Lecture 7

Wednesday, May 17, 2023 10:01 AM

Example $t_1 = 1s$ $X_1 = 4m$

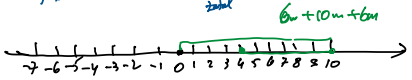
after 2 s passed position was at 10 m

after 5s passed position was at the origin

took 6s object to move 6m left.

1) Displacement, 2) Distance, 3) Vav 4) Speed

Total Total



$t_1 = 1s$	$X_1 = 4m$
$t_2 = 3s$	$X_2 = 10m$
$t_3 = 8s$	$X_3 = 0$
$t_4 = 14s$	$X_4 = -6m$
	X_f

1) $\Delta X = X_f - X_i = -6m - 4m = -10m$

2) $S = 22m$

3) $V_{AV} = \frac{\Delta X}{\Delta t} = \frac{-10m}{13s} = -\frac{10}{13}\frac{m}{s}$ $\Delta t = t_f - t_i = 14s - 1s = 13s$

4) Speed $= \frac{S}{\Delta t} = \frac{22m}{13s} = \frac{22}{13}\frac{m}{s}$

1) Displacement between position of 10m and -6 m

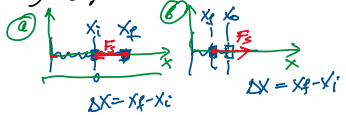
2) Displacement after 3s passed

$\Rightarrow$ Forces:

(1) Contact Forces

Force exerted by objects in direct contact

- Spring

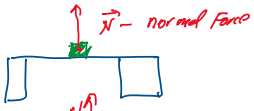


a) $F = -K\,\Delta x$

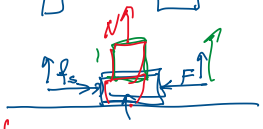
b) $F = -K\,\Delta X$ Hook's Law

- String

- Normal Force



- Frictional Forces



$f_s = \mu_s N$ Static Friction

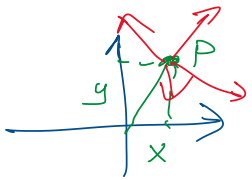
$f_k = \mu_k N$

(2) Fundamental Forces
(action at Distance)

- Gravitational Force (Gravitationsfeld)
- Electrical Force / Magnetic Force (Feld) → James Maxwell (1831–1879) Electromagnetic Force
- 1973 Electroweak Force
- (3) Weak Force (neutrino) → Steven Weinberg, Abdus Salam
- (2012) Higgs
- 4) Strong Nuclear Force (1915) Ernest Rutherford
- Standard Model
- Lieddle racer
- God Particle
- Graad Unification!
- 10d + t
- 3d + t
- 5) Quintesence — Dark Energy

⇒ Formulation of Dynamics

(1) Consider in Inertial Reference Frame



(2) Considering P.O. in IRF

(3) Isolate Forces acting on P.O

- $\vec{F}_{Net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4 \ldots$

(4) $\vec{F}_{Net} = 0$, $\vec{V}_{P.O} = const$

Equilibrium Problems

Baby Version

$$\begin{cases} \vec{a} = 0 \\ \vec{V} = \text{const} \\ \vec{r} = \vec{r}_i + \vec{V} \cdot t \end{cases}$$

5) Junior

$\vec{F}_{net} \neq 0 = \text{const}$

Non Equilibrium Problem

$$\begin{cases} \vec{a} = \text{const} \\ \vec{V}(t) = V_i + a \cdot t \\ \vec{r}(t) = \vec{r}_i + \vec{V}_i \cdot t + \frac{\vec{a} t^2}{2} \end{cases}$$

6) Adult Version

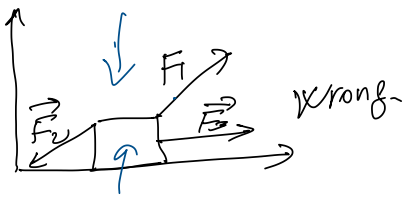
$\vec{F}_{net} \neq 0 \neq \text{const}$

$$\begin{cases} \vec{a} \neq \text{const} \\ \vec{V}(t) = \int_0^t \vec{a}(t)\, dt \\ \vec{r}(t) = \int_0^t \vec{V}(t)\, dt \end{cases}$$

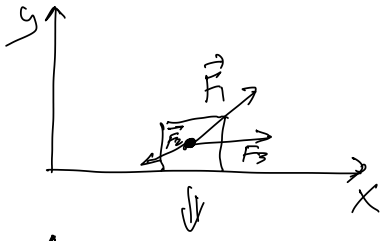
⇒ How to Calculate $\vec{F}_{net}$?

Free Body Diagrams

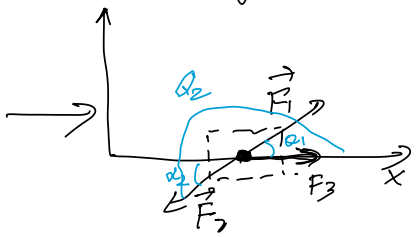
1) IRF
2) F.D
3) Identify Forces



Wrong



Correct FBD



$F_1 \quad F_2 \quad F_3$

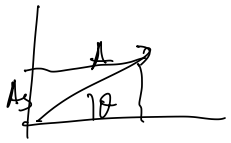
$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$$

(x) (y)

$$F_{net}^x = F_1^x + F_2^x + F_3^x \qquad F_{net}^y = F_1^y + F_2^y + F_3^y$$

$\cos(\alpha+180) = -\cos\alpha$

$\sin(\alpha+180) = -\sin\alpha$



$A_x = A\cos\theta$

$A_y = A\sin\theta$

$$F_{net}^x = F_1\cos\theta_1 + F_2\cos(\alpha_2+180) + F_3$$

$$F_{net}^x = F_1\cos\theta_1 - F_2\cos\alpha_2 + F_3, \quad F_{net}^y = F_1\sin\theta_1 + F_2\sin(\alpha_2+180)$$

$$F_{net}^y = F_1\sin\theta_1 - F_2\sin\alpha_2$$

Equilibrium $F_{net}^x = 0$ $F_{net}^y = 0$

$$F_1\cos\theta_1 - F_2\cos\alpha_2 + F_3 = 0$$

$$F_1\sin\theta_1 - F_2\sin\alpha_2 = 0$$