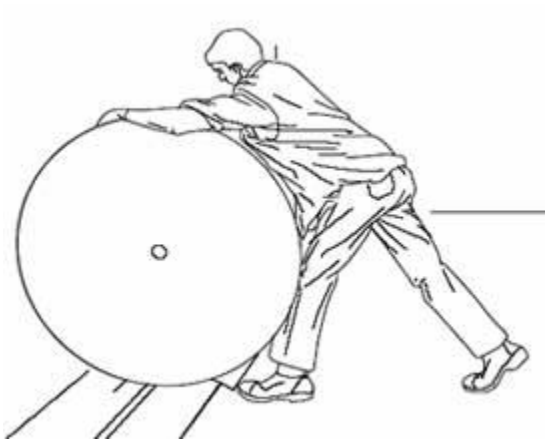
Autumn Term

ASKWITH C.P. SCHOOL

# FORCES

Class Four | Simon Heppenstall

If we need to move something, we have to either push or pull it. When we push or pull it, we are applying a force to it.



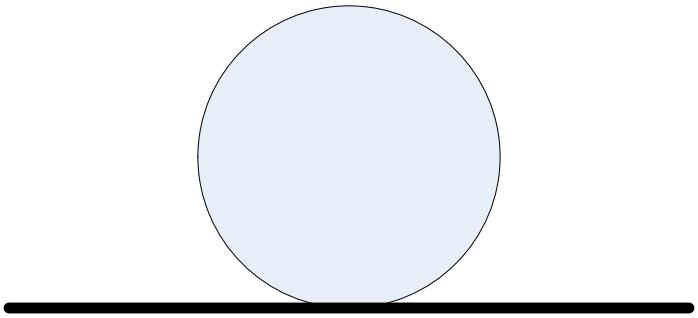
The man in the diagram is pulling the roll of paper. He is applying a force to the roll.

Forces are invisible. You cannot see them. You can see their effects on objects.

Even when the man is not pushing the paper, there is still force acting on it. The force of GRAVITY pulls everything towards the centre of the Earth.

This stops things from floating off into space. When we mark forces onto a diagram, we draw an arrow. We draw long arrows for big forces and small arrows for little forces.

In the diagram below, a ball is resting on the ground. Draw an arrow on the diagram showing the force of gravity.



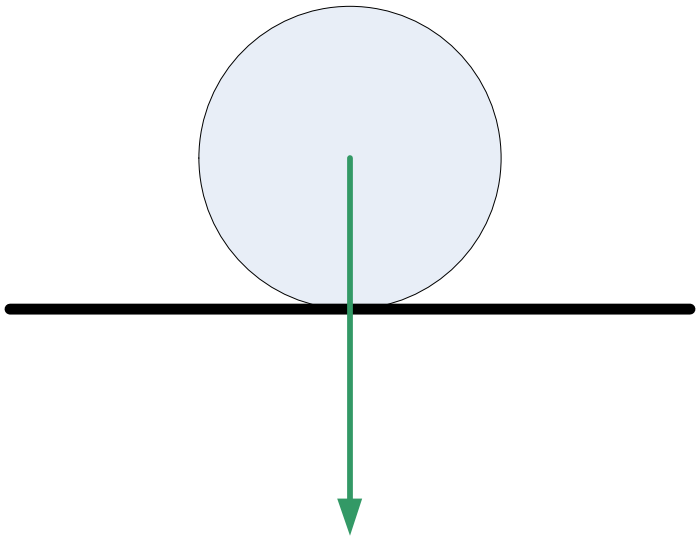
If we wanted to move the ball from its REST position, we would have to apply a force.

Rest is the word we use to say that something is perfectly still. It does not want to move. It is just happy to stay where it is.

Tom decides he wants to move the ball by kicking it. What type of force would that be? Would it be a push or a pull?

Draw a diagram to show the forces acting on the ball when Tom kicks it.

If the forces acting on an object are keeping the object in one position then we say they are BALANCED. Balanced forces mean that there is no overall push or pull, one way or the other.



