

1.1 Introduction to forces

After this topic, you will be able to:

- use force arrows to explain what forces do
- compare different types of force
- describe how to measure forces and give the unit of force.

Think back

- 1 What **two** things can a force be?
- 2 Name a force that needs contact.
- 3 Name a force that does not need contact.

Key idea

A force can be a push or a pull. There are different types of force. Some forces are contact forces and others are non-contact forces. We can only see the effect of forces.



▲ **Figure 1** This rocket took the Perseverance rover to Mars.

You may think you have nothing in common with a rocket, but both you and a rocket are affected by forces. Forces act on all objects, no matter how big or small they are.

What do forces do?

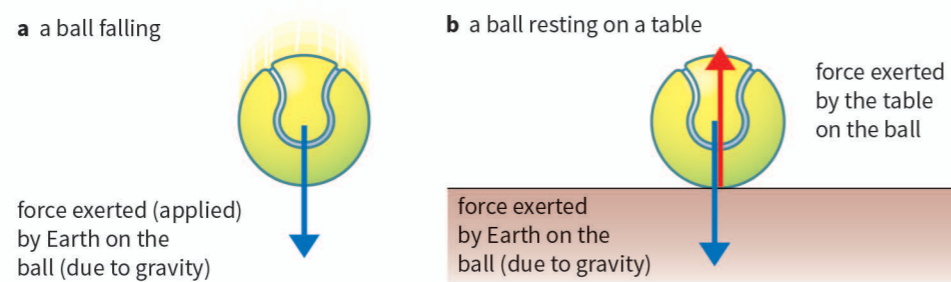
The rocket in Figure 1 is going to Mars. It moves away from the surface of Earth very quickly. There is a force pushing the rocket up and a force pulling it down. A force can be a **push** or a **pull**.

Forces explain why objects move the way they do, or why they do not move — but that is not all. Forces can also change the direction that an object is moving in, or change its shape.

How do you describe forces?

You cannot see forces. However, you can see the effects they have on objects. When you draw a diagram, you can add arrows to show the forces that are acting.

You do this using ‘force arrows’. These show the direction and the size of the force. Forces act on objects. Therefore, the arrow must touch the object in the diagram, like in Figure 2.



▲ **Figure 2** The force arrows show the forces acting on a tennis ball.

- A** Draw a force diagram of you sitting on a table. Label the force arrows.

What are the different types of force?

Some forces act when you are touching something. These are called **contact forces**. **Friction** and **air resistance** are contact forces. Support forces, like upthrust (a force that pushes up), are also contact forces.

The force of **gravity** acts on a tennis ball travelling through the air. Earth pulls the ball down even though it is not touching it. Gravity is a **non-contact force**. The force between magnets is another non-contact force.

- B** Name **two** contact forces acting on you when you are swimming.

What is an interaction pair?

Forces always come in pairs, called **interaction pairs**. In Figure 3:

- Gravity pulls the child down. This is the force of *Earth* on the *child*.
- The child pulls Earth up. This is the force of the *child* on *Earth*.

There is another interaction pair of forces acting on the child.

- The bar supports the child. This is the force of the *bar* on the *child*.
- The child pulls on the bar. This is the force of the *child* on the *bar*.

- C** During the launch (takeoff) of a rocket, Earth exerts (applies) a force on it. Describe the other force in this interaction pair.

How do you measure forces?

You can measure force with a **newton meter** (sometimes called a spring balance). You can see a newton meter in Figure 4. All forces are measured in **newtons (N)**.



▲ **Figure 4** A student is pulling the block with a force of 5 N.

Key words

push, pull, contact force, friction, air resistance, gravity, non-contact force, interaction pair, newton meter, newton (N)



▲ **Figure 3** Forces are acting on the child hanging from the bar.

Summary questions

- 1** Copy and complete the sentences.

You can sort forces into contact and _____ - _____ forces. We can show the forces acting on an object using a force _____. Forces come in pairs, called _____ pairs. Force is measured in _____.

- 2** Describe the forces in **one** of the interaction pairs acting on an apple hanging from the branch of a tree.

Stretch zone

- 3** You are probably sitting on a chair as you read this.

Explain why the two forces that are acting on you are *not* in the same interaction pair.