Key points to learn

Forces	Are pushes or pulls
Newton meter	What you measure force with in newtons (N)
Interaction pair	Forces always exist as pairs and are produced when objects interact
Effect of forces	Forces can deform, compress or stretch objects or change their speed or direction of motion
Contact forces	Occur when objects are touching. Examples are friction, air resistance and water resistance
Friction	Can be reduced by lubrication
Drag forces	Water and air resistance are examples of drag forces. Drag forces can be used to slow down objects such as parachutes
Stream-lining	Air resistance and water resistance can be reduced by streamlining
Non-contact forces	Occur when objects are not touching. Examples are gravitational, electrostatic and magnetic forces

Key points to learn

Support surfaces	Solid surfaces provide a support force when objects are compressed
Springs and ropes	Extend when you apply a force
Hooke's Law	(For some objects) if you double the force the extension doubles
Field	A region where something feels a force, for example, a mass in a gravitational field
Mass	The amount of stuff an object is made up of, measured in kilograms
Weight	Is the force of the earth on an object
Balanced Forces	When forces acting on an object are equal in size and acting in opposite directions, they are balanced. The object is in equilibrium.
Unbalanced forces	If the forces acting on an object are not in balance, the object will speed up, slow down or change direction

KS3: P1.1 Forces Knowledge Organiser

Content

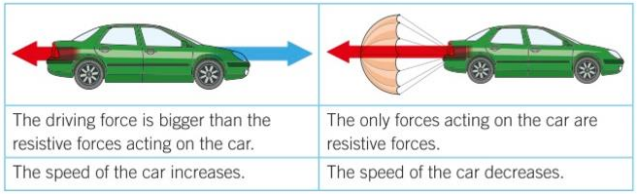
Physics

- 1.1 Forces
- 1.2 Sound
- 1.3 Light
- 1.4 Space
- 2.1 Electricity and magnetism
- 2.2 Energy
- 2.3 Motion and pressure

Foul fact!

Astronauts on the International Space Station cannot burp. The gas and liquid does not separate in their stomachs while they are in orbit.

Additional Information



The driving force is bigger than the resistive forces acting on the car.	The only forces acting on the car are resistive forces.
The speed of the car increases.	The speed of the car decreases.

P1 Checklist

Chapter 1

Activate

Lesson	Developing	Secure	Extending
P1 1.1 Introduction to forces	I can identify some forces acting on objects in everyday situations. ☐	I can explain what forces do. ☐	I can explain the difference between contact and non-contact forces. ☐
	I can identify an interaction pair. ☐	I can describe what is meant by an interaction pair. ☐	I can explain which pairs of forces are acting on an object. ☐
P1 1.2 Squashing and stretching	I can state an example of a force deforming an object. ☐	I can describe how forces deform objects. ☐	I can explain how forces deform objects in a range of situations. ☐
	I can recognise a support force. ☐	I can explain how solid surfaces provide a support forces. ☐	I can explain how solid surfaces provide a support force, using scientific terminology and bonding. ☐
	I can use Hooke's Law to identify proportional stretching. ☐	I can use Hooke's Law to predict the extension of a spring. ☐	I can apply Hooke's Law to make quantitative predictions with unfamiliar materials. ☐
P1 1.3 Drag forces and friction	I can identify examples of drag forces and friction. ☐	I can describe the effect of drag forces and friction. ☐	I can explain the effect of drag forces and friction in terms of forces. ☐
	I can describe how drag forces and friction arise. ☐	I can explain why drag forces and friction arise. ☐	I can explain why drag forces and friction slow things down in terms of forces. ☐
P1 1.4 Forces at a distance	I can identify gravity as a force that acts at a distance. ☐	I can describe the effect of a field. ☐	I can apply the effects of forces at a distance to different fields. ☐
	I can state that gravity changes with distance. ☐	I can describe the effect of gravitational forces on Earth and in space. ☐	I can explain how the effect of gravity changes moving away from Earth. ☐

Checklist

Chapter 1

Lesson	Developing	Secure	Extending
P1 1.5 Balanced and unbalanced	I can identify familiar situations of balanced and unbalanced forces. ☐	I can describe the difference between balanced and unbalanced forces. ☐	I can explain the difference between balances and unbalances forces. ☐
	I can define equilibrium. ☐	I can describe situations that are in equilibrium. ☐	I can describe a range of situations that are in equilibrium. ☐
	I can identify when the speed or direction of motion of an object changes. ☐	I can explain why the speed or direction of motion of objects can change. ☐	I can explain why the speed or direction of motion of objects can change using force arrows. ☐

