* Conservation laws, fundamental forces, estimation of distances :

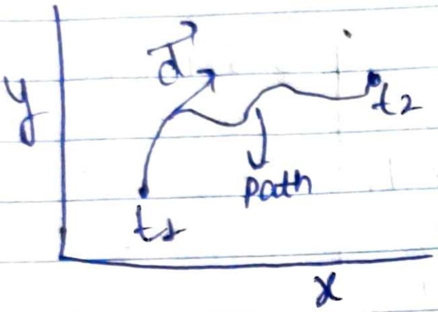
Applied force is known

$$F = -kx$$

$$F = \frac{e^2}{r^2}\hat{r} = \frac{1}{4\pi\epsilon_0}\frac{e_1 e_2}{r^2}\hat{r}$$

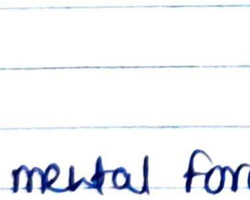
Workdone

$\vec{F}$ acts on a particle and the body moves



$$\int_{t_1}^{t_2} \vec{F}\cdot\vec{ds}$$

We say that a force is conservative if the workdone is independent of the path.



→ Total work done is zero.

$$F = -\frac{dV(r)}{dr}$$

$$= \frac{1}{2}m\vec{v}^2 + V(r) = \text{constant}$$

$\frac{1}{2}m\vec{v}^2$ ↓ K.E. $V(r)$ ↓ P.E.

* Fundamental forces

→ Gravitation
→ Electromagnetic
→ Nuclear
→ Weak

Force by Gravitational

$$F_G \propto \frac{1}{r^2}$$ → Mass

$$F_C \sim \frac{1}{r^2}$$

+ve   -ve

Interaction	Range	Strength
Gravitation	∞	$\approx 10^{-37}$
Electromagnetic	∞ (screened)	$\approx 10^{-2}$
Nuclear forces	10^{-15} m	≈ 1
Weak forces	$< 10^{-17}$ m	$\approx 10^{-7}$

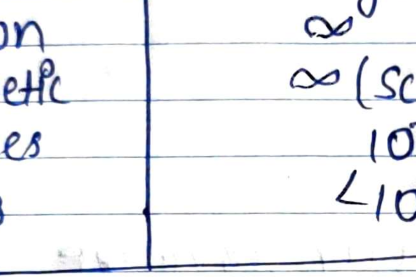
Gravitational Force

$$F = \frac{GMm}{r^2}$$

$$ma = \frac{GMm}{r^2}$$

$S = r\theta$

$r = \frac{S}{\theta}$



$C = 2\pi R = 40000$ km