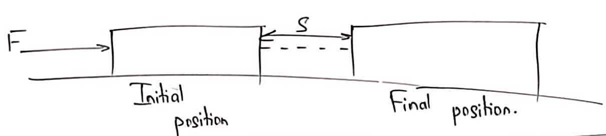
2. Work and Energy.

Work.



$\boxed{W = F \times s}$ → Scalar quantity.

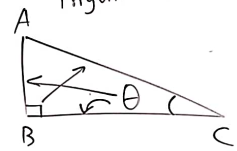
Unit of Work.

SI unit : Joule

CGS unit : erg.

Right Angled Triangle.

Trigonometry.



θ = theta

AB = Opposite side

BC = adjacent side

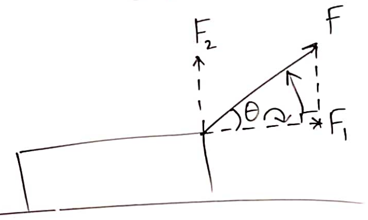
AC = hypotenuse.

$$\text{Cosine } \theta = \cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$$

$$= \frac{BC}{AC}$$

2. Work and Energy.

Work.



$$\cos\theta = \frac{\text{adj. side}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{F_1}{F}$$

$$\boxed{F_1 = F\cos\theta}$$

$$W = F_1 \times s$$

$$W = (F\cos\theta) \times s$$

$$\boxed{W = Fs\cos\theta}$$

5/7/24

Friday

Types of Work.

1) Positive Work.

$\theta = 0^\circ$

$\boxed{\cos 0^\circ = 1}$

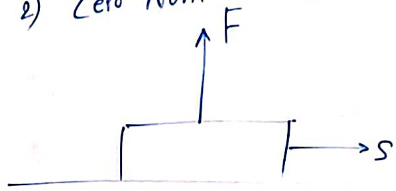
$W = Fs\cos\theta$

$W = Fs\cos 0^\circ$

$W = Fs(1)$

$\boxed{W = Fs}$

2) Zero Work



$\theta = 90^\circ$

$\boxed{\cos 90^\circ = 0}$

$W = Fs\cos\theta$

$W = Fs\cos 90^\circ$

$W = Fs(0)$

$\boxed{W = 0}$

3) Negative Work.

$\theta = 180^\circ$

$\boxed{\cos 180^\circ = -1}$

$W = Fs\cos\theta$

$W = Fs\cos 180^\circ$

$W = Fs(-1)$

$\boxed{W = -Fs}$

5/7/24

Friday

Force.

SI unit = Newton

CGS unit = dyne.

SI:

$F = ma$

$F = kg \times m/s^2$

$F = \boxed{kg \cdot m/s^2}$

↓

Newton

CGS:

$F = ma$

$= g \times cm/s^2$

$F = \boxed{g \cdot cm/s^2}$

↓

dyne

$N = kg \times m/s^2$

$1N = 1\,kg \times 1\,m/s^2$

$1N = 1000g \times 100\,cm/s^2$

$1N = 1000 \times 100 \;\; g \cdot cm/s^2$

$1N = 100000 \boxed{g \cdot cm/s^2}$

$1N = 10^5$ dyne.

Work

SI unit = Joule

CGS unit = erg.

SI:

$W = F \times s$

$W = N \times m$

$= \boxed{N \cdot m}$

↓

Joule

CGS:

$W = F \times s$

$=$ dyne $\times$ cm

$W = \boxed{dyne \cdot cm}$

↓

erg.

$J = N \times m$

$1J = 1N \times 1m$

$1J = 100000$ dynes $\times$ 100 cm

$1J = 10000000$ dyne · cm

$1J = 10000000$ erg

$1J = 10^7$ erg

5/7/24

Friday

Energy:
↳ Capacity to do work.

SI unit : Joule

CGS unit : erg.

1) Kinetic Energy.

