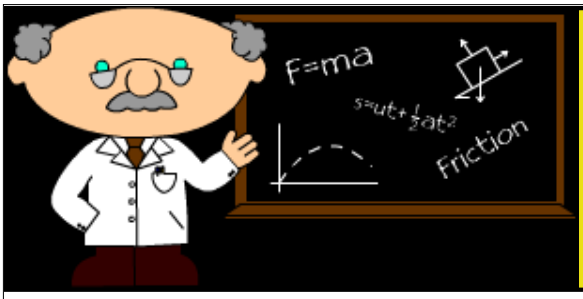
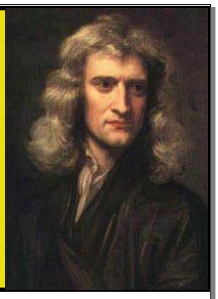


Unit 2: Dynamics

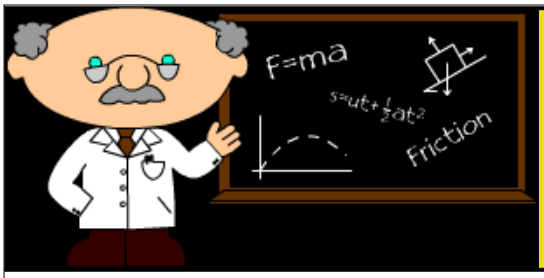


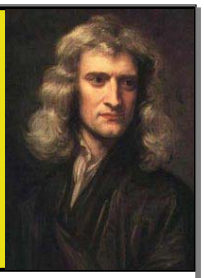
2.4 The Normal Force

Recall: The four fundamental forces of nature are:

Gravity
Electromagnetic
Weak Nuclear
Strong " "

Some non-fundamental forces include weight and the normal force...





Weight - a measure of the force fo gravity acting on an object

- the direction of the force (weight) acts in the same direction as the acceleration downwards towards the center of the Earth

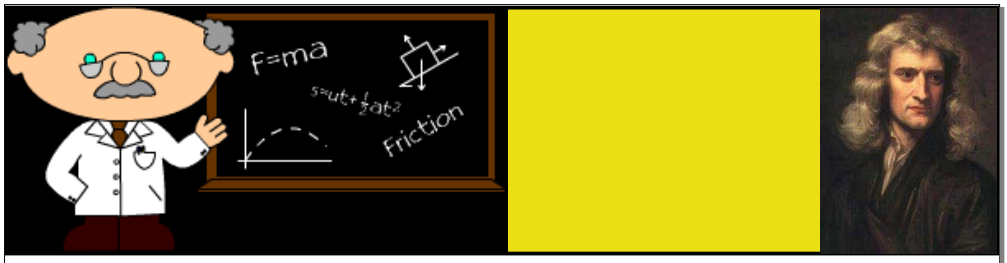
$\vec{F_g} = \vec{w} = m\vec{g}$

Ex.) What is the weight of a person of mass 60 kg? (Assuming that the person is on the Earth.)

$\vec{w} = m\vec{g}$

$= 60 \cdot -9.81$

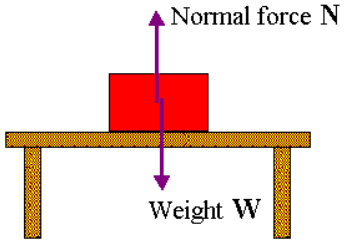
$= \boxed{5.9 \times 10^2 \text{ N}}$

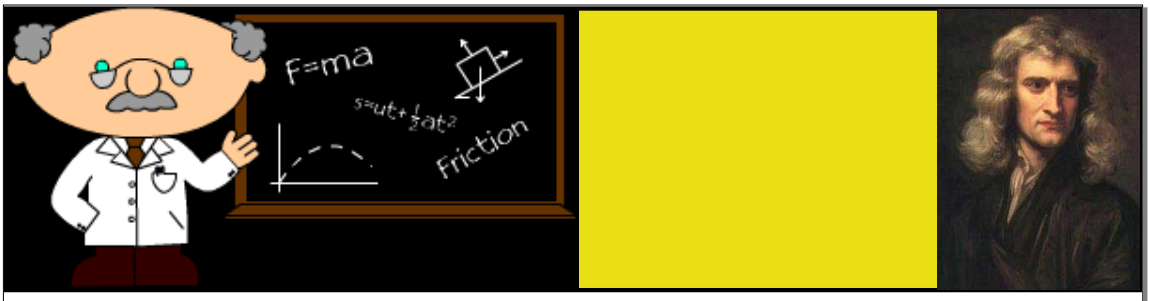


The Normal Force

Take a look at the Kleenex box sitting on the front table. What forces are acting on the box?