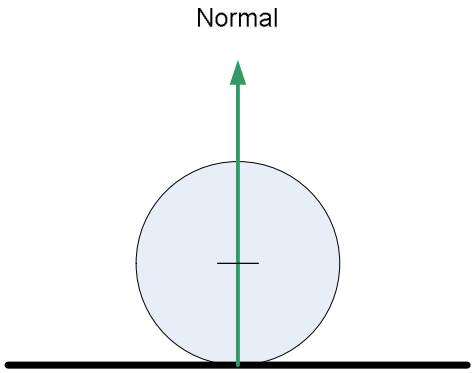
Gravity

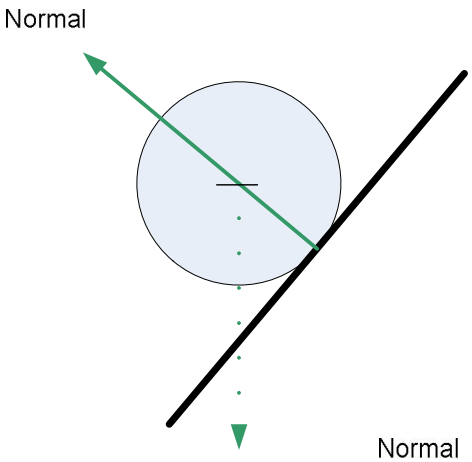
Look at the diagram above. It shows that Gravity is pulling the ball towards the centre of the Earth. Why isn't the ball falling to the centre of the Earth?

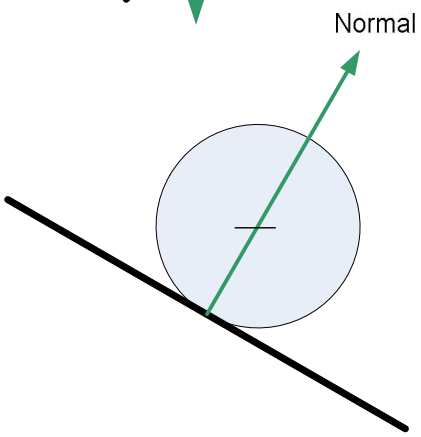
The reason is that the floor is stopping the ball from moving. The way it does that is by pushing the ball upwards. We call this force, the NORMAL.

The Normal acts from where two surfaces touch. It is perpendicular to the surface upon which the ball is resting.

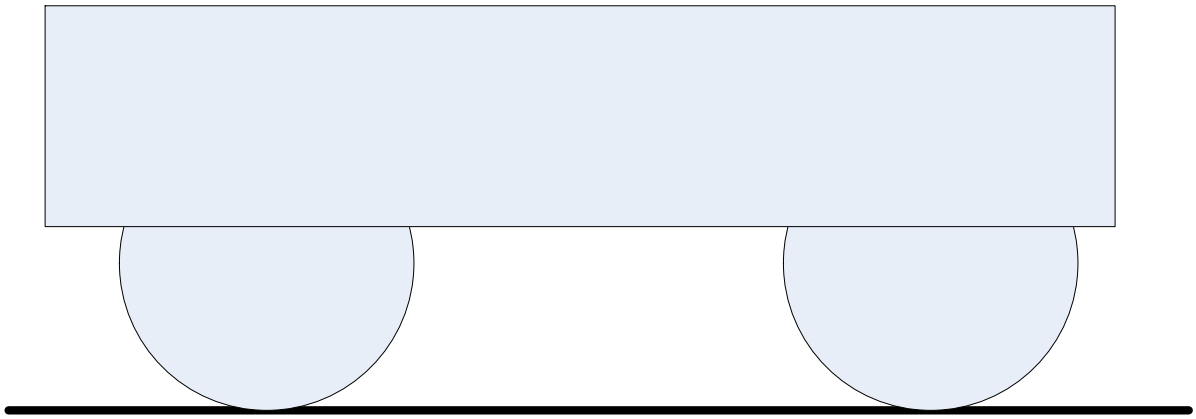
The Normal is marked on each of these diagrams. Mark on the force of Gravity. The ball is rolling down a slope on some of the diagrams.



Mark the force of Gravity and the Normal onto this picture of a railway wagon. You need to mark Gravity once and the Normal twice.



Gravity acts from a point in every object called the CENTRE OF GRAVITY. This is the point inside an object where gravity can be said to be acting.

Balance across your finger. To get the ruler to balance, your finger must be directly under the centre of gravity.

