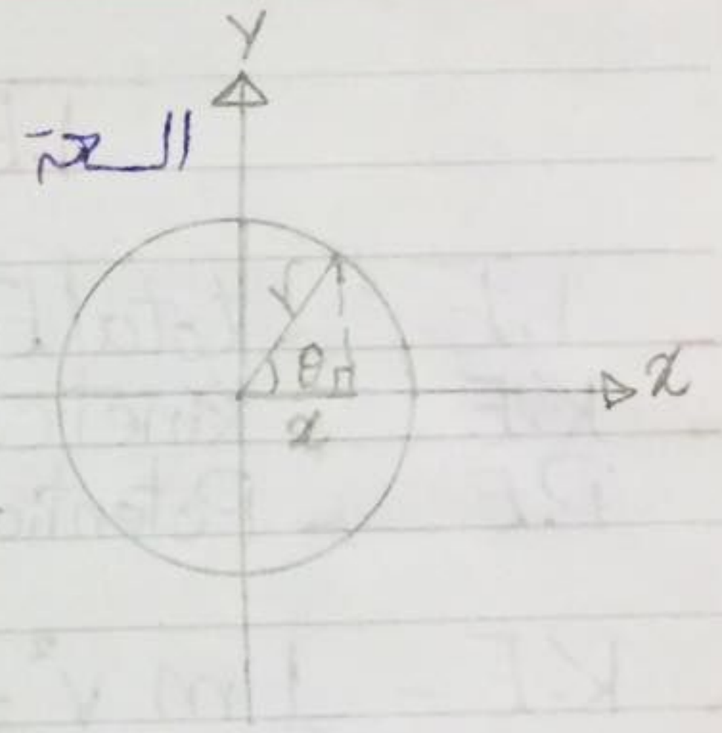
Physics

Lecture 2

* Simple Harmonic motion *

Linear motion حركة خطية	Circular motion حركة دائرية
$x \rightarrow$ distance $\rightarrow$ مسافة	$\theta \rightarrow$ seta
$v \rightarrow$ Velocity $\rightarrow$ سرعة	السرعة الزاوية $\omega \rightarrow$ omega
$a \rightarrow$ acceleration $\rightarrow$ عجلة	$\alpha \rightarrow$ Alpha
$v = \frac{x}{t}$	$\omega = \frac{\theta}{t}$, $\theta = \omega t$



r: Amplitude السعة

- From the Figure من الشكل :-

$$\rightarrow x = r\cos\theta = r\cos\omega t$$

$$\rightarrow V = \frac{dx}{dt} = -r\omega\sin\omega t$$

$$\rightarrow a = \frac{dv}{dt} = -r\omega^2\cos\omega t = -\omega^2 x$$

السرعة V = تفاضل المسافة x
العجلة a = تفاضل السرعة V

If: $x = r\sin(\omega t + \alpha)$, Find a

$$\rightarrow V = \frac{dx}{dt} = \omega r\cos(\omega t + \alpha)$$

$$a = \frac{dv}{dt} = -\omega^2 r\sin(\omega t + \alpha) \quad \because r\sin(\omega t + \alpha) = x$$

$$\therefore a = -\omega^2 x$$

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* $\omega = 2\pi F \Longrightarrow F = \frac{\omega}{2\pi}$, $T = \frac{1}{F} = \frac{2\pi}{\omega}$

If: $x = 5 \sin(2\pi t + \frac{\pi}{4})$

Find v, a at t = 1 sec. اوجد قيمة السرعة والعجلة عندما يكون الزمن = 1 ثانية

→ $V = \frac{dx}{dt} = 10\pi \cos(2\pi t + \frac{\pi}{4})$

, at $t = 1$, $V = 10 \times \frac{22}{7} \cos(2 \times \frac{22}{7} \times 1 + \frac{180}{4}) = 19.66$ m/s

→ $a = \frac{dv}{dt} = -20\pi^2 \sin(2\pi t + \frac{\pi}{4})$

, at $t = 1$, $a = -20 \times (\frac{22}{7})^2 \sin(2 \times \frac{22}{7} \times 1 + \frac{180}{4}) = -154$ m/s²

