Last lesson

State the 3 main forces that often provide centripetal force.

Last term

State Newton's 1st law.

Last topic

What is the difference between distance and displacement?

Even earlier

Describe convection.

10 minutes!

Last lesson

Friction, tension, gravity or electrostatic

Last term

The motion of an object will remain the same unless acted on by a resultant force.

Last topic

Distance is a scalar and therefore we need to know the total distance travelled. Displacement is distance in a given direction, so we only need the overall distance travelled from start to finish. (Displacement is a vector)

Even earlier

The process of heat transfer in liquids and gases. Particles gain thermal energy, collide and vibrate, moving apart. This makes this part of the substance less dense than the rest; it rises above the rest. Moved away from heat source, loses thermal energy, stops vibrating, particles move close together again. More dense, so sinks. Process repeats. Convection current formed.

Newton's 3rd law

Date: 20-May-20

Objectives

AO1 – Know Newton's laws. Understand and draw force diagrams.

AO2 – Be able to identify action-reaction pairs.

AO3 – Apply Newton's laws to describe the motion of an object.

Lesson Sequence

CP2

Newton's 1st Law
F = ma
Weight
Throwback: Prefixes and SF
Centripetal Force
Newton's 3rd law
Reaction time
Stopping distance
CP2 Test

CP4

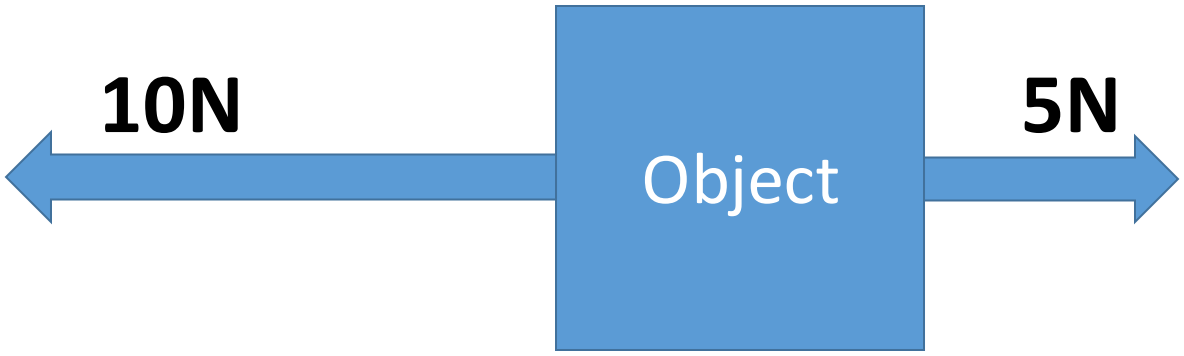
Wave properties
Wave equation
Wave behaviours
CPAC: Measuring waves in liquids and solids
End of Topic Test

Force Diagrams:

So the size is represented by the length of the arrow, and the direction is also represented!

- We can use force diagrams to help represent the
- There are 2 main rules for using force diagrams.
- Forces are vector quantities so we have to make sure we represent the size AND the direction of each force…

Let's say a force of 10N is acting on the object to the left, we represent this force using an arrow **to the left**, as show…



Let's say another force of 5N is acting on the object to the right, we represent this force using an arrow **that is half the size of the 10N arrow to the right**, as show…

Have a go at drawing force diagrams for the following descriptions…

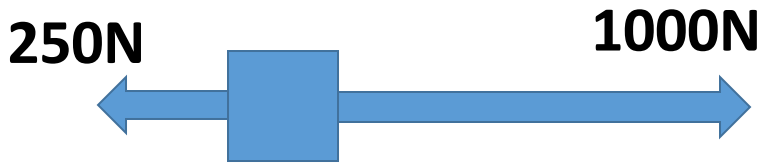
Represent the object as a box

Extension: Calculate the resultant force acting on the objects.

1) A plane has a thrust force of 1000N and an air resistance force of 250N.
2) A fish is sinking in the ocean, it has a buoyancy force of 30N, and a weight force of 60N.
3) A ball is flying through the air. It has a thrust force of 10N, a weight force of 3N, and an air resistance force of 4N.
4) A man pushes a box across the floor. He applies a driving force of 200N, and there is a frictional force of 50N.
5) A Skydiver in free-fall.

