"Physics"

* Lecture 3 *

- Vectors المتجهات :-

If: $\vec{A} = 2\vec{i} + 3\vec{j} + \vec{k}$, $\vec{B} = \vec{i} - \vec{k}$

$\therefore \vec{A}\cdot\vec{B} = 2\times1 + 3\times0 + 1\times-1 = 2 - 1 = 1$ «dot product.»

$$\vec{A}\times\vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 3 & 1 \\ 1 & 0 & -1 \end{vmatrix} = -3\vec{i} + 3\vec{j} - 3\vec{k}$$ «crass product.»

* $\vec{A}\cdot\vec{B} = \|\vec{A}\| \, \|\vec{B}\| \cos\theta$

* $\vec{A}\times\vec{B} = \|\vec{A}\| \, \|\vec{B}\| \sin\theta$

* $\vec{A}\times\vec{B} = -\vec{B}\times\vec{A}$

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* $W = F \cdot S$

* $E = K.E + P.E$
  $= \frac{1}{2}mv^2 + mgh$

* $P = \frac{W}{t}$

W → work → الشغل
F → force → القوة
S «d» → distance → المسافة
K.E → Kinetic energy → طاقة الحركة
P.E → potential energy → طاقة الوضع
P → power → القدرة

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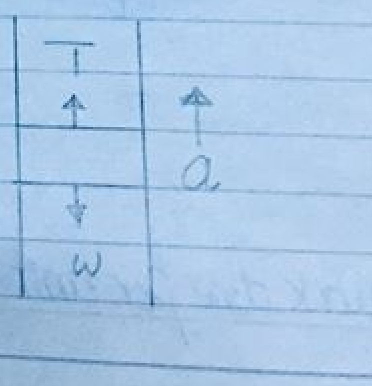
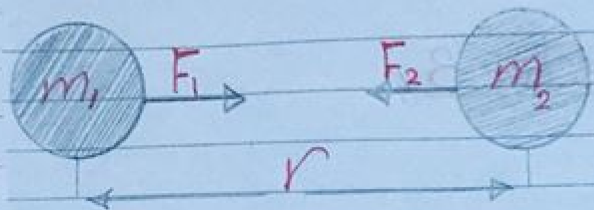
* Newton's Laws *

→ $F = ma = T - W - F_F$

F_F ↓ friction force





$$F_1 = F_2 = G\frac{m_1 m_2}{r^2}$$

, G: gravitional Constant ثابت الجاذبية
$= 6.67\times10^{-11}$

- Newton's Second Law: $F = ma$

$$, F = G\frac{m_1 m_2}{r^2}$$

$$\therefore ma = G\frac{m_1 m_2}{r^2}$$

$$\boxed{\therefore a = G\frac{M}{r^2}}$$

, a: acceleration due to gravity عجلة الجاذبية

on Earth: $a = 9.81\ ms^{-1}$

* Stress ∝ linear strain *

$$\frac{F}{A} \propto \frac{\Delta l}{l} \quad , \therefore \frac{F}{A} = Y\frac{\Delta l}{l}$$

$$\therefore F = Y\frac{\Delta l}{l}A$$

$$, \int dw = \int F\, dl$$

$$W = \int Y\frac{\Delta l}{l}A\, dl$$

$$= \frac{YA}{l}\int \Delta l\, dl = \frac{YA}{l}\times\frac{1}{2}(\Delta l)^2$$

$$= \frac{1}{2}\frac{YA\Delta l}{l}\cdot\Delta l$$

$$= \frac{1}{2}\cdot F\cdot\Delta l$$

Stress.up,, $= \frac{F}{A}$

V → Volume → حجم
A → Area → مساحة
l → length → طول
, $V = Al$

- work done per unit volume: $\frac{W}{V} = \frac{1}{2}\cdot\frac{F}{A}\cdot\frac{\Delta l}{l}$

* Stress α Volumetric Strain *

$P \propto \frac{\Delta V}{V}$, $\therefore P = B \frac{\Delta V}{V}$

$P = \frac{F}{A} \Rightarrow F = PA$

, $Al = V$

, $W = \int F \, dl$

$= \int PA \, dl$

$= \int P \, dv = \int B \frac{\Delta V}{V} dv$

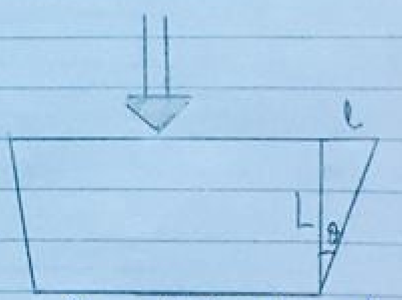
$= \frac{B}{V} \int \Delta V \, dv$

$= \frac{B}{V} \cdot \frac{1}{2} \Delta V^2 = \frac{1}{2} B \frac{\Delta V}{V} \cdot \Delta V$

$= \frac{1}{2} P \Delta V$

- work done per unit volume: $\frac{W}{V} = \frac{1}{2} P \frac{\Delta V}{V} = \frac{1}{2}$ stress x strain

* Stress α Shear Strain *



$\frac{F}{A} \propto \theta$, $\therefore \frac{F}{A} = N\theta$, $F = N\theta A$

, $W = \int F \, dl$, $\because \theta = \tan\theta = \frac{l}{L}$

θ: very small angle

$\theta = \tan\theta$

$\therefore W = \int N . \frac{l}{L} A \, dl$

$= \int N \frac{l}{\cancel{L}} L^2 \, dl = NL \int l \, dl$

$= NL \times \frac{1}{2} l^2 = \frac{1}{2} F l$

$A = L^2$

$V = AL$

- work done per unit volume: $\frac{W}{V} = \frac{1}{2} \frac{F}{A} \cdot \frac{l}{L} = \frac{1}{2}$ stress x strain.