T.E = K.E + P.E

- T.E → total Energy → الطاقة الكلية
- K.E → Kinetic Energy → طاقة الحركة
- P.E → Potential Energy → طاقة الوضع

→ $K.E = \frac{1}{2} m v^2 = \frac{1}{2} m r^2 \omega^2 \sin^2(\omega t + \alpha)$

$x = r \cos(\omega t + \alpha)$
$V = -r\omega \sin(\omega t + \alpha)$

→ $P.E = -\int F \, dx$

$= -\int ma \, dx$

$= -\int m(-\omega^2 x) \, dx$

$= \frac{1}{2} m \omega^2 x^2 = \frac{1}{2} m \omega^2 r^2 \cos^2(\omega t + \alpha)$

→ $T.E = \frac{1}{2} m r^2 \omega^2 \sin^2(\omega t + \alpha) + \frac{1}{2} m \omega^2 r^2 \cos^2(\omega t + \alpha)$

$= \frac{1}{2} m \omega^2 r^2 \left(\sin^2(\omega t + \alpha) + \cos^2(\omega t + \alpha) \right)$

$= \frac{1}{2} m \omega^2 r^2$

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* Simple Pendulum *
البندول البسيط

$$F = -mg \sin\theta$$

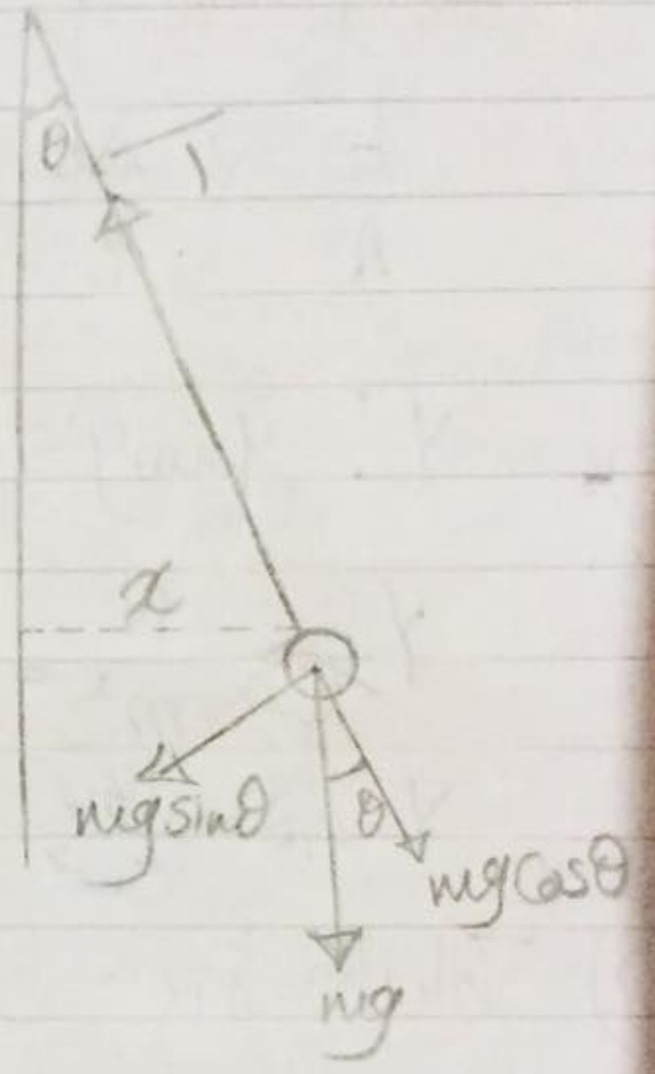
, θ: very small angle

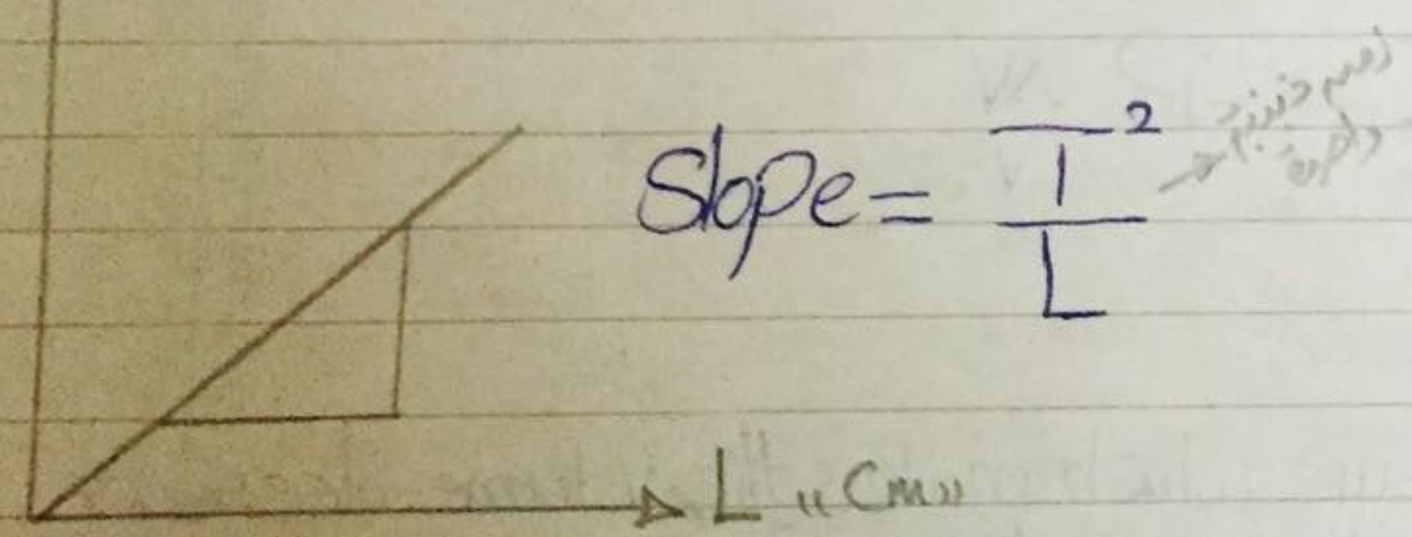
, $\sin\theta = \tan\theta = \theta$, $\because \sin\theta = \frac{x}{L}$

$$\therefore F = -mg\frac{x}{L} = ma = -\omega^2 x$$