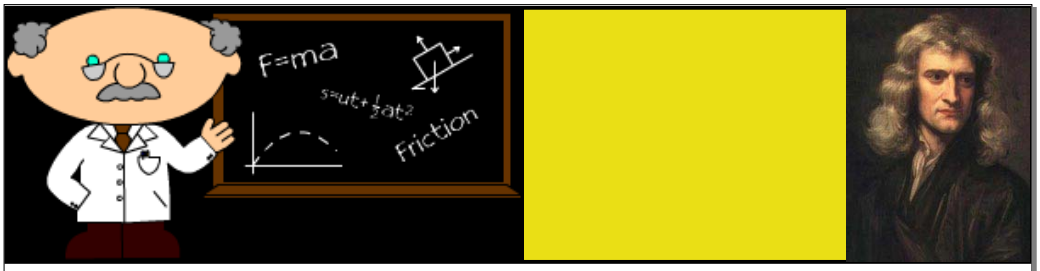
Newton's Third Law states that every action force has an equal and opposite reaction force. So what reaction force counteracts gravity(because the Kleenex box is not falling...) This force is called the NORMAL FORCE.





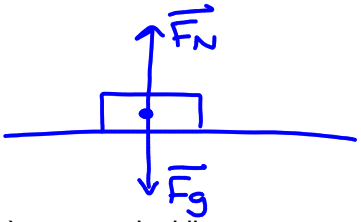
$$\vec{F}_N = -\vec{F}_G$$

The normal force is equal in magnitude but opposite in direction to the force of gravity. It occurs when an object comes in contact with any surface and always acts perpendicularly to that surface.

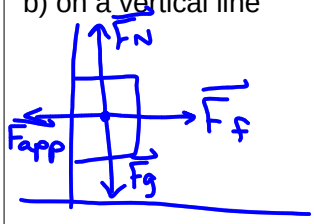


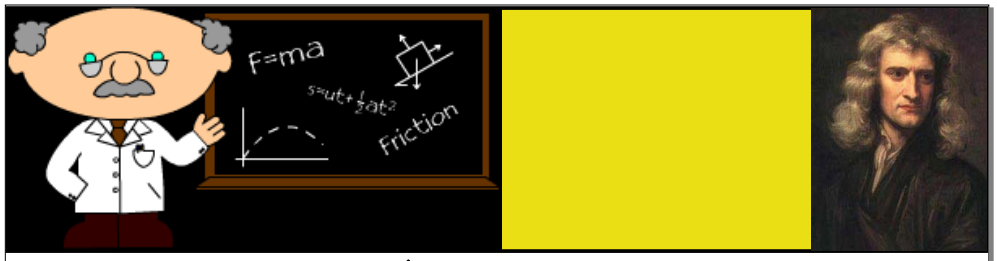
Ex.) Draw free body diagrams for the following scenerios:

a) on a horizontal line

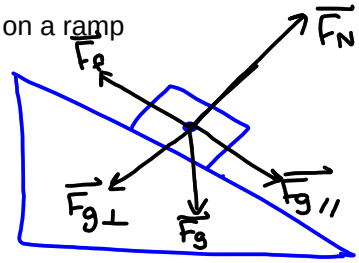


b) on a vertical line

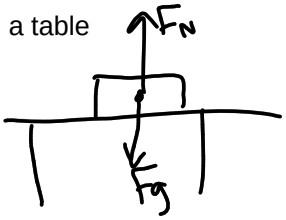


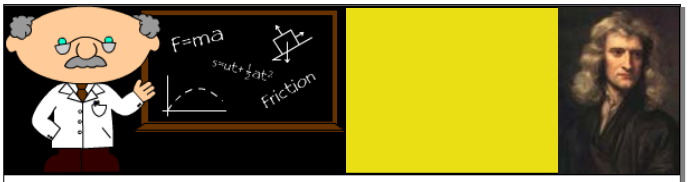


c) on a ramp



d) on a table





In the previous examples, the box was not moving. Another way to say that, is the net force acting on the box was zero.