Answers:

1)



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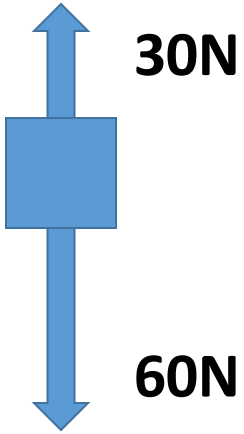

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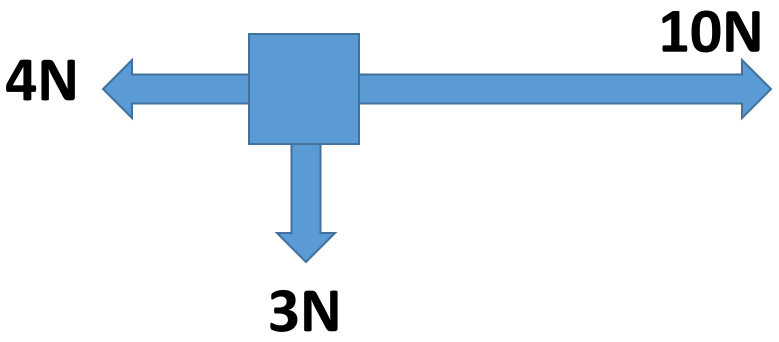
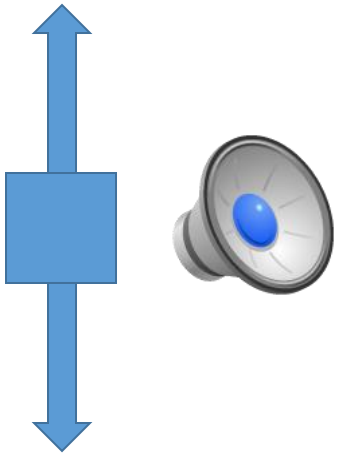


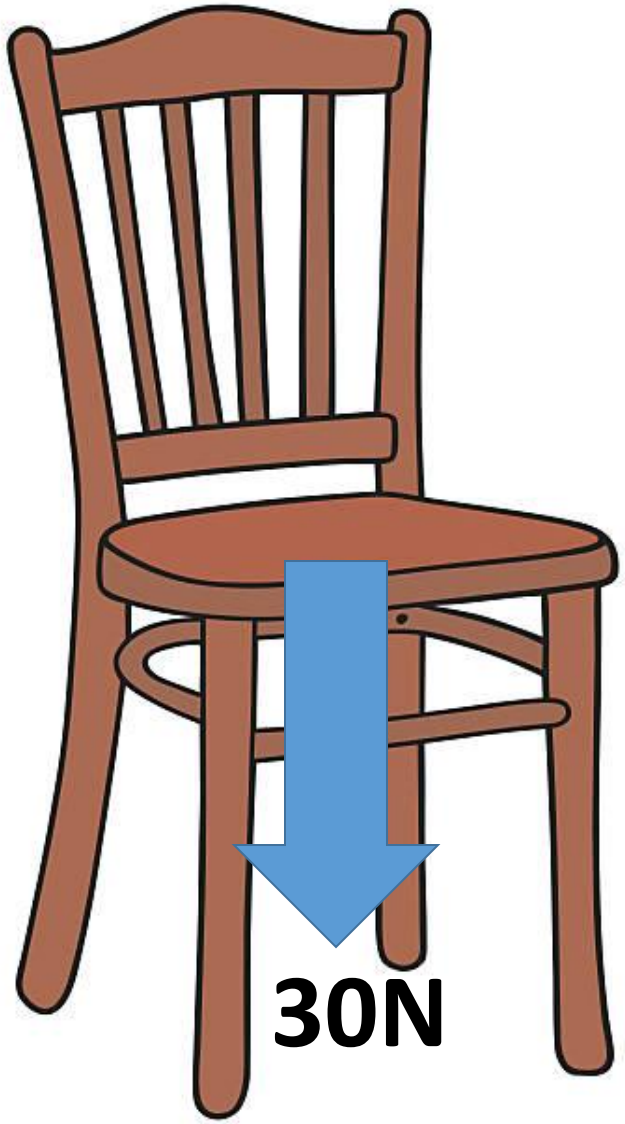
4)

5) Equal sized arrows. (constant speed means zero resultant force)



What happens when two forces acting are balanced?

There is a resultant force of zero, so the object will either be stationary or move with constant speed because of Newton's 1st law.



