Apparent Weight

Apparent weight is the perceived weight of an object that is accelerating vertically.

An object's real or actual weight is the force exerted upon it by the Earth via its gravitational field.

real weight $F_g = mg$

Real weight and apparent weight will be the same if an object is in equilibrium the vertical direction.

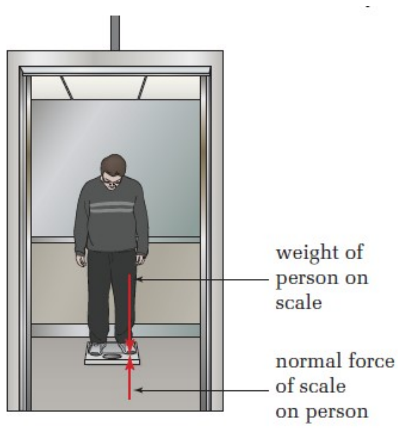
If not in equilibrium vertically, then
an object's **apparent weight** is equal (but opposite) to the normal force, applied force, or tension force exerted on it by another object.

Apparent weight = $F_{g\,app} = \underline{F_N}$ if resting on a surface.

$F_{g\,app} = \underline{F_T}$ if being supported by rope or string or light wire.

$F_{g\,app} = \underline{F_A}$ if being supported by a hand.

p. 184 in textbook



When would the scale reading be equal in magnitude to Bob's true weight?

at rest or constant velocity - no acceleration

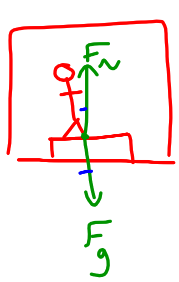
When would the scale reading be greater in magnitude than Bob's true weight?

accelerating upwards

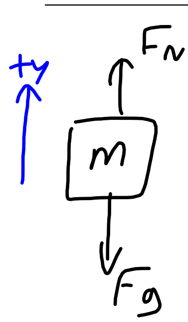
When would the scale reading be smaller in magnitude than Bob's true weight?

accelerating down

Draw FBD for Bob.



motion?



Apparent Weight Examples

Ex. 1: A woman of mass 48.9 kg steps into an elevator. What is the normal force exerted on the woman when....

a) the elevator is at rest?

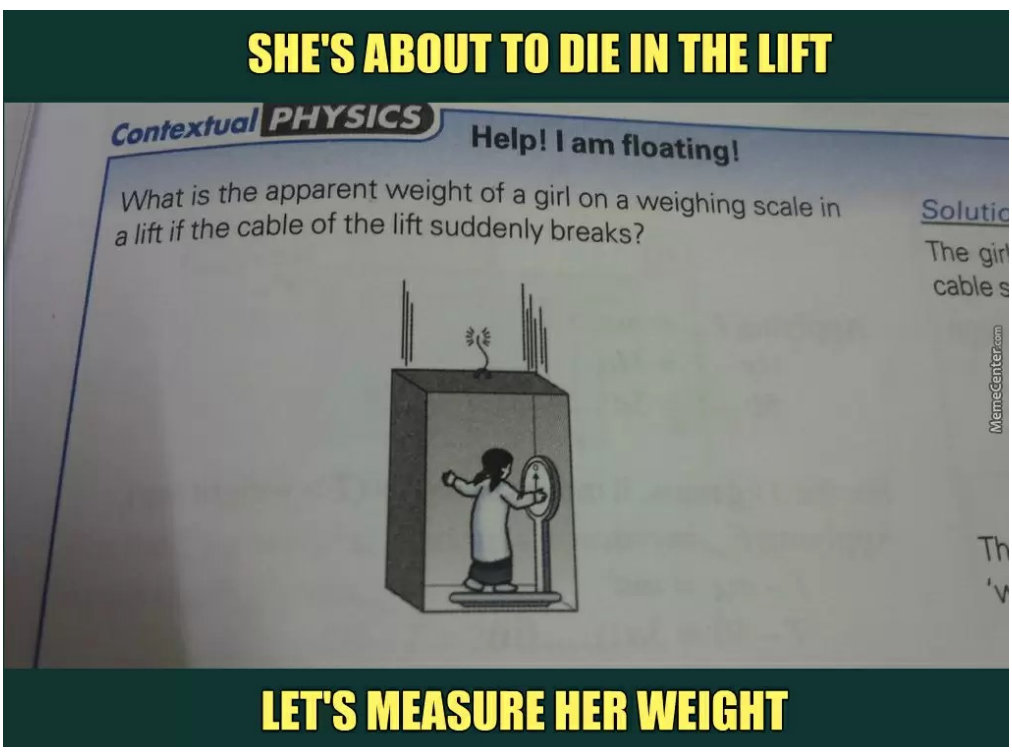
b) the elevator is accelerating upwards at 0.38 m/s^2 [up] as it begins to move upward?

