Chapter 5. Newton's Laws

Newtons First Law (Law of Inertia)

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

Newton's Second Law

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

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

Combining proportionalities

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

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

$$F \propto ma$$

$$F = kma$$

Special k:

$$k = \frac{1\,N}{1\,kg \cdot m/s^2}$$

$$\vec{F}_{net} = m\vec{a}$$ ← NEWTON'S SECOND LAW

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

m is the mass (kg)

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

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$m = 7.00 \times 10^2 kg$

$T = 7.50 \times 10^3 N$

$\vec{a} = ?$

DRAW A FBD:

+ up

$T = 7.50 \times 10^3 N$

$F_g = (7.00 \times 10^2 kg)(9.81 m/s^2)$

$F_g = 6867 N$

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

$T - F_g = ma$

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

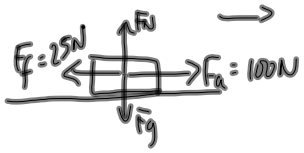
$633 N = (7.00 \times 10^2 kg)a$

$a = +0.90 m/s^2$

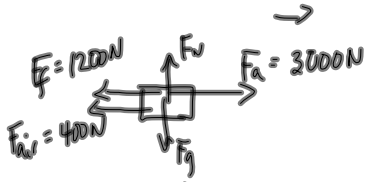
$\vec{a} = 0.90 m/s^2 [UP]$

going up speeding up
OR going down down slowing down

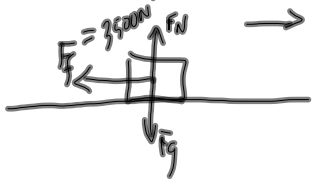
Some more:



$F_{net} = 100N - 25N = 75N$



$F_{net} = 3000N - (1200N + 400N$



$F_{net} = -3500N$

TO DO:

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② Assignment

③ Sims - Forces in 1D.