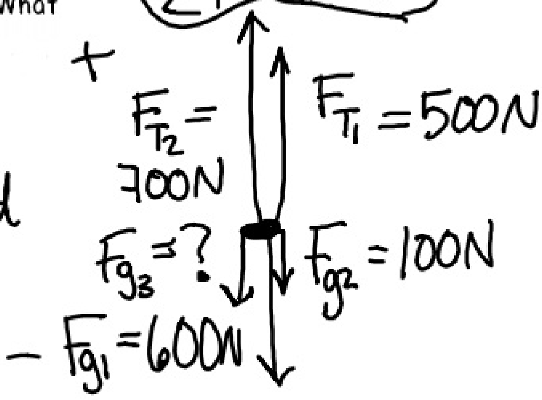
Bellwork

Note the readings on the scales. Burl the painter has a weight of 600 N, and carries a 100-N bucket of paint. What is the weight of the scaffold?

Hint: Draw a FBD for the scaffold. Then use $\Sigma F = ma$

FBD scaffold



$$\Sigma F = ma$$

$$+F_{T_1} + F_{T_2} - F_{g_1} - F_{g_2} - F_{g_3} = m\cancel{a}^{0}$$

$$500N + 700N - 600N - 100N - F_{g_3} = 0$$

$$500N - F_{g_3} = 0$$

weight of scaffold $\boxed{F_{g_3} = 500N}$

$$F_g = mg$$

$$\frac{500N}{9.8\frac{m}{s^2}} = \frac{m(\cancel{9.8\frac{m}{s^2}})}{\cancel{9.8\frac{m}{s^2}}}$$

mass of scaffold $\boxed{m = 51.02\ kg}$

Physics I - Elevators and Apparent Weight

Actual Weight = $F_g = mg$ (gravity Force)

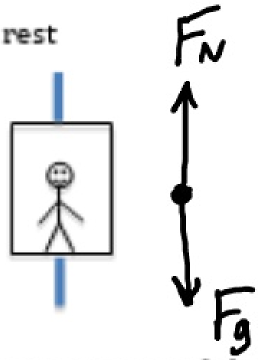
Apparent Weight = F_N = normal force

Often F_N = F_g , but not always!

Consider a person in an elevator...

*when only 2 forces, Strongest force points same direction as acceleration.

At rest



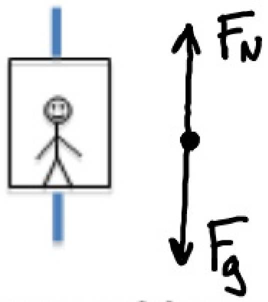
$\vec{a} = 0\ \frac{m}{s^2}$

$\vec{V} = 0\ \frac{m}{s}$

Balanced

$F_N = F_g$

Constant Velocity (up or down)