Your finger provides the Normal force which is pushing the ruler upwards. This balances out the gravity. If you move the ruler to one side, the gravity still pulls

the ruler down from the same position, but this time, your finger is not there to provide the normal. Instead, the normal is at some other point along the ruler. Have a go and watch what happens.

Draw a diagram of the forces when the ruler is balanced.

Draw a diagram of the forces when the ruler falls.

Balanced forces are when they keep things as they are. Unbalanced forces are when they force something to move.

The Ancient Chinese people found that some rocks had strange effects and they worked out that they could use these effects to find their way.

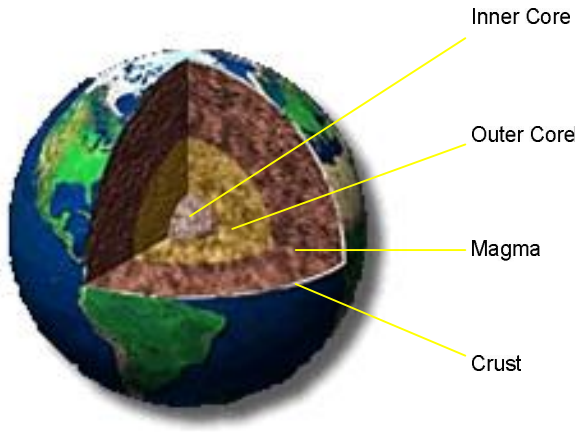
Nowadays, we know that this effect is called MAGNETISM and it is a force that affects three different materials.

These materials are Iron, Cobalt and Nickel. These materials can be attracted and repelled by each other. Their alloys, such as steel, are also affected by this phenomenon.

An alloy is a metal made of two or more elements (eg Steel = Iron + Carbon). Attracted means pulled together. Repelled means pushed apart.

The magnets can be used to find the North Pole. We use this to help us to find out where we are going. It helps us to put maps the right way round.

The Earth can sometimes be thought of as a huge magnet. The magnetic field around the Earth is a result of the currents of molten magma moving around inside the Earth.




If we dangle a magnet by a piece of nylon thread, the magnet should align itself with the Earth's magnetic field.

A magnet has an invisible field around it. This field is where the magnet will affect objects placed near it. As you move further away from the magnet, the strength of the field becomes weaker.

The magnetic field is invisible. You can see how it affects other objects though.

If you place a light iron or steel object on a table and gradually move your magnet towards it, you will see the object move.

If you have two magnets, you can make them attract each other and repel each other. Have a go. How do you affect whether the magnets attract or repel?

Draw a diagram below showing two magnets…

…attracting

…and repelling

Magnets are polar materials. That means they have a North and a South Pole.

When you push two magnets together, the North and the South poles attract each other. Opposites attract.

When you push two magnets together, North and North repel each other or push each other away. Like poles repel.

Draw a diagram to show this effect.

Buoyancy is a force that pushes up on objects when they are surrounded by a fluid. A fluid is a gas or a liquid.

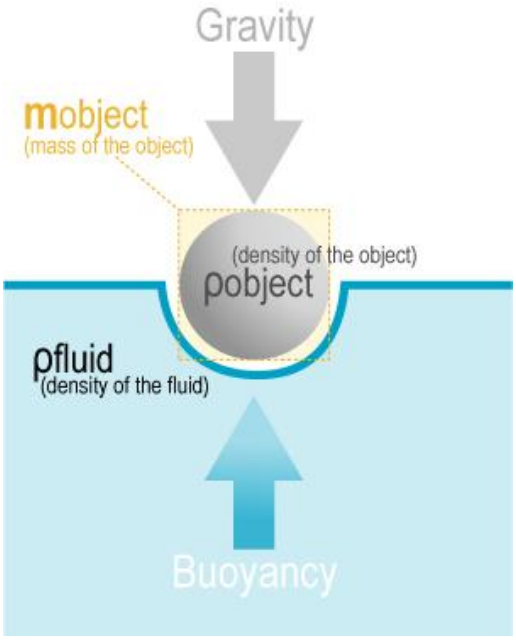
Archimedes was sitting in the bath when he realised that some things floated and some things sank. He thought about it and reasoned that there must be some force pushing up on the objects that floated.

Even the objects that sink appear less heavy.

