_1\left(1 - \frac{1}{n_{1rel}}\right) + t_2\left(1 - \frac{1}{n_{2rel}}\right) + \dots$

Moseley's law: $\frac{1}{\lambda} \propto RZ^2$

he. charged

$\nu \propto Z^2$ or $\sqrt{\nu} \propto Z$

to $\nu = A(Z-b)^2$

$\sqrt{\nu} = a(Z-b)$ ((Z−b) - effective charge of Nucleus)

(X-rays)

Effective half life for a nucleus decaying by two different process of half-life t_1 & t_2

$\frac{1}{t_{eff}} = \frac{1}{t_1} + \frac{1}{t_2}$

$A \xrightarrow{t_1} B$, $A \xrightarrow{t_2} C$

P inside bubble: $P - P_a = \frac{4S}{R}$ = P_{excess}

P inside drop: $P - P_a = \frac{2S}{R}$ = P_{excess}

air bubble in liquid: $P - P_a = \frac{2S}{R}$ = P_{excess}

capillary rise: $h = \frac{2S\cos\theta}{\rho r g}$

~~$2\pi r$~~ $F = S \times l$

Thus $F = 2\pi r S \cos\theta = mg$

$= \rho \times A \times h \times g$

$= \rho \times \pi r^2 \times h \times g$

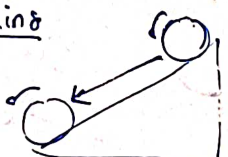
$\boxed{U = SA \ \& \ S = F/l}$

Thus $h = \frac{2S\cos\theta}{r\rho g}$

variation of g with depth: $g_{inside} \approx g\left(1 - \frac{h}{R}\right)$

" " " " height: $g_{outside} \approx g\left(1 - \frac{2h}{R}\right)$

rolling

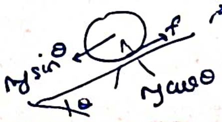


~ $mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

$I = mk^2$ $\omega = \frac{v}{R}$

we get $v^2 = \frac{2gh}{1 + k^2/R^2}$

(or) tough way



1) $R.f = I\alpha$ = Torque (radius, friction)

2) $\alpha = a/R$ ($a = \alpha R$)

and ~~$a=\alpha g$~~

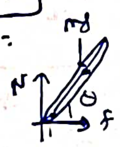
3) $ma = mg\sin\theta - f$

centroid: $\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$

$v_{liquid} = \sqrt{\frac{B}{\rho}}$, $v_{solid} = \sqrt{\frac{Y}{\rho}}$, $v_{gas} = \sqrt{\frac{\gamma P}{\rho}}$

friction = μN

cyclist turn:



N & f give $\vec{R}$ which is along cycle to avoid τ about C.O.M

$R\cos\theta = mg$

$R\sin\theta = \frac{mv^2}{R}$

Thus $\tan\theta = \frac{v^2}{Rg}$

Intensity $I = \frac{P_0^2}{2\rho v}$

simple pendulum : $T = 2\pi\sqrt{l/g}$

physical pendulum : $T = 2\pi\sqrt{\frac{I}{mgl}}$

$\tau = I\alpha = mgl\sin\theta \approx mgl\theta$

$\alpha = \frac{mgl}{I}\theta = \omega^2\theta$

Torsional pendulum : $T = 2\pi\sqrt{\frac{I}{k}}$

$\tau = k\theta = I\alpha$

$\alpha = \omega^2\theta = \frac{k}{I}\theta$

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plane wave : $E = E_0\sin\omega(t - \frac{x}{v})$: $I = I_0$

spherical wave : $E = \frac{aE_0}{r}\sin\omega(t - \frac{x}{r})$: $I = \frac{I_0}{r^2}$

$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$, $m = \frac{\mu_1 v}{\mu_2 u}$ → Basically $\left(\frac{v/\mu_2}{u/\mu_1}\right)$

Heat transfer :

$R = \frac{x}{KA}$

resistance

newton law of cooling : $\frac{dT}{dt} = -bA(T - T_0)$

$C_v(\text{mixture}) = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$

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potentiometer — (a) to find unknown EMF

<NO OVER THINK>

DAMN SIMPLE RATIO always for all cases

$\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}$

(b) internal resistance of cell

(c) $\varepsilon' = x l_1$

(c) $IR = x l_2$

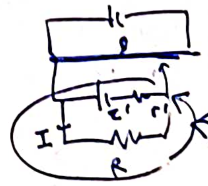
x is potential drop per length

$x = \frac{\Delta V}{l}$

also $I = \frac{\varepsilon'}{r' + R}$

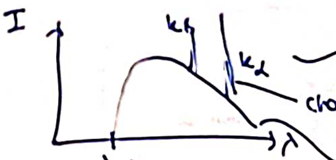
$r' = \left(\frac{l_1 - l_2}{l_2}\right)R$

inner loop



X ray — e^- are accelerated & strike metal in coolidge tube

→ Thus KE of e^- converted to EM radiation in form of X-ray



$\lambda_{min} = \frac{hc}{eV}$, max energy when all KE = eV converted

accelerating potential.

k_α — e^- kicked out from k shell, then L → k ($n = 2 \to 1$)

k_β : M → k ($n = 3 \to 1$)

L_α : M → L ($n = 3 \to 2$)

B field solenoid = $\mu_0 n i$

B field Toroid = $\frac{\mu_0 N i}{2\pi r}$

MOI

- $\frac{MR^2}{2}$
- $\frac{2}{5}MR^2$
- $\frac{2}{3}MR^2$
- $\frac{Mh^2}{6}$

COM

- COM at centroid $y_c = h/3$
- semi-ring : $y_c = \frac{2R}{\pi}$; $\times\frac{2}{3}$
- $y_c = 4R/3\pi$
- shell : $y_c = R/2$; $\times\frac{3}{4}$
- hemisphere solid : $y_c = \frac{3R}{8}$
- hollow cone : $y_c = \frac{h}{3}$; $\times\frac{3}{4}$
- solid cone : $y_c = h/4$ (for rectangular pyramid)

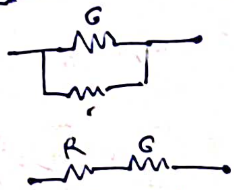
Volume of cone / pyramid = $\frac{1}{3}(\vec{a}\times\vec{b}\cdot\vec{c})$

$= \frac{1}{3}\pi r^2 h$ or $\frac{1}{3}(\text{Area}) \times h$

$= \frac{l b h}{3}$

Galvanometer as Ammeter :

volmeter :



★ conical pendulum

$T\cos\theta = mg$

$T\sin\theta = m\omega^2 R$

Thus $\omega^2 = \frac{g\tan\theta}{R}$

Now $R = l\sin\theta$

Thus $\omega^2 = \frac{g}{l\cos\theta}$

$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{l\cos\theta}{g}}$

$T = 2\pi\sqrt{\frac{l\cos\theta}{g}}$

Both ends Fixed

[opp. in open pipe]

$\nu_0 = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$ (Fundamental)

1st overtone (2nd harmonic) = $\frac{2}{2L}\sqrt{\frac{T}{\mu}}$

2nd overtone (3rd harmonic) = $\frac{3}{2L}\sqrt{\frac{T}{\mu}}$

one end Fixed

$\nu_0 = \frac{1}{4L}\sqrt{\frac{T}{\mu}}$ (Fundamental)

1st overtone (3rd harmonic) $\frac{3}{4L}\sqrt{\frac{T}{\mu}}$

2nd overtone (5th harmonic) $= \frac{5}{4L}\sqrt{\frac{T}{\mu}}$

For open pipe

(open at ends)