$\vec{a} = 0$

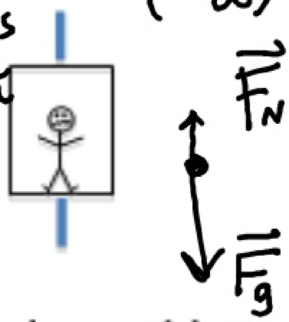
$\vec{V}$ is ↑ or ↓

$F_N = F_g$

Slowing Down While Rising

$(-a)$

Feels light



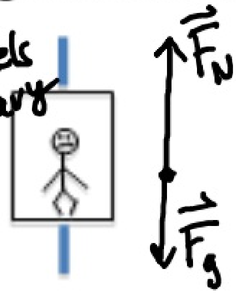
$\vec{a}$ is $(-)$

$\vec{V}$ is $(+)$

$F_g > F_N$

Slowing Down While Descending

Feels Heavy



$\vec{a}$ is $(+)$

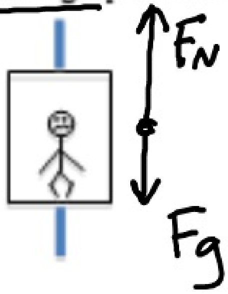
$\vec{V}$ is $(-)$

$F_N > F_g$

Speeding Up While Rising

$+$

$-$

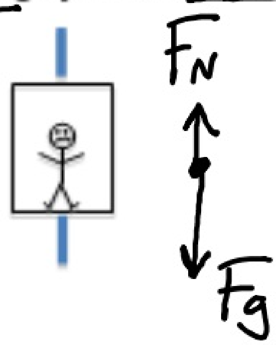


$\vec{a}$ is $(+)$

$\vec{V}$ is $(+)$

$F_N > F_g$

Speeding Up While Descending



$\vec{a}$ is $(-)$

$\vec{V}$ is $(-)$

$F_g > F_N$

What happens of the elevator cord is cut?

$+$

$$\Sigma F = ma$$
$$-F_g = ma$$
$$-mg = ma$$
$$-9.8\,\tfrac{m}{s^2} = a$$

$-$ ↓ F_g

in free fall!

$F_N = 0$

Ex) If a 55 kg person in an elevator accelerates downwards at 1.5 m/s². What fraction of their original weight do they seem to have?

negative

RATIO: $\dfrac{\text{Apparent weight}}{\text{Actual weight}} = \dfrac{F_N}{F_g} = \dfrac{457N}{539N} = 0.85$

Find F_N: $\Sigma F = ma$ → $F_N - F_g = ma$

↑ F_N

↓ $F_g = (m)(9.8\,\tfrac{m}{s^2}) = 539N$

$F_N - 539N = (55kg)(-1.5)$

$\boxed{F_N = 457N}$

Ex) If a rope can withstand 200 N of tension before breaking, how quickly can you lift (accelerate) a 10 kg box before the rope breaks?

↑ $F_T = 200N$

$$\Sigma F = ma$$
$$F_T - F_g = ma$$
$$200N - 98N = (10kg)\,a$$
$$\frac{102N}{10kg} = a$$

↓ $F_g = (10kg)(9.8\,\tfrac{m}{s^2}) = 98N$

$$\boxed{a = +10.2\,\tfrac{m}{s^2}}$$

1. $\vec{a} = -1.5\ \frac{m}{s^2}$ ✓

2. $F_T = 18{,}540\ N$

3. $m = 1.54\ kg$

4. $a = -3.5\ \frac{m}{s^2}$

$+$ ↑ $F_{air} = (0.85)(666N) = 566N$

$-$ ↓ $F_g = mg = (68kg)(9.8\frac{m}{s^2}) = 666N$

$$\Sigma F = ma$$
$$+F_{air} - F_g = ma$$
$$566N - 666N = (68kg)a$$
$$-100N = (68kg)a$$
$$\boxed{a = -1.5\ \frac{m}{s^2}}$$

2.

$+$ ↑ $F_T = ?$

$-$ ↓ $F_g = (1{,}800kg)(9.8\frac{m}{s^2}) = 17{,}640N$

$$\Sigma F = ma$$
$$+F_T - F_g = ma$$

$a \rightarrow +0.5\frac{m}{s^2}$ "lifted"

$$F_T - 17{,}640N = (1800kg)(0.5\frac{m}{s^2})$$

FBD (fish)

↑ $F_T = 22N$

↓ $F_g = mg = (9.8\frac{m}{s^2})m$

$$\Sigma F = ma$$
$$+F_T - F_g = ma$$
$$22N - (9.8\frac{m}{s^2})\cdot m = m\cdot(4.5\frac{m}{s^2})$$
$$+9.8\frac{m}{s^2} m \quad +9.8\frac{m}{s^2}\cdot m$$
$$\frac{22N}{14.3} = \frac{(14.3\frac{m}{s^2})m}{14.3}$$
$$\boxed{1.54kg = m}$$

4

↑ $F_T = 63N$

↓ $F_g = (10kg)(9.8\frac{m}{s^2}) = 98N$

$$\Sigma F = ma$$
$$F_T - F_g = ma$$
$$63N - 98N = (10kg)a$$

speeding up $\boxed{a = -3.5\frac{m}{s^2}}$ "lowered" (–) velocity