NAME:__________________________________

U2:L3 Mass VS Weight

A person with mass, **m**, who is located at or near the surface of the Earth will always have some weight… $\vec{F}_g = mg$.

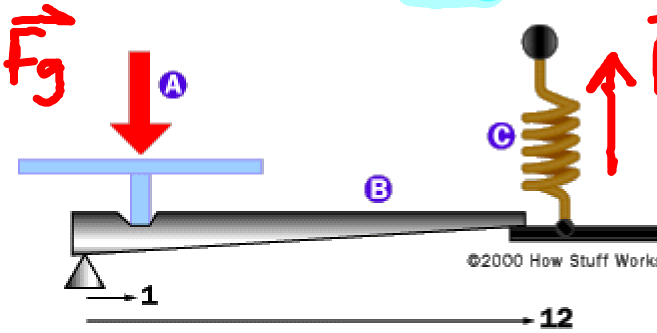
$\vec{F}_g$: Force of Gravity (N)

g: $\vec{a}$ due to gravity, "g" = 9.8 m/s² on Earth } vector

m: mass of object (Kg) } SCALAR

When a person stands on a scale, the reading (the number of pounds or Newtons) on the scale is actually the Normal Force that the scale exerts back towards the person to support the person's weight.

$\vec{F}_{APP} = \vec{F}_g$



$\vec{F}_N$; no $\vec{v}$, no $\vec{a}$, $\Sigma\vec{F} = 0_N$, $\vec{F}_N = \vec{F}_g$

Scale converts $\vec{F}_N$ from N → Kg

mass = scale

weight = $\vec{F}_g$

My WEIGHT on Earth is around 560N

My WEIGHT on the moon is around 90N

My MASS is always 56kg!!

$\vec{F}_g = m \times a$

$\vec{F}_g = mg$

$\vec{F}_g = 56\,Kg\,(9.8\,m/s^2) \approx 560_N$

$\vec{F}_g = mg$

$90_N = 56\,Kg\,(g)$

$\frac{90}{56} = g$

$1.607\,m/s^2 = g$

$\approx 1.625\,m/s^2 = g_{moon}$ → 16% of Earth's g

Things get complicated when the scale and the person experience acceleration.

This will change the contact force **(the Normal Force)** between the person and the scale.

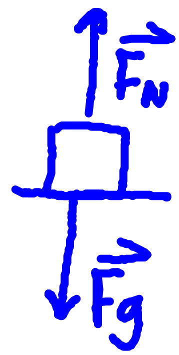
Weight can change, mass does not change

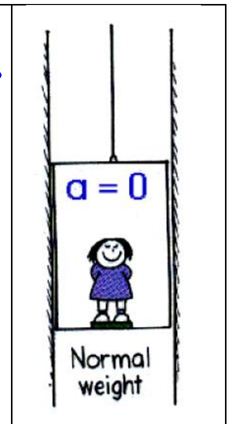
Elevators...

$\vec{a} = 0\,m/s^2$
- not moving ($\vec{v} = 0\,m/s$)
- constant velocity

$$\vec{F_g} = \vec{F_N}$$

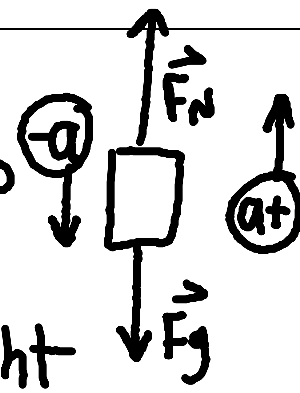
"TRUE weight"

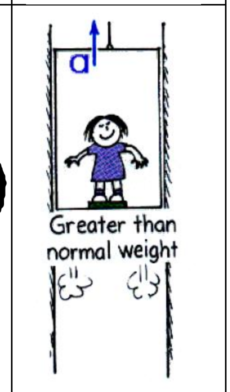




going ↑ and speeding ↑
going ↓ and slowing ↓
★ Scale must push ⇧ to accelerate

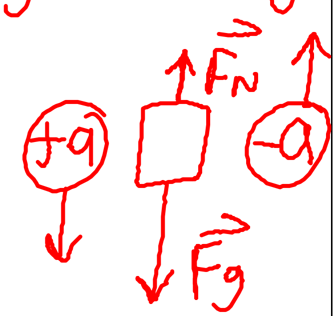
HEAVIER than true weight

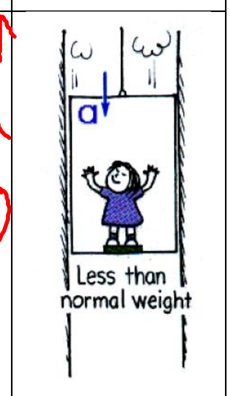




going ↑ slowing ↓ OR going ↓ speeding ↑
★ your whole mass is not pushing on scale

LOWER than true weight

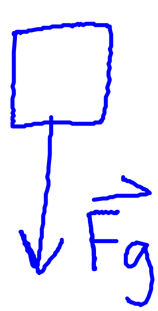


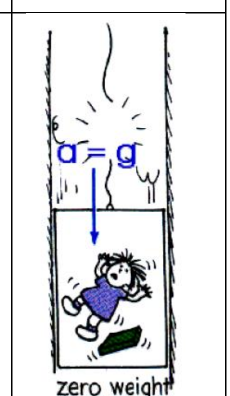


Freefall (cable breaks)

$\vec{a} = g = 9.8\,m/s^2$

$\vec{F_N} = 0\,N$

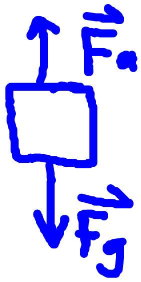




"apparent weight"

$\vec{F}_g = 3000N$

1) An elevator that weighs 3.0×10^3N accelerates upwards at $\vec{a} =$ 1.0 m/s². What force does the cable exert?



$\vec{F}_g = mg$

$m = \frac{F_g}{g} = \frac{3000N}{9.8 m/s^2} = 306.12 kg$

$\Sigma\vec{F} = \vec{F}_T - \vec{F}_g$

$\vec{F}_T = \Sigma\vec{F} + \vec{F}_g$

$\vec{F}_T = ma + mg$

$\vec{F}_T = 306.12N + 3000N$

$\vec{F}_T = 3306.12N$

2) A person who wighs 490 N stands on a scale in an elevator.

a) What does the scale read when the elevator is not moving?

490N

b) What is the reading on the scale when the elevator rises at a constant velocity?

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

490N

c) The elevator slows down at a rate of -2.2m/s² What does the scale read?

(a−)

$\vec{F}_g = mg$

$490N = m(9.8 m/s^2)$

$m = 50 kg$

$\Sigma\vec{F} = ma$

$\vec{F} = 50kg(-2.2 m/s^2)$

$F_N = -110N$

d) The elevator accelerates at 2.7 m/s². What does the scale read?

(−)

$\Sigma\vec{F} = \vec{F}_g + \vec{F}_N$

$\Sigma\vec{F} = 490N + ma$

$50kg(2.7 m/s^2)$

$\Sigma\vec{F} = 490 + 135N = 335N$

e) What would the scale read if the cable snapped and the elevator was in free-fall downwards?

$0N$