P20 Unit 2 - Forces

Newton's Third Law of Motion

Review: Laws of Motion

Newton's First Law:

Newton's Second Law:

Review: What is the difference between mass and weight?

Newton's Third Law

Forces do not exist all by themselves, they occur in pairs. We can never have one force acting all by itself*.

Newton's Third Law explains this:

> *"For every force, there is an equal and opposite force."*

This force is equal in magnitude and opposite in direction.

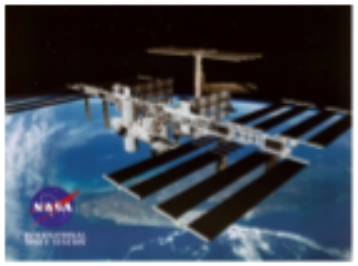
***Although we only focus on one force for simplicity.**

ex) Henrik Sedin has a puny mass of 75 kg. Zdeno Chara has a manly mass of 125 kg. If Chara pushes Sedin with a force of 15 N, what is the acceleration of both players?

Secret Rock'em Sock'em Thing

The forces are the same, only opposite. Do two force calculations.

Repair Scare



You are in outer space fixing the International Space Station. Your tether suddenly breaks and you find yourself at rest in space.

You don't have fancy rockets or anything to get back to the station. You do, however, have a wrench.

How can you get back to the station?

Weight

- A measure of the force of gravity acting on an object.

- The direction of the force (weight) acts in the same direction as the acceleration ($\vec{g}$), downwards towards the centre of the earth.

- Newton's second law is sometimes written as:

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

Where:

$\vec{F}_g$ = weight (N)

m = mass (kg)

$\vec{g}$ = -9.81 m/s^2

The Normal Force

To explain the normal force, let us examine a box on a line.

- What forces are acting on this box?

Newton's 3rd Law states there must be an equal in magnitude but opposite in direction force acting on the box to counter-act the force of gravity.

This counter-acting force is called the normal force.

$$\vec{F}_N = \text{Normal Force}$$

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

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

Let's look at some more boxes on a line...

The Many Adventures of Boxy

- on a line...

- on a more different line...

- On a ramp...

- On a table...

In all of the previous situations, the box was not moving. This is because the vector sum of all forces acting on it was zero.

We could also say that the total force acting on the box was zero.

Total Force* = the vector sum of all forces acting on an object.

***The total force is sometimes referred to as the net force.**

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 total force?

b) What is the total force?

The forces don't have to act in only one dimension either...

ex) Pat and Melissa are pulling a cart. Pat pulls with 25 N due East and Melissa pulls with 15 N at 30° N of E.

a) What is the total force on the cart?

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