So, if this dog sits on the chair…

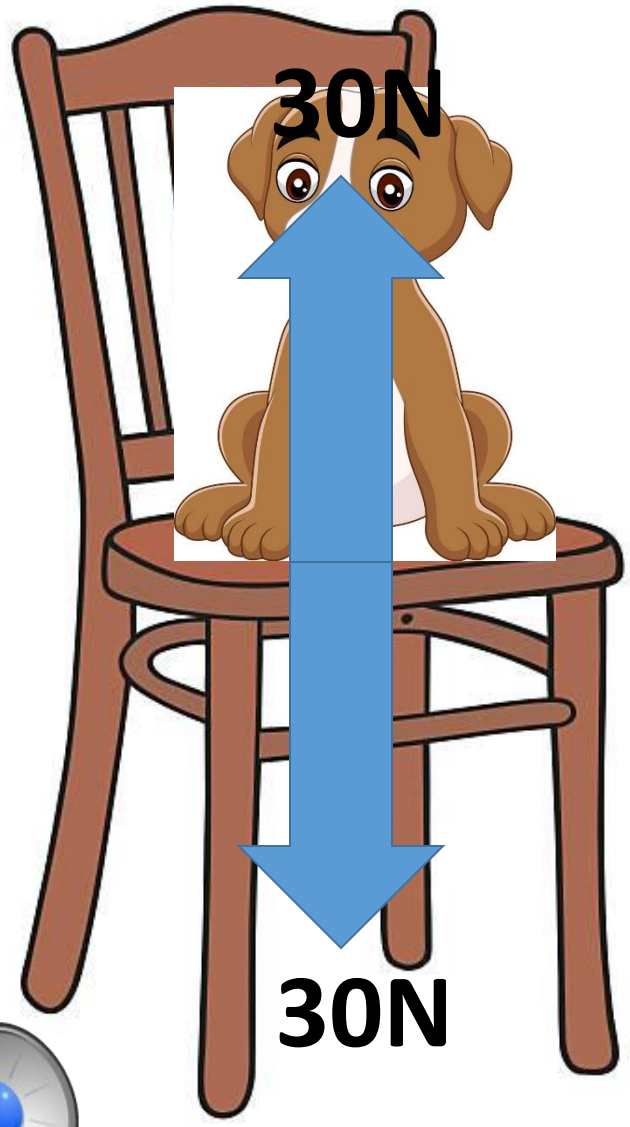
…and the only force he applies is the downward force of his weight…

Why does the chair hold him up?

Surely, there is a resultant force downwards of 30N?

So shouldn’t the dog fall through the chair?

Introducing: Newton's 3rd law…



Newton's 3rd law states that (if an object is stationary or at constant speed), when a force is applied to an object, an e… also acts on that obje…

These forces… pairs.

So, with our… the dog's weigh…

So now there are 2 balanced forces (a resultant force of zero), which explains why the dog isn't falling through the chair!

…this causes a reaction force of equal size (30N) in the opposite direction (up) from the chair onto the dog. This is known as the 'reaction' force (or sometimes it's called the 'normal' force).

Another example…

This girl is leaning on the wall with a force of 60N, and is stationary.

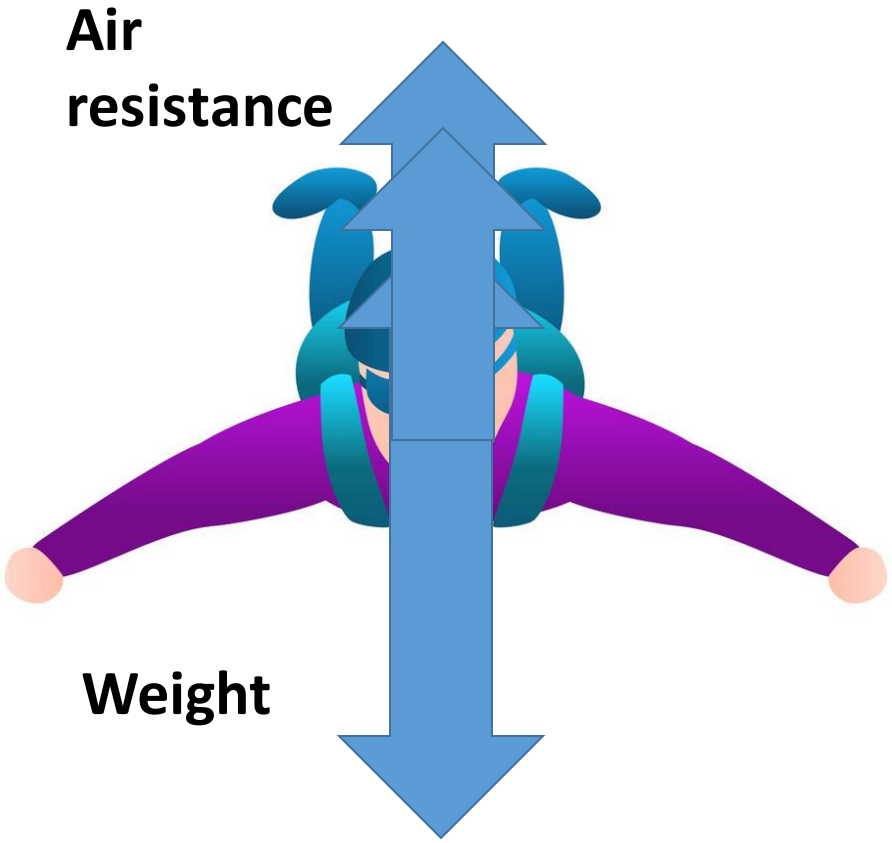
So the action force is 60N from the girl to the wall.