c) the elevator is accelerating ~~at~~ down at 0.28 m/s^2 [down] as the ~~rising elevator starts to slow down?~~

Ex. 2: Suppose your brown paper bag can withstand only 98 N of force before it rips. Suppose your groceries have a mass of 7.5 kg. Can you lift your bag off of the table at an acceleration of 2.5 m/s^2 up without ripping the bag?

$F_A = 92$ N no rip

Do Practice Problems 21-23 on Page 186

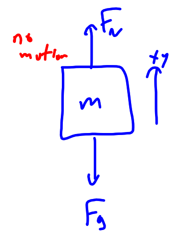


Ex 1) $m = 48.9\,kg$

$\vec{g} = 9.81\,m/s^2$ [down]

$\vec{F_N} = ?$

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



a) $F_{Net,y} = F_N - F_g = ma_y = 0\,N$

$\therefore F_N = F_g = mg = (48.9\,kg)(9.81\,m/s^2)$

$= 480.\,N$

b) $\vec{a_y} = 0.38\,m/s^2$ [up]

$F_{Net,y} = F_N - F_g = ma_y$

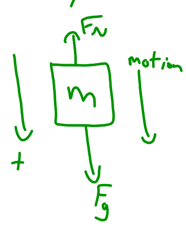
$F_N = F_g + ma_y = m(g + a_y)$

When accelerating up $g_{app} = g + a_y$

$F_N = (48.9\,kg)(9.81\,m/s^2 + 0.38\,m/s^2)$

$= 498.291\,N = 498\,N > F_g$

c) $\vec{a_y} = 0.28\,m/s^2$ [down]



$F_{Net,y} = F_g - F_N = ma_y$

$F_N = F_g - ma_y$

$F_N = m(g - a_y)$

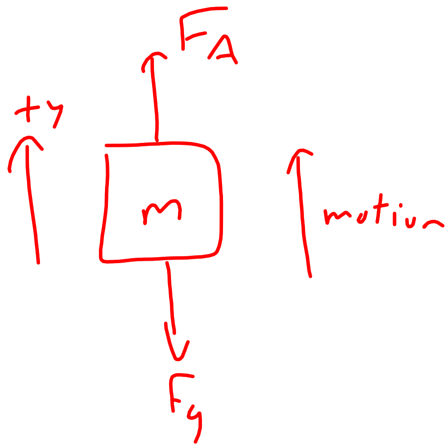
When accelerating down g_{app} less than g by amount a_y. Free Fall is when $a_y = g$

$\therefore F_N = m(g - a_y) = 0\,N$

$F_N = (48.9\,kg)(9.81\,m/s^2 - 0.28\,m/s^2)$

$= 466.017\,N = 466\,N < F_g$

Ex 2)



$m = 7.5\,kg$

$\vec{a}_y = 2.5\,m/s^2$ [up]

$\vec{g} = 9.81\,m/s^2$ [down]

$F_{A,max} = 98\,N$

$F_A = ?$

$$F_{Net,y} = F_A - F_g = ma_y$$

$$= F_A = ma_y + mg = m(g + a_y)$$

$$= (7.5\,kg)(9.81\,m/s^2 + 2.5\,m/s^2)$$

$$= 92.325\,N = \boxed{92\,N} < F_{A,max}$$

Bag will not rip