SHM

Light wave ⇒ Transverse wave ⇒ shows polarisation

longitudinal wave ⇒ Interference & diffraction

$\omega^2 = k/m$

$V_{max} = A\omega$

$a_{max} = A\omega^2$

$V = \omega\sqrt{A^2 - x^2}$

$\omega = \frac{2\pi}{T}$

particle vel = $A\omega$

wave vel ⇒ $\frac{\omega}{K}$

① $F = -kx$

force const (not spring const)

② $\frac{d^2x}{dt^2} + \omega^2 x = 0$ → Linear SHM $T = 2\pi\sqrt{\frac{m}{K}}$

③ $\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$ → angular SHM $T = 2\pi\sqrt{\frac{I}{K}}$

④ spring mass system : vertical, Horizontal, in lift, in liquid, (on plane)

Same ratio same formula.

$T = 2\pi\sqrt{m/k}$ → spring time

$T = 2\pi\sqrt{\frac{l}{g}}$ ← pendulum for point bobs

⑤ series comb^n

k_{eq}	Time
$\frac{1}{k_{eq}} = \frac{1}{k_1} + \frac{1}{k_2}$	$T^2 = T_1^2 + T_2^2$

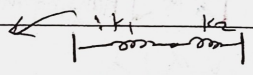
$T = 2\pi\sqrt{\frac{l_{com}}{g}}$ (for Non point bobs)

⑥ ||el comb^n

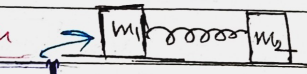
k_{eq}	Time
$k_{eq} = k_1 + k_2$	$\frac{1}{T^2} = \frac{1}{T_1^2} + \frac{1}{T_2^2}$

⑦ Antiparallel comb^n

$k_{eq} = k_1 + k_2$

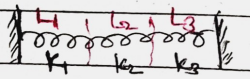


⑧ Reduced mass system



$\frac{1}{\mu_{red}} = \frac{1}{m_1} + \frac{1}{m_2}$

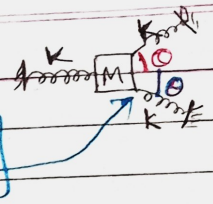
⑨ Cutting of spring



$k_{cut} = \frac{\text{Total fraction}}{\text{Given length}} \times \text{Total spring const.}$

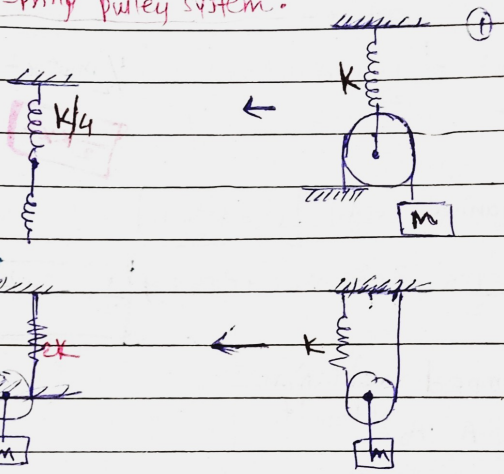
$k_1 = \frac{(L_1 + L_2 + L_3)}{L_1} \times k$

⑩ Inclined springs



$k_{eq} = k + 2k\cos^2\theta$

⑪ Spring pulley system.



⑫ oscillation of liquid in U-tube

$T = 2\pi\sqrt{h/g}$ → immersed portion length

⑬ oscillation in earth tunnel

$T = 2\pi\sqrt{\frac{h}{g}}$

⑭ oscillation of cylinder in water

$T = 2\pi\sqrt{h/g}$ $\frac{h}{H} = \frac{\sigma}{\rho}$

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{m}{\rho A g}}$

⑮ simple pendulum

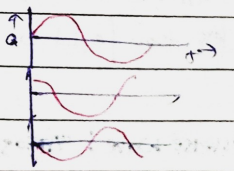
$T = 2\pi\sqrt{l/g_{eff}}$

⑯ differential eq^n of $\frac{d^2x}{dt^2} + \omega^2 x = 0$

$x = A\sin(\omega t + \phi_0)$

$V = A\omega\cos(\omega t + \phi_0)$

$a = -A\omega^2\sin(\omega t + \phi_0)$



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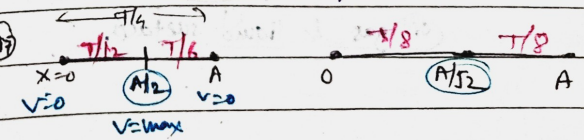
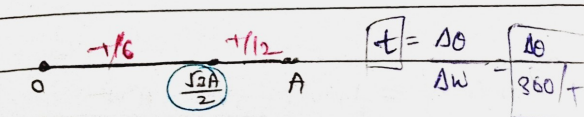




$t = \frac{\Delta\theta}{\Delta\omega} = \frac{\Delta\theta}{360}T$

SHM wrt k = force const.
wave wrt k = angular wave no.
Newton's laws of motion: k = spring const

① K.E : wrt time / wrt position

$\frac{1}{2}mv^2 = \frac{1}{2}m\omega^2A^2\cos^2\omega t$ / $\frac{1}{2}m\omega^2(A^2-x^2)$

$\frac{1}{2}k(A^2-x^2)$

② P.E wrt time / wrt posn

$\frac{1}{2}kx^2 = \frac{1}{2}m\omega^2A^2\sin^2\omega t$ / $\frac{1}{2}m\omega^2x^2$

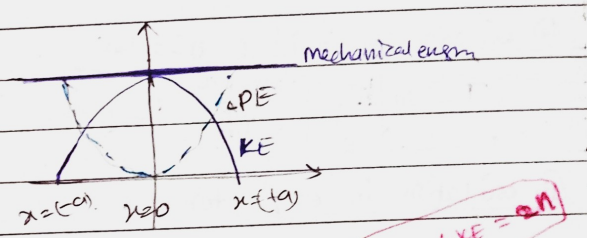
$\frac{1}{2}kx^2$

③ Mechanical energy $E = K + U$

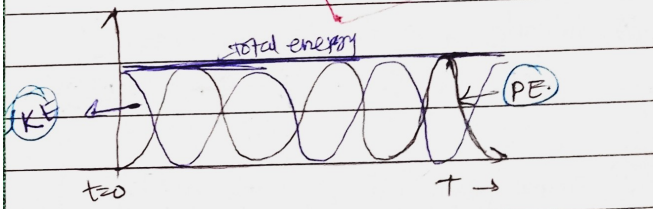
$E = \frac{1}{2}m\omega^2A^2(\sin^2\omega t + \cos^2\omega t)$ $\frac{1}{2}m\omega^2A^2$

* Damped oscillation

$A = A_0 e^{(-b/2m)t}$



(ω) freq. for PE & KE = 2ω



① The essential cond^n for the formation of beats is
→ diff. in freq of two sources should be less than / equal to 10.

Transverse wave: Propagate through solid & on gas & liquid surface.

Intensity $= \frac{1}{2}mv^2 = \frac{1}{2}\rho V\omega^2A^2\omega^2$

$I \propto A^2$ $= \frac{1}{2}\rho V\omega^2A^2 4\pi^2f^2$