

Chapter 5 - Newton's laws

Newton's First Law (Law of Inertia)

An object at rest or in uniform motion will remain at rest or in uniform motion unless acted on by an external force.

Newton's Second Law

$a \propto F$ (acceleration is directly proportional to the force)

$a \propto \frac{1}{m}$ (acceleration is inversely proportional to the mass)

combining proportionalities:

$$a \propto F \left(\frac{1}{m} \right)$$

$$a \propto \frac{F}{m}$$

$$F \propto ma$$

$$F = kma$$

Special k:

$$\frac{1 \text{ N}}{1 \text{ kg} \cdot \text{m/s}^2}$$

$$\vec{F}_{\text{net}} = m\vec{a}$$

where \vec{F}_{net} is the unbalanced force (N)

m is the mass (kg)

\vec{a} is the acceleration (m/s^2)

MP/162

$m = 7.00 \times 10^2 \text{ kg}$

$T = 7.50 \times 10^3 \text{ N}$

$\vec{a} = ?$

$\vec{F}_{\text{net}} = m\vec{a}$

$T - F_g = ma$

$7.50 \times 10^3 \text{ N} - 6867 \text{ N} = (7.00 \times 10^2 \text{ kg})a$

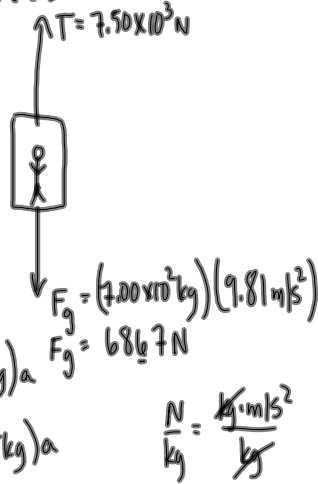
$633 \text{ N} = (7.00 \times 10^2 \text{ kg})a$

$a = +0.90 \text{ m/s}^2$

$\vec{a} = 0.90 \text{ m/s}^2 \text{ [up]}$

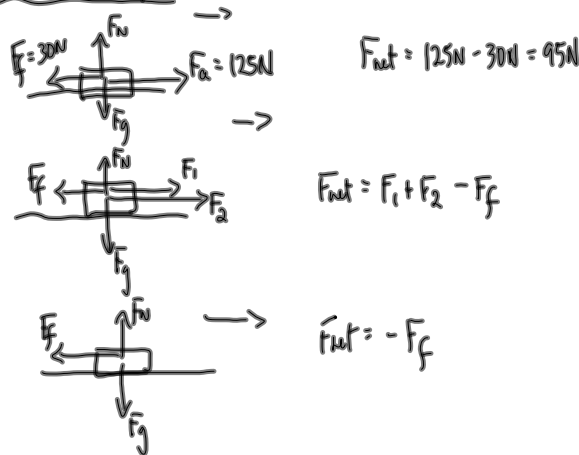
Draw a FBD

(up +)



the elevator could be:
 - going up / speeding up
 OR
 - going down / slowing down

Some more examples:



TO DO:

- ① PP/163
- ② Assignment
- ③ Sims - Forces in 1D