1.1 Introduction to forces

Learning objectives

After this topic you will be able to:

- explain what forces do
- describe what is meant by an interaction pair.

What does a rocket have in common with you? There are forces acting on you and on the rocket.

▲ This rocket took a rover to Mars.

What do forces do?

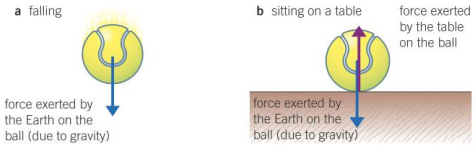
A rocket going to Mars moves away from the surface of the Earth very quickly. There is a force pushing the rocket up and forces pulling it down. A force can be a **push** or a **pull**.

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