The reaction force is 60N from the wall onto the girl.

The forces balance, and the girl stays upright.

Wat about an object at constant speed…

A skydiver initially has unbalanced forces. Their weight force will be bigger than the drag/air resistance force. This is why they accelerate towards the ground (at first).



Over time, the drag force will start to increase until it matches the size of the weight force (because of Newton's 3rd law).

When it balances out, the forces become an action-reaction pair, and terminal velocity is reached (the skydiver falls at constant speed).

So why do skydivers wear parachutes?

Opening a parachute increases your drag/air resistance force more quickly, so equilibrium is reached sooner, so acceleration is stopped sooner.

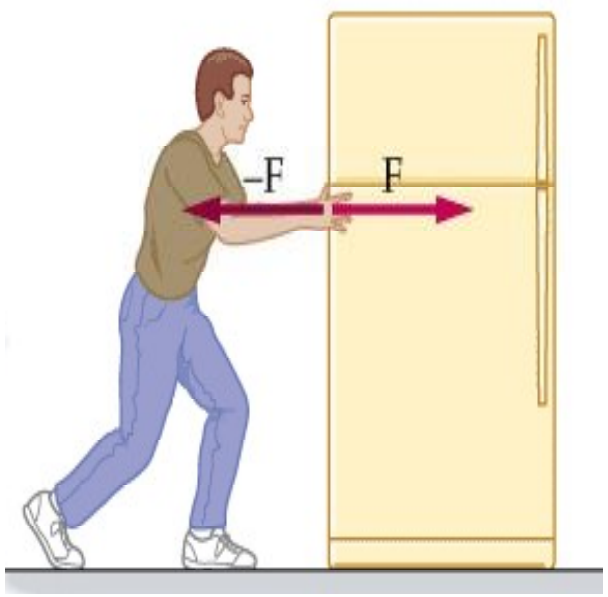
Can you think of 5 more action-reaction pairs that you experience day-to-day?

Pairs of forces

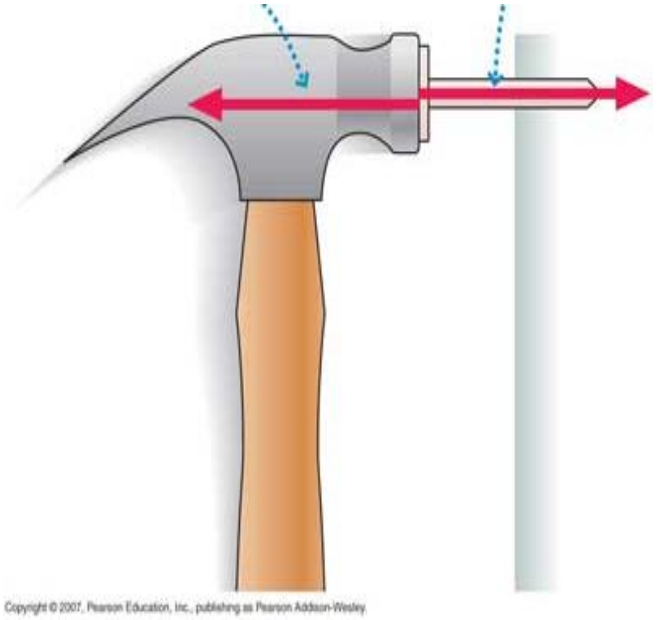
People often get confused between action-reaction forces and balanced forces.

In both cases the sizes of the forces are equal and act in opposite directions, but:

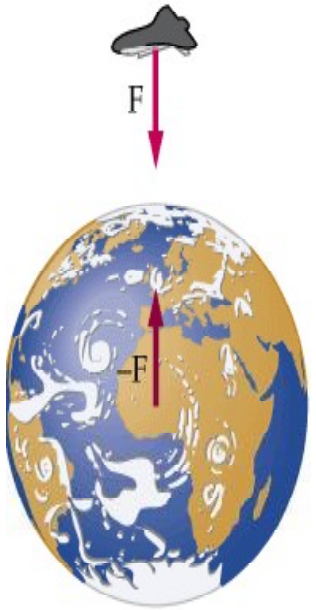
- action–reaction forces act *on different objects*
- balanced forces all act *on the same object*
- action–reaction forces are always *the same type of force*
- balanced forces are *not* always the same type of force.



