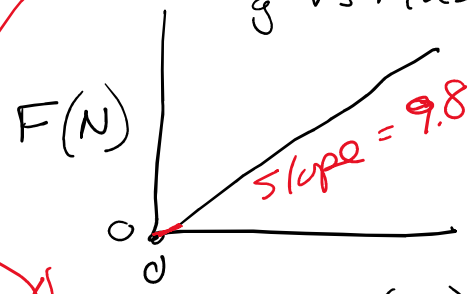
April 8, 2024

Physics 11 honours – FBDs in 1-D and 2-D

- Note: Gravitational mass vs inertial mass (what's the diff?)

F_g vs mass



$F \propto m$

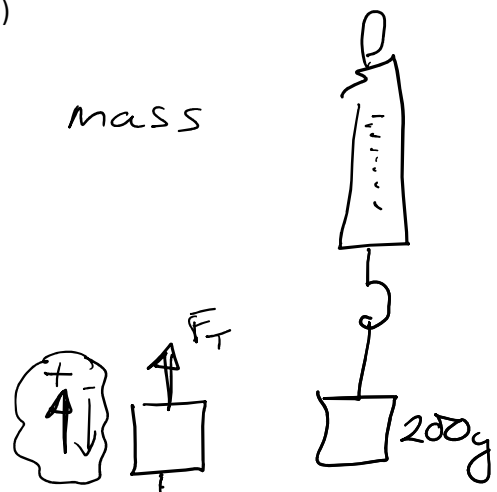
$y = mx + b$

$F = (9.8\ N/kg)\,m$

$m = \frac{F_g}{g}$

Weight $\equiv F_g$

F_g vs mass



$\vec{v} = 0$

$\therefore \vec{a} = 0$

$\Sigma F = m\vec{a} = 0$

F_T = force of tension

$\Sigma F = m\vec{a} = F_T - F_g$

$0 = F_T - F_g$

$F_T = F_g$

$F = ma$

$(N) = (kg)\cdot(m/s^2)$

$F = (9.8\ N/kg)\,m$

$F_g = mg$

$\frac{N}{kg} = \frac{kg \cdot m/s^2}{kg}$

$g = 9.8\ m/s^2 = 9.8\ N/kg$

applicable to acceleration

gravitational field strength

Inertial Mass

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

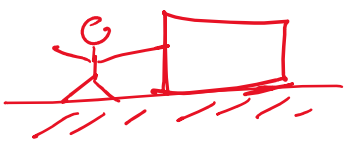
$$m = \frac{\Sigma F}{\vec{a}} =$$

$$\boxed{F_f \equiv \mu F_N}$$

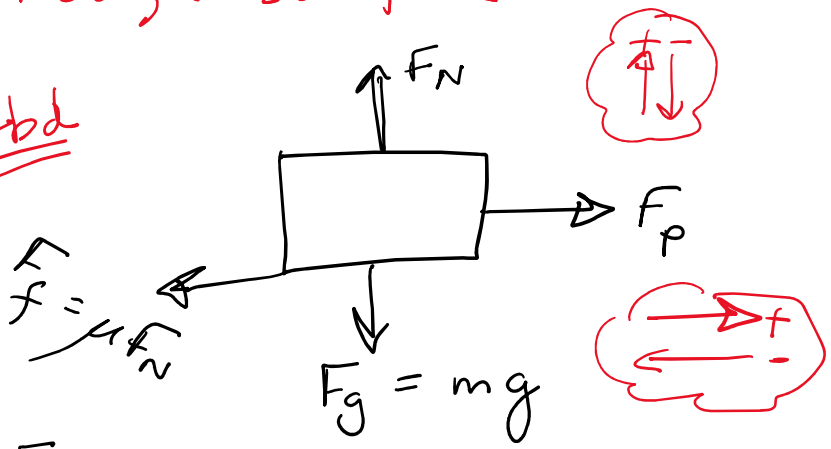
μ ← coefficient of friction

fbd a box being pushed horizontally on a rough surface

sketch



fbd



$$y\text{//}\quad \Sigma F_y = m\cancel{a_y} = F_N - mg$$

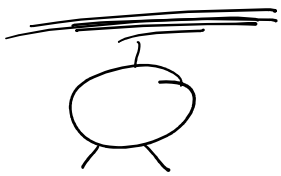
$$\therefore F_N = mg$$

$$x\text{//}\quad \Sigma F_x = \boxed{ma_x = F_p - \mu F_N}$$

$$ma_x = F_p - \mu mg$$

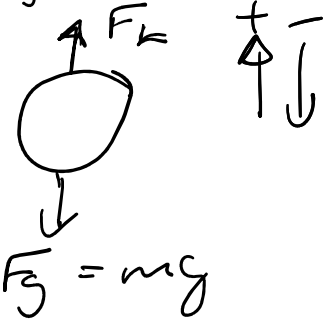
Elevator probs (vertical)

eg. helicopter



$F_{Lift} = F_L$

fbd



$$\sum F = \boxed{ma = F_L - mg}$$

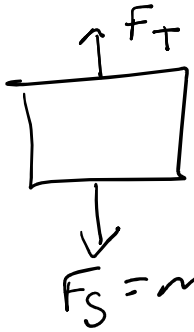
$$F_L = ma + mg = m(a+g)$$

∴ if $\vec{a} = 0$ $\quad \boxed{F_L = mg}$

if $\vec{a}$ is + (up) $\quad F_L > mg$

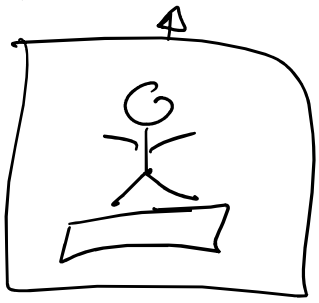
if $\vec{a}$ is − (down) $\quad F_L < mg$

Elevator (from outside)



$$\sum F = \boxed{ma = F_T - mg}$$

Person standing on a scale in an elevator

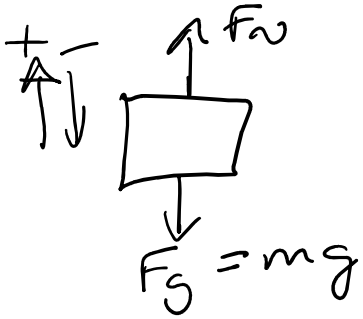


$F_N \Rightarrow$ scale reading

$F_N \Rightarrow$ apparent weight

$F_g = mg$ = true weight

if $F_N = 0$ ... apparent weightlessness



$\Sigma F = ma = F_N - mg$

$\therefore F_N = ma + mg$

$F_N = m(a+g)$

if $\vec{a} = 0$ $F_N = mg$ = true weight

if $\vec{a}$ is +(up) $F_N > mg$

if $\vec{a}$ is −(down) $F_N < mg$

if the cable breaks ...

$\vec{a} = -g$ $F_N = m(-g + g) = 0N$