The Greatest Physicist of them all

Sir Isaac Newton

I don't usually support watching a video in class, but exceptions must be made for the greatest mind in history.

Tyson on Newton

My favourite quote by Sir Isaac Newton:

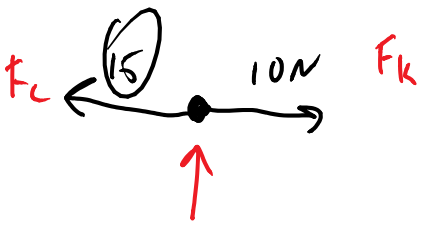
> *"If I have seen further than others it is only because I have stood on the shoulders of giants."*

Newton's Three Laws:

Newton's First Law (The law of inertia):
Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it.

You will keep moving how you're moving until a force acts on you. It's true if you're moving at 0m/s or 100m/s.

eg: ~~Lauren~~ Chris and Kyle both want Devon to be in their group. ~~Lauren~~ Chris pulls Devon with a force of 15N and Kyle pulls with a force of 10N. What is the net force (F_{net}) on Devon?



$F_{net} = W - L$
$= 15 - 10$
$= 5N$
towards Chris.

Newton's Second Law (Accelerating bodies):

The relationship between an object's mass *m*, its acceleration a, and the applied force *F* is *F* = m*a*. Acceleration and force are vectors. In this law the direction of the force vector is the same as the direction of the acceleration vector.

eg: Since ~~Lauren~~ chris won the tug of Devon war, what is Devon's acceleration towards ~~Lauren~~ chris?

What is the velocity of Devon $t = 5$

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

$$5 = 53(a)$$

$$\frac{5}{53} = a$$

$$= 0.1 \text{ m/s}^2$$

$v = at$

$v = (.1)5$

$= .5 \text{ m/s}$

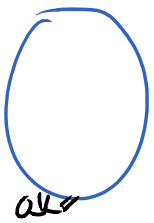
Newton's Third Law (action / reaction):

For every action there is an equal and opposite reaction.

Is there any difference between hitting a nail with a hammer and a nail hitting the hammer?

When you do a push up, are you pushing yourself up, or are you pushing the Earth away from you?

How does a rocket fly?



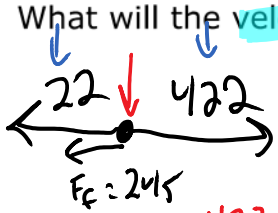
action ↔ reaction

gas out back ‖ pushes rocket up

Forces go well with kinematics and projectiles. Once we have a force and a mass, we can easily obtain acceleration. With acceleration we can find v_f, v_0, d, t, ...

eg: A force of 422N is used by Nathan to drag a 50kg zombie into a fire. The zombie claws at the ground (zombies don't like fire) with a force of 22N. What will the velocity of the zombie be 2s after pulling?

1) $F_{net} = L - L$ → F.B.D
2) $F = ma$
3) $v = at$



$F_{net} = W - L$
$= 422 - 267$
$= 155N$

$\mu = .5$
$F_f = \mu F_n$
$= .5(50)(9.8)$
$= 245N$

$F = ma$
$155 = 50a$
$\frac{155}{50} = 3.1 \frac{m}{s^2}$

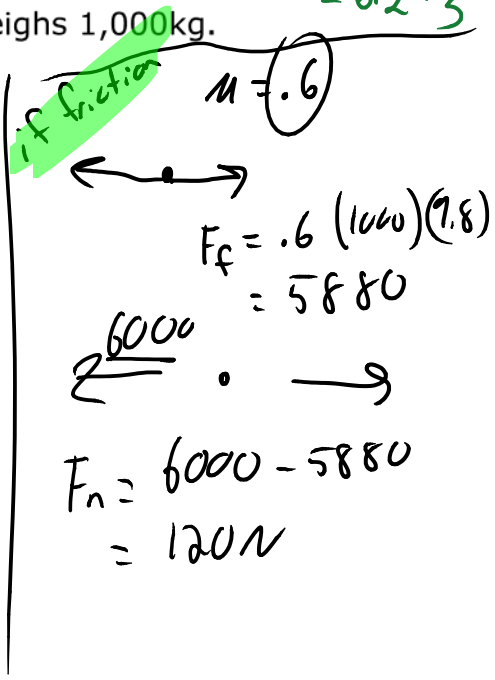
$v = at$
$= 3.1(2)$
$= 6.2 \frac{m}{s}$

eg: If Christian accelerates from a red light and is seen to be travelling at a velocity of 60km/hr 10s later. What was the force that the car had to exert? Assume the car weighs 1,000kg.

hint: ~~F=1670N~~

$\Delta v = at$
$60 - 0 = a(10)$
$\frac{60}{10} = 6 \frac{m}{s^2}$

$F = ma$
$= 1000(6)$
$= 6000$



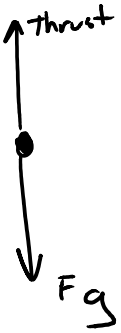
$F_n = 6000 - 5880$
$= 120N$

eg: Kyle was upset that he lost Devon to ~~Lauren~~ Chris's group so he drags Devon over to his group. Assume Devon weighs ~~72~~ 53kg. Kyle exerts a force of 222N. The coefficient of friction is .3 .
What is the acceleration of Devon?

$a = 1.25 \ m/s^2$

eg: Rocket

The acceleration of this rocket is 1.8m/s^2. Takeoff mass is 22 tonnes. Find the force exerted by the engines. (1 tonne = 1,000kg)



$F_{net} = F_{engine} - F_g$

$F_{engine} = F_{net} + F_g$

$= ma + mg$

$= m(a+g)$

$= 1\,\text{tonne} \cdot \frac{1000\,kg}{1\,\text{tonne}} (1.8 + 9.8)$

$= 11{,}600\,N$