Glossary
Chapter 1

Key word	Definition
air resistance	The force on an object moving through the air that causes it to slow down (also known as drag).
balanced	Forces acting on an object that are the same size but act in opposite directions.
compress	To squash into a smaller space.
contact force	A force that acts when an object is in contact with a surface, air, or water.
deform	To change shape.
drag force	The force acting on an object moving through air or water that causes it to slow down.
driving force	The force that is pushing or pulling something.
elastic limit	The point beyond which a spring will not return to its original length when the force is removed.
electrostatic force	The force acting between two charged objects.
equilibrium	Balanced.
extension	The amount by which an object gets longer when a force is applied.
field	A region where something feels a force.
friction	The force that resists movement because of contact between surfaces.
gravity	A non-contact force that acts between two masses.
Hooke's Law	The law that says that if you double the force on an object the extension will double.
interaction pair	When two objects interact there is a force on each one that is the same size but in opposing directions.
kilogram (kg)	A unit of mass, symbol kg.
lubrication	A substance that reduces friction between surfaces when they rub together.
magnetic force	The force between two magnets, or a magnet and a magnetic material.
mass	The amount of matter (stuff) a thing is made up of.
newton (N)	The unit of force, symbol N.

Glossary
Chapter 1

newtonmeter	A piece of equipment used to measure weight in newtons.
non-contact force	A magnetic, electrostatic, or gravitational force that acts between objects not in contact.
pull	A type of force.
push	A type of force.
reaction	The support force provided by a solid surface like a floor.
resistive forces	Any forces that act to slow down a moving object.
streamlined	Shaped to reduce resistance to motion from air or water.
tension	A stretching force.
unbalanced	Opposing forces on an object that are unequal.
water resistance	The force on an object moving through water that causes it to slow down (also known as drag).
weight	The force of the Earth on an object due to its mass.

Balanced and unbalanced

What are balanced forces?

When the forces acting on an object are the same size but in opposite directions we say that they are **balanced**. You can think of balanced forces like two teams in a tug of war. If each team pulls with the same force the rope doesn't move. The forces cancel out. The object is in **equilibrium**. All stationary objects are in equilibrium. There must be a support force acting on them to balance out their weight.

Quick question

State what equilibrium means.

What are unbalanced forces?

The forces acting on this rocket-powered car are **unbalanced**. They are not the same size so they do not cancel out. The **driving force** from the engine is much, much bigger than the **resistive forces** from air resistance and friction.

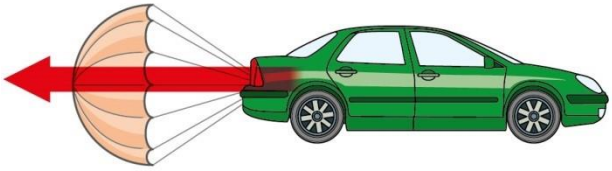
Quick question

State the difference between balanced forces and unbalanced forces.

How do unbalanced forces change speed and direction?

When the car's rocket-powered engine starts up the driving force will become very big very quickly. When the driver wants to stop he will fire a parachute to slow the car down. In both cases the forces on the car are unbalanced.

The driving force is bigger than the resistive forces acting on the car. The speed of the car increases.



The only forces acting on the car are resistive forces. The speed of the car decreases.

Every time you go around a corner in a car the friction between the tyres and the road changes the direction of the car.

Introduction to forces

A force can be a push or a pull.

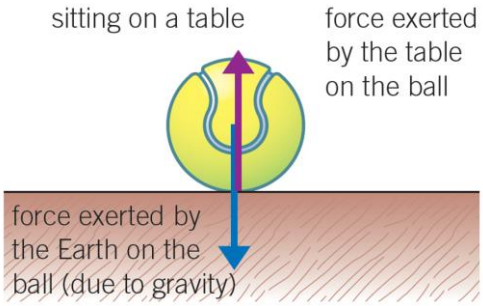
Forces explain why objects move in the way that they do, or why they don't move at all. Forces can change the direction that objects are moving in, and change their shape.