1. A man pushes against a fridge freezer with a force of 500N. What is the reaction force?



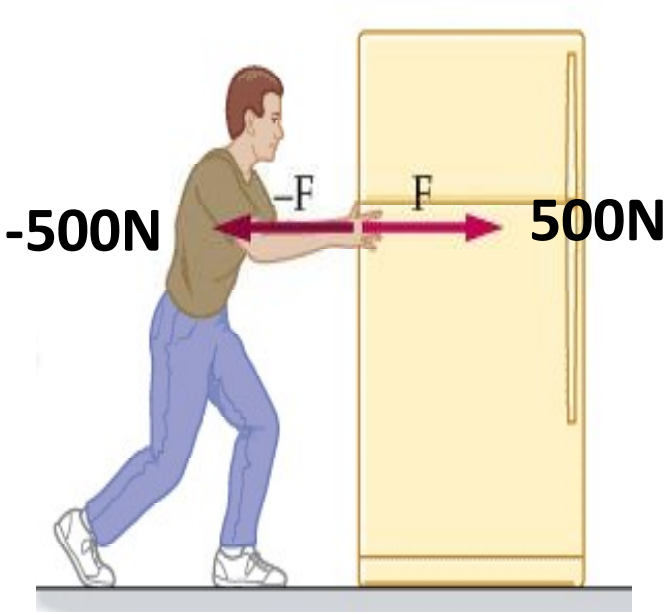
2. A person hits a nail with a force of 75N, the nail does not move. What is the reaction force?

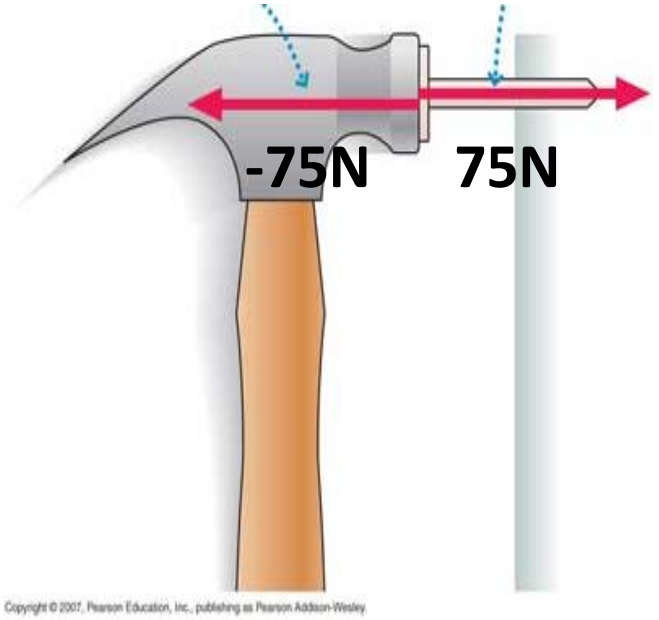


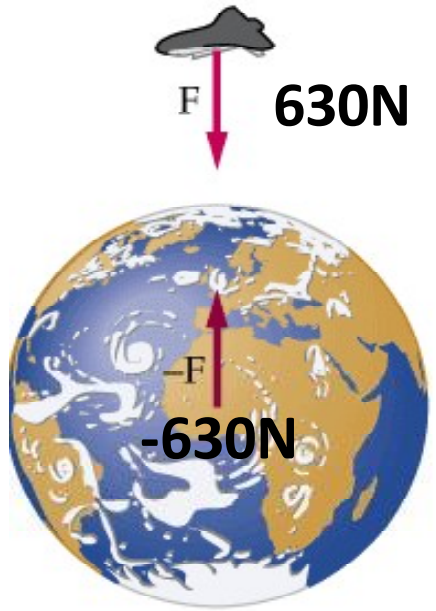
3. A woman stands on Earth with a force of 630N. What is the reaction force?

What would happen if I **increased** the force exerted in each of these examples?

What would happen if I **decreased** the force exerted in each of these examples?







- From what you have learnt so far, come up with a definition for Newton's 3rd Law.
  - **Every action has an equal and opposite reaction.**

Newton's 3rd Law of Motion

When body A exerts a force on body B, body B exerts an equal and opposite force on body A.

My third law says that if I push to the right I will move backwards as well.