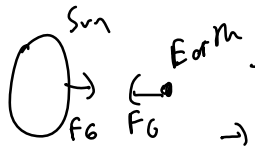
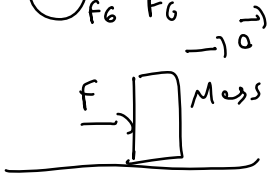
Note Title 2/22/2012

# Newton's Laws

All particles follow certain trajectories, these motions are subject to eqns. of motn → interaction (forces)




→ Grav. force instantaneous



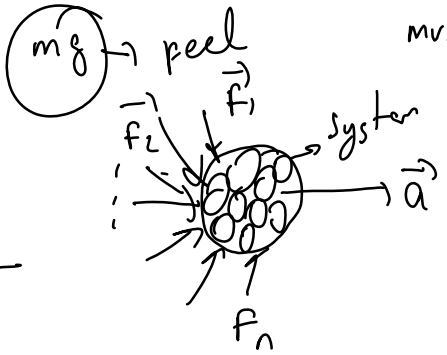

⇒ Force ∝ acceleration

mass → defined

multiplicative factor

**2nd law**

$$\sum_{i=1}^{N} \vec{F}_i = \sum_{j=1}^{N'} m_j \vec{a}$$




**1st law**

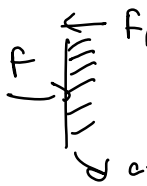
$\sum \vec{F} = 0 \rightarrow a = 0 \Rightarrow$

1) The object is not moving.

2) It's moving with a const vel.

$v(t) = v_0 + a\Delta t$ ($a = 0$)

**3rd law**




$\Rightarrow \vec{F}_R = -\vec{F}$ = Action → Reaction

$\sum \vec{F} = 0 \Rightarrow \vec{F} + \vec{F}_R = 0 \Rightarrow \vec{F}_R = -\vec{F}$

$\sum \vec{F} = \sum m \vec{a} \Rightarrow \sum F_x = \sum m a_x$

$\sum F_y = \sum m a_y$

$\sum F_z = \sum m a_z$

$F = m a$

$1\,N = 1\,kg \left(\frac{m}{s^2}\right)$

* Distinction between mass and weight

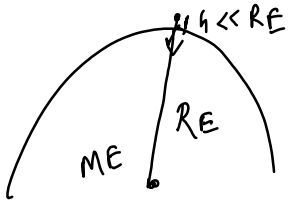
m = multip. factor (universal property)

m = 1kg → on earth and also on moon

**weight** = $mg$ ← grav. acc. [An object which attracts m]

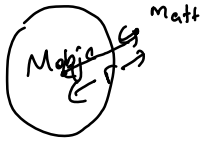
$F = mg_e \simeq F_{Grav(earth)}$

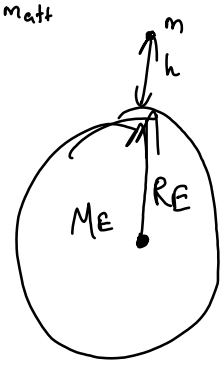
$mg_{moon} = F'_{grav(moon)}$




$g_{earth}$ is approximation of the real quantity.

$$F_{Gravity} = G\frac{M_{object}\, m_{attracted}}{r^2} = ma$$



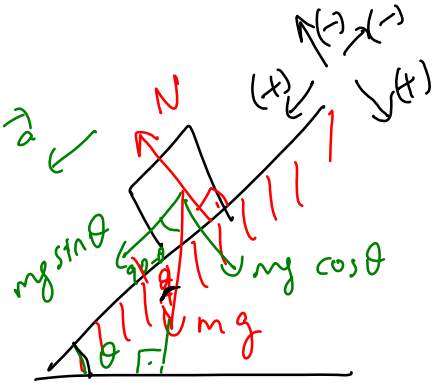

$$\frac{G M_{earth}\, m}{r^2} = G\frac{M_E m}{(R_E + h)^2} = mg \quad a$$

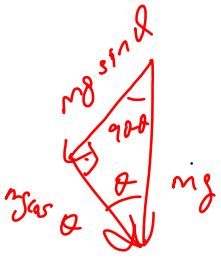
$h << R_E$

$R_E + h \simeq R_E$

$$g = \frac{G M_E}{(R_E)^2} = 9.81\ m/s^2$$

F.B.D.