$F_{net} = \Sigma$ forces $\quad \Sigma$ = sum

Net Force - the vector sum of all forces acting on an object

Ex.) Consider a box on a line, being acted on by 2 forces.

$\vec{F}_1 = 35$ N

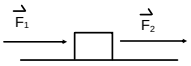
$\vec{F}_2 = 20$ N

a) What is the net force?

$F_{net} = F_1 + F_2$

$= 35 + 20$

$= \boxed{55N}$

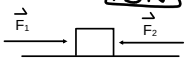


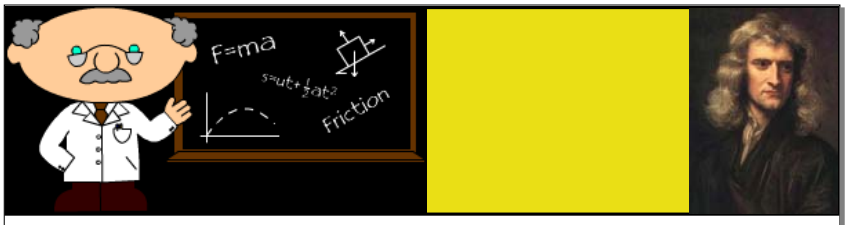
b) What is the net force?

$F_{net} = F_1 + F_2$

$= 35 + -20$

$= \boxed{15N}$





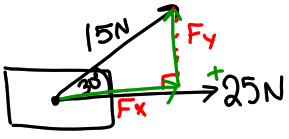
Forces act in more than one dimension...

Ex.) Amanda and Kirsti are pulling a cart. Amanda pulls with 25 N due East and Kirsti pulls with 15 N at 30° N of E.

a) What is the total force on the cart?

$\cos 30° = \frac{\vec{F}_x}{15}$ $\quad \vec{F}_x = +13N$

$\sin 30° = \frac{\vec{F}_y}{15}$ $\quad \vec{F}_y = +7.5N$



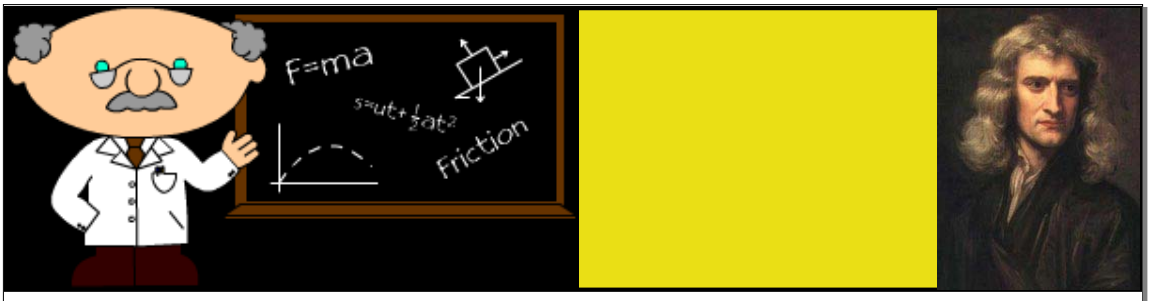
$F_{net_x} = 25 + 13 = 38N$

$F_{net_y} = 7.5N$

$R = \sqrt{38^2 + 7.5^2} = 39$

$\tan\theta = \frac{7.5}{38}$ $\quad \theta = 11°$

$F_{net} = \boxed{39N\ [11°\ N\ of\ E]}$



b) If the cart has a mass of 65 kg, what is the acceleration of the cart?

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

$39 = 65\vec{a}$

$a = 0.60 m/s^2$

"Newton's 2nd & 3rd Laws"

"3.4 Newton's 3rd Law"