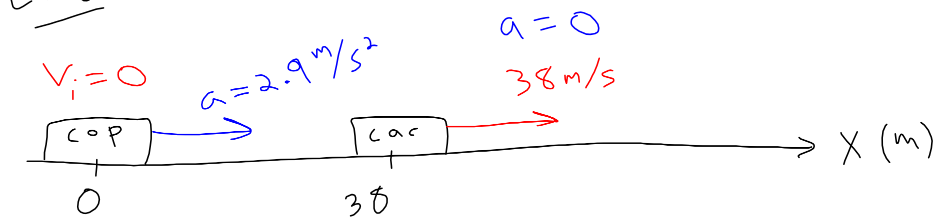
initial condition:

$t = 0$



car

$V_i = 38\ m/s$

$a = 0$

$V_f = 38\ m/s$

$X_i = 38\ m$

$X_f = ?$

$t = ?$

cop

$V_i = 0$

$a = 2.9\ m/s^2$

$V_f = ?$

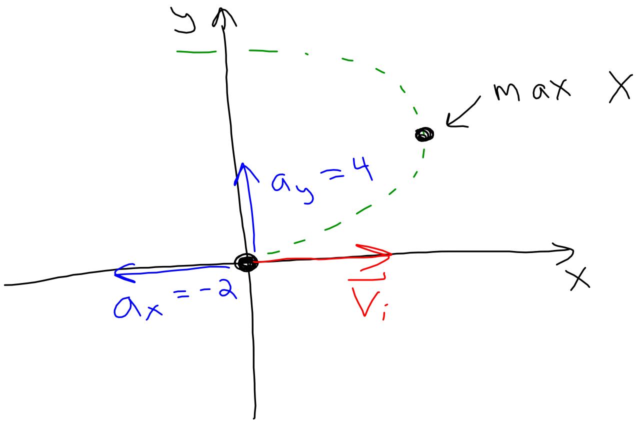
$t = ?$

$X_f =$

t(s)	X_{car} (m)	X_{cop} (m)
0	38	0
1	76	$X = \frac{1}{2}(2.9)(1)^2 = 1.45$
2	114	$X = \frac{1}{2}(2.9)(2)^2 = 5.8$
⋮	⋮	⋮
20	798	580
⋮	⋮	⋮
25	988	906
⋮	⋮	⋮
27	1064	1057
t	$38t + 38$	$\frac{1}{2}(2.9)t^2$

$$38t + 38 = \frac{1}{2}(2.9)t^2$$

↳ quadratic eq → $\boxed{27.17\ s}$



x-dir

$x_i = 0$

$V_i = 6$

$a = -2$

$V_f = 0$

find x_f and time

y-dir

$V_i = 0$

$y_i = 0$

$a_y = 4$

$y_f = ?$

<u>Chapter 5 - The laws of motion</u>

So far, we have described <u>how</u> objects move

e.g. the car has a = 0 and v = 20 m/s

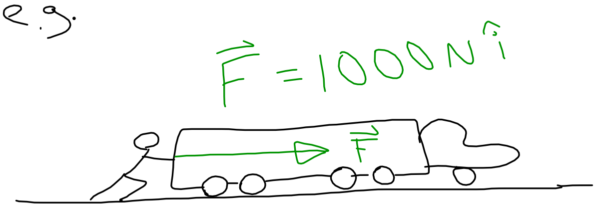
Now, we will investigate <u>why</u> objects move.

Section 5.1 - the concept of force

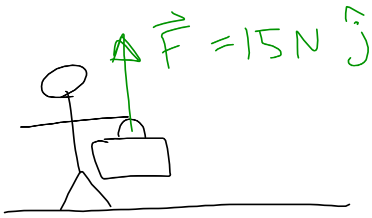
A force is basically a push or a pull on some object.

It has magnitude and direction, so it is a vector.

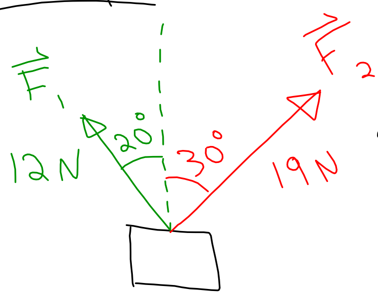
e.g.



e.g.