$\sum \vec{F}_\perp = 0$ since no motion

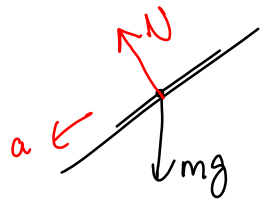
$\sum F_\perp = mg\cos\theta - N = 0$ (since it's not moving along $\perp$)

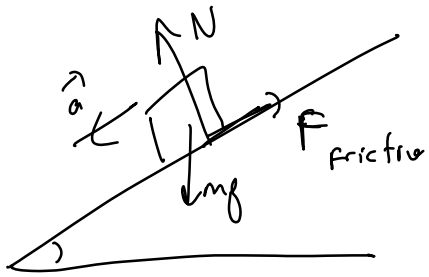
$N = mg\cos\theta$

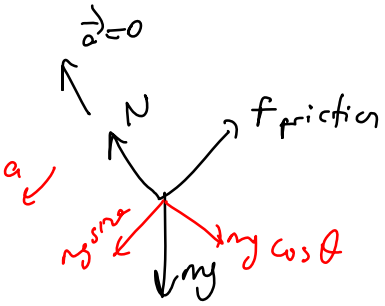
$\sum F_{//} = ma$

$mg\sin\theta = ma \Rightarrow$ **$a = g\sin\theta$**

# Free body diagram




$\Sigma \vec{F}_{\perp} = 0$ (not moving)

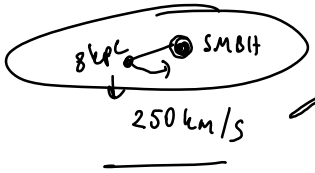
$\Sigma \vec{F}_{//} = ma$ (moving)

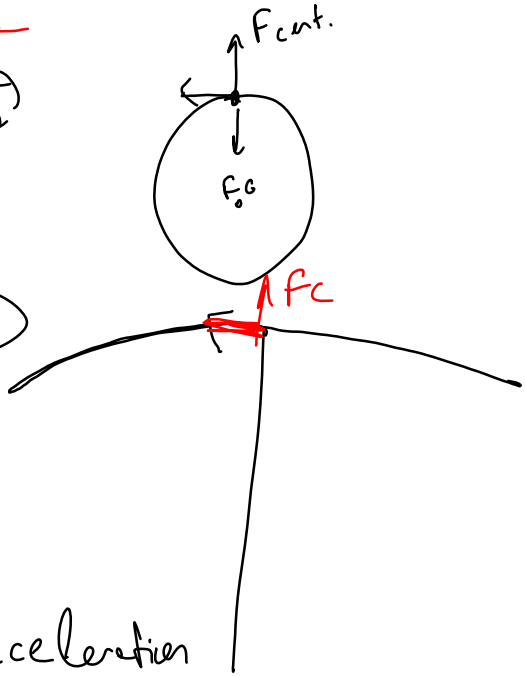
$\Sigma F_{\perp} = -N + mg\cos\theta = 0$

$\Sigma F_{//} = mg\sin\theta - f_{friction} = ma$

## Inertial Reference System

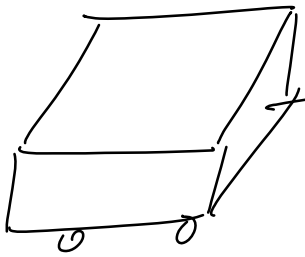
$\Sigma \vec{F} = m\vec{a}$


$8 \times 3 \times 10^{8} \times (10^{3})^{2}$

Inertial system = no acceleration



$a = 0$

$v \neq 0$ = inertial

$a \neq 0$ = not inertial

Non-inertial


Elevator = $mg - ma$ = weight reading on scale