Force diagrams

You can't see forces but you can see the effect of them.

When you draw a diagram you add arrows to the show forces that are acting. Force arrows show the direction and the size of the force.

Forces act on objects so the arrow must touch the object in the diagram.



Quick question

Draw a force diagram to show the forces acting on an object sitting on a table.

Interaction pairs

Forces always come in pairs. The pairs are called **interaction pairs**.

In the diagram of the tennis ball sitting on the table:

- Gravity pulls the tennis ball down. This is the force of the Earth on the tennis ball.
- The tennis ball pulls the Earth up. This is the force of the tennis ball on the Earth.

How do you measure forces?

You can measure force with a newtonmeter). All forces are measured in newtons (N).

Quick question

Give the unit of force.

Non-contact forces

Acting at a distance

A gravitational force acts on a diver jumping off a diving board. It is a **non-contact force**. There are other types of non-contact force. Magnets exert a **magnetic force** on magnetic materials or other magnets without touching them. If you rub a balloon you can pick up bits of paper with it. This is an electric or **electrostatic force**. Magnetic and electrostatic forces are non-contact forces.

Quick question

Identify three forces that act at a distance.

Force fields

In physics a **field** is a special region where something experiences a force. There is a magnetic field around a magnet where magnetic materials experience a force. There are gravitational fields where things with mass experience a force. The further away from the mass, magnet, or charge, the field gets weaker. **Contact forces** only act when the objects are touching each other. Non-contact forces act at any distance, even if the objects are not touching.

Weight and mass

Weight is a force so it is measured in newtons (N). **Mass** is the amount of 'stuff' something is made up of and it is measure in kilograms (kg) You can calculate weight using an equation:

weight (N) = mass (kg) x **gravitational field strength**, *g* (N/kg)

On Earth gravitational field strength is about 10 N/kg. This means that, if your mass is 50 kg, for example, then your weight on Earth is:

weight = 50 kg × 10 N/kg = 500 N

Gravitational field strength is different on other planets and stars. Your weight would be different on different planets because *g* would be different but your mass would remain the same.

Quick question

State the unit of mass and the unit of weight.

Types of forces

Changing shape

When a ball hits the floor the ball **deforms**. Forces can **compress** (squash) or **stretch** objects. When you exert a force you can deform an object. You can compress it or you can stretch it.

Quick question

Describe what happens to a tennis ball when it hits the ground

How can the floor push you up?

The floor is a solid; solids are made up of particles arranged in a regular pattern. The particles are joined strongly together by bonds. When you stand on the floor your weight pushes the particles together. The bonds are then compressed and push back. This 'push back' supports you.

Stretching

Bungee cords, springs, and even lift cables all stretch when you exert a force on them. The amount that they stretch is called the **extension**.

Springs are special. If you *double* the force on the spring the extension will *double*. If the extension doubles when you double the force then the object obeys **Hooke's Law**. The graph of force against extension is a straight line, or **linear**. Hooke's Law is a special case. Not everything behaves like a spring when you stretch it. If you double the force on an elastic band the extension may not double.

Quick question

State Hooke's Law.

What is friction?

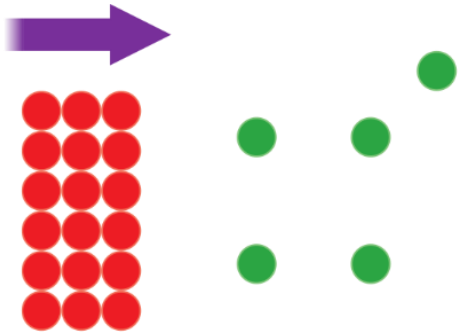
When a book is resting on the table you can push on it but it may not move. **Friction** grips objects. As you increase the force by pushing harder the book will start to move. If you remove the force the book slows down and stops. This is because the rough surfaces can no longer move past each other.

Quick question

State two things that friction does.

What are drag forces?

A dolphin swimming through the water and a surfer paddling through water will both experience **water resistance**. As a snowboarder jumps through the air he will experience **air resistance**. Water resistance and air resistance are **drag forces**. To understand drag forces you need to think about the particles in the air and the water.



A solid moves through a gas.

A solid moves through a liquid.

As a dolphin moves through the water it pushes the water particles out of the way. This produces a drag force, which slows it down.

Quick question

Name the drag force acting on an aeroplane in flight.