$$\therefore \omega^2 = \frac{g}{L} \quad , \quad \omega = \sqrt{\frac{g}{L}} = \frac{2\pi}{T}$$

$$, T = 2\pi\sqrt{\frac{l}{g}} \Longrightarrow g = 4\pi^2\frac{L}{T^2} = \frac{4\pi^2}{S} \rightarrow \text{slope}$$





$$Slope = \frac{T^2}{L}$$

$$T = \frac{1}{F} = \frac{2\pi}{\omega}$$

* Elacticity * المرونة

* Stress * الإجهاد

* Strain * انفعال

Strain
- longitudinal طولي $\frac{\Delta l}{l}$
- Volumetric حجمي $\frac{\Delta V}{V}$
- Shear اتجاهي θ

$$stress = \frac{F}{A}$$

* Hook Law :-

Stress ∝ Strain

1) Longitudinal strain :

$$\frac{F}{A} \propto \frac{\Delta l}{l} \Longrightarrow \frac{F}{A} = Y \frac{\Delta l}{l}$$

* Y : Young's modulus يتغير بتغير المادة

$Y \rightarrow \frac{N}{m^2}$	kg , m
$Y \rightarrow \frac{dyne}{cm^2}$	gm, cm

2) Volumetric Strain :

$$\frac{F}{A} \propto \frac{\Delta V}{V} \Longrightarrow \frac{F}{A} = -B \frac{\Delta V}{V}$$

* B : Bulk's modulus

-ve sign means the pressure which makes the volume decrease.
الإشارة السالبة تعني الضغط الذي يجعل الحجم يقل.

3) Shear Strain :

$$\frac{F}{A} = \eta \theta$$

* η : rigidity modulus
صلابة