Expression for kinetic energy for $u=0$

$$\boxed{W = F \times S} \quad - (1)$$

By Newton's second law of motion

$$\boxed{F = ma} \quad - (2)$$

We know that,

$$S = ut + \frac{1}{2}at^2$$

$$S = (0)t + \frac{1}{2}at^2$$

$$S = 0 + \frac{1}{2}at^2$$

$$\boxed{S = \frac{1}{2}at^2} \quad - (3).$$

Put value of F and S in eq. (1)

$$W = ma \times \frac{1}{2}at^2$$

$$W = \frac{1}{2} \times m \times a^2 t^2$$

$$\boxed{W = \frac{1}{2} \times m \times (at)^2} \quad - (4)$$

We know that,

$$V = u + at$$

$$V = 0 + at$$

$$\boxed{V = at} \quad - (5)$$

Put $V = at$ in eq (4)

$$W = \frac{1}{2} \times m \times v^2$$

$$W = K.E.$$

$$\boxed{KE = \frac{1}{2}mv^2}$$

5/7/24

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Potential Energy.

$\boxed{W = F \times S}$ - (1)

$F = ma$

$\boxed{a = g}$ (g = acceleration due to gravity)

$\boxed{F = mg}$ - (2)

$\boxed{S = h}$ - (3)

Put values of F and s in eq (1)

$W = mg \times h$

$W = mgh$

$W = PE$

$\boxed{PE = mgh}$

Friday

Free Fall
↳ When an object falls only under the influence of gravity.

$\boxed{u = 0,\ a = g}$

1] At point A

$KE = \frac{1}{2} mv^2$

$KE = \frac{1}{2} m(0)^2$

$KE = \frac{1}{2} m(0)$

$KE = 0$

$PE = mgh$

$PE = mgh$

$TE = KE + PE$

$= 0 + mgh = \boxed{mgh}$ — ①

2] At point B

$KE = \frac{1}{2} mv_B^2$

$v^2 = u^2 + 2as$

$v_B^2 = 0 + 2gx$

$v_B^2 = 2gx$

$KE = \frac{1}{2} \times m \times 2gx$

→ $KE = mgx$.

$PE = mgh$

$PE = mg(h-x)$

→ $PE = mgh - mgx$

$TE = KE + PE$

$= \cancel{mgx} + mgh - \cancel{mgx}$

$\boxed{TE = mgh}$ — ②

3] At point C

$K.E = \frac{1}{2} mv_c^2$

$v^2 = u^2 + 2as$

$v_c^2 = (0)^2 + 2gh$

$v_c^2 = 0 + 2gh$

$v_c^2 = 2gh$.

$AC = AB + BC$

$h = x + BC$

$\boxed{BC = h - x}$

$KE = \frac{1}{2} m \times 2gh$

→ $KE = mgh$

$PE = mgh$

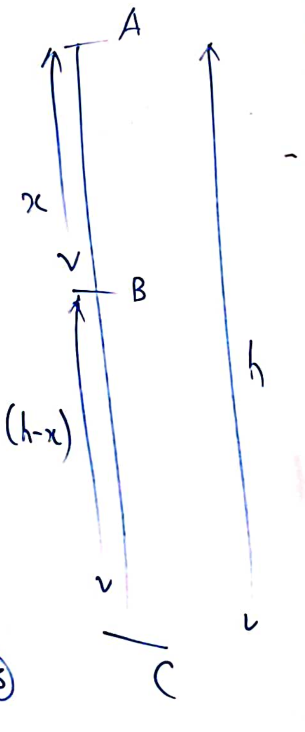
$PE = mg(0)$

→ $PE = 0$

$TE = KE + PE$

$= mgh + 0$

$\boxed{TE = mgh}$ — ③



5/7/24

Friday

Power (P)

↳ Rate at which work is done.

① $P = \frac{\text{Work}}{\text{Time}}$

② $P = \frac{\text{Energy}}{\text{Time}}$

$P = \frac{E}{t}$

$\boxed{E = P \times t}$

SI Unit of Power :

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

$= \frac{\text{Joule}}{\text{Second}}$

$= \boxed{\text{Joule per second}}$

↓

Watt (W)

Industrial Unit of Power

↓

horsepower (hp)

$\boxed{1\ hp = 746\ \text{Watt}}$

Commercial unit of electrical energy :⟶ Kilowatt hour. (Unit)

$E = P \times t$

$\therefore kWh = kW \times hr$

$1\ kWh = 1\ kW \times 1\ hr$

$= 1000\ W \times (60 \times 60)\ s$

$= 1000\ W \times 3600\ s$

$1\ kWh = 3600000\ \boxed{W \cdot S}$

↳ Joule

$1\ kWh = 3600000\ J$

$= 36 \times 10^5\ J$

$\boxed{1\ kWh = 3.6 \times 10^6\ J.}$

↓

Unit.