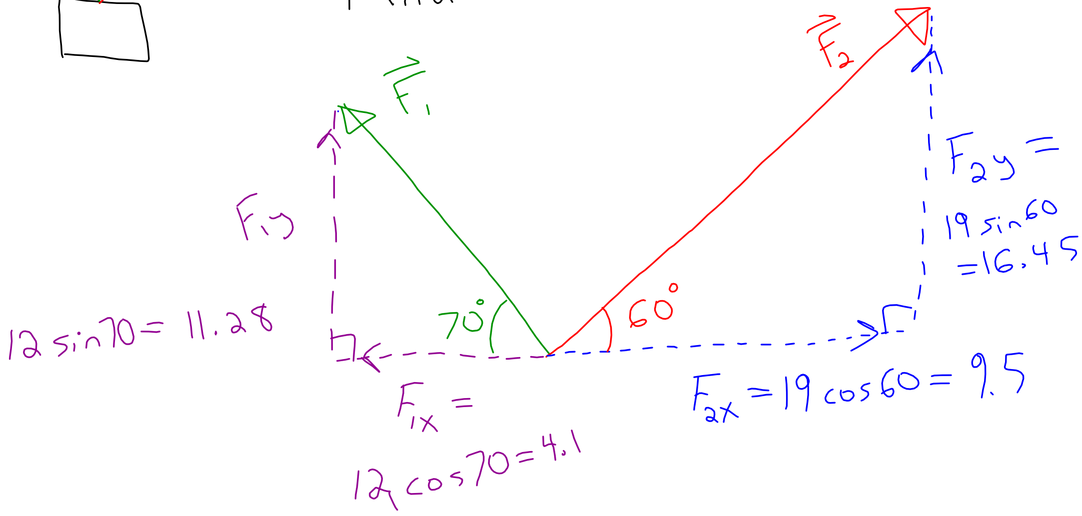


Example



aerial view

Find the net force on the block.



$$\vec{F}_{net} = (9.5 - 4.1)N\,\hat{i} + (11.28 + 16.45)N\,\hat{j}$$

Sec. 5.2 - Inertial reference frames

see: https://www.youtube.com/watch?v=umLcFAI5SZg

and: https://www.facebook.com/NOVApbs/videos/1900444973591374

Newton's 1st law: When observed from an inertial reference frame, objects move with constant $\overrightarrow{\text{velocity}}$ ($\vec{a} = 0$) unless a force acts on the object.

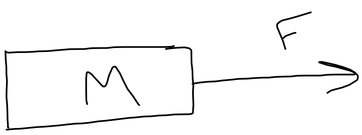
A formal definition of force can then be given as:

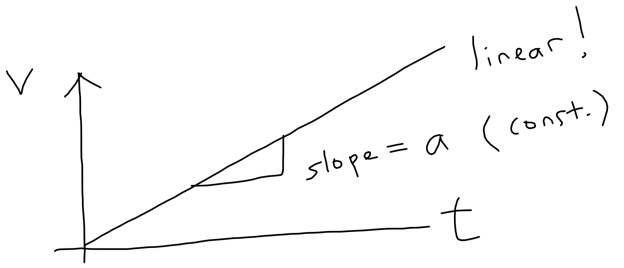
Force: that which causes a change in motion ($\overrightarrow{\text{velocity}}$) of an object

Sec. 5.3 - Mass

Mass = the property of an object that determines how much it resists changes to its motion (velocity)

Sec. 5.4 - Newton's 2nd Law





Mass	F_x	$\frac{dv}{dt}$
1 kg	1 N	1 m/s²
2 kg	1 N	0.5 m/s²
1 kg	2 N	2 m/s²
2 kg	2 N	1 m/s²
50 kg	100 N	2 m/s²

Observation:

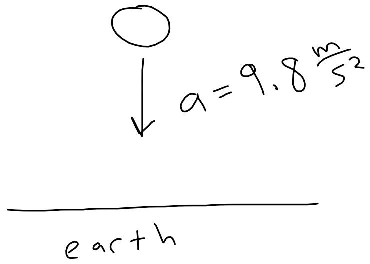
$$a = \frac{F}{m}$$

$$\boxed{\begin{array}{l}\text{Newton's 2nd Law:} \\ \sum \vec{F} = m\vec{a}\end{array}}$$ *

$$[F] = \frac{kg \cdot m}{s^2} = N$$

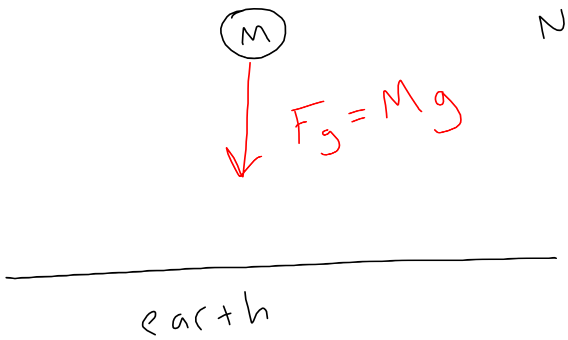
5.5 - Gravitational force (a.k.a. weight)

Recall:



$$\boxed{F_g = mg}$$ where $g = 9.8\, m/s^2$

Newton's 2nd Law: $F = ma$



$$\Rightarrow \cancel{M}g = \cancel{M}a$$

$$\boxed{a = 9.8 \frac{m}{s^2}}$$

Example:

A man weighs 900 N on Earth. What's his weight on Jupiter where $a_g^J = 25.9 \frac{m}{s^2}$?