We call this force, buoyancy. Although it is more noticeable in liquids, buoyancy is also acting in gases, such as those which form the air.

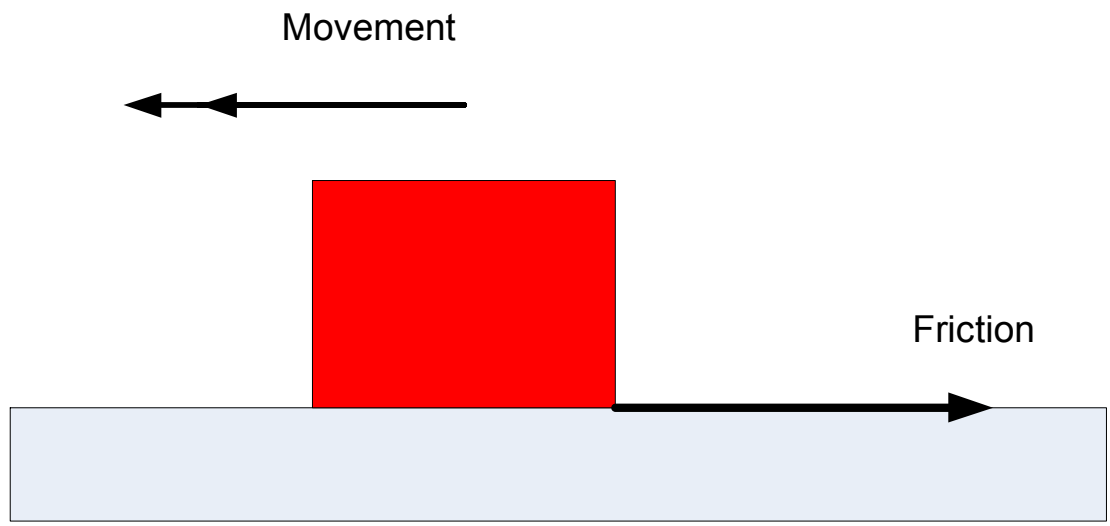
Buoyancy accounts for objects reaching a terminal velocity when they are falling. If it wasn't for buoyancy, the objects would just continue to increase in speed because of gravity.

Objects that float have a greater force of buoyancy than that of gravity acting upon them.



Friction is a force that is caused when two objects rub together. Some people think that it is caused by the roughness of the objects, but actually, it is better to think of friction as a "sticky force," a little bit like sticky tape.

Friction always opposes motion. If something is moving in one direction, friction will try to slow it down.




Friction is very useful, for without it, we would not be able to move. We would constantly slide about. Ice has very low friction. That is why people fall on it.

Rubber has a high friction and so we use it when grip is essential, such as on the soles of shoes and boots and on the wheels of cars.

Sometimes, we try to get rid of friction. Skin friction on aircraft is when the air runs along the body of the aircraft. Skin friction is reduced by countersinking rivets and by polishing the surface of the aircraft.

In engines, we reduce friction by adding a LUBRICANT such as oil. This gets between solid surfaces that would otherwise have lots of friction and lubricates them (or makes it so that one surface can easily glide over the other).

One place where we have to have friction is when we are climbing a ladder. If there was no friction, the ladder would slide down and away from the wall and anyone up the ladder would get hurt.

It is important to remember that friction always tries to slow things down. When we have too much friction, we can try to reduce it by lubricating two surfaces with a liquid such as oil.

Why do we use rubber on the soles of our shoes?

What property of ice makes it very slippery?

Think of two further examples where friction is an important force and explain why it is.

Draw a picture of a car and show friction as the car moves forward.

There are various scientists that did a lot of work on forces.

**Archimedes** was a mathematician in the time of the Ancient Greeks and Romans. He invented many things, including Archimedes Screw, but is most famous for working out Archimedes' Principle.

**Galileo Galilei** discovered that objects fell to the floor at the same rate, no matter what their size.

**Sir Isaac Newton** combined the work of Kepler and Galileo to come up with his laws of motion and discover gravity.

**Robert Hook** examined how forces affected springs.

**Hans Christian Ørsted** discovered magnetic fields.

**Michael Faraday** looked at the relationship between electricity and magnetism.

Using either books or the Internet, find out about **Johannes Kepler**.