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: Bond and Haille both want Sander to be in their group. Bond pulls Sander with a force of 15N and Haille pulls with a force of 10N. What is the net force (F_{net}) on Sander?

F_{net} = Winners − Losers

= 15 − 10

= 5

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 Bond won the tug of Sander war, what is Sander's acceleration towards Bond?

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

$$5N = 86\,a$$

$$\frac{5}{86} = a = 0.058\ m/s^2$$

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?

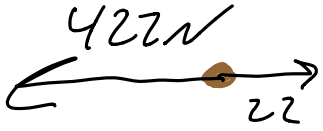
Forces go well with kinematics and projectiles. Once we have a force and a mass, we can easily obtain acceleration. With acceleration we can find v_f, v_0, d, t, …

eg: A force of 422N is used by Thomas 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) $F_n = W - L$

2) $F = ma$

3) $V = at$



$F = ma$

$400 = 50a$

$\frac{400}{50} = 8\ m/s^2$

$V = at$

$V = 8(2)$

$V = 16\ m/s$

eg: If Willow 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

$V = at$

$60\ \frac{km}{hr} \cdot \frac{1\ hr}{3600s} \cdot \frac{1000\ m}{1\ km} = 16.7\ m/s$

$V = at$

$16.6667 = (a)10$

$\frac{16.6667}{10} = a = 1.6667\ m/s^2$

$F = ma$

$= 1000(1.6667)$

$= 1666.7\ N$

$\approx 1700\ N$

eg: Haille was upset that she lost Sander to Bond's group so she drags Sander over to her group. Assume Sander weighs 77kg. Haille exerts a force of 222N. The coefficient of friction is .3 . What is the acceleration of Sander?

$\mu = .3$

$F_f = \mu(F_N - ma)$

$F_f = .3(77)(-9.81)$

$= 226.611\ N$

Haille isn't strong enough.

Sander don't move.

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)

$a = 1.8 m/s^2 \qquad m = 22{,}000$

$F = ma$

$39.6 kN = (22{,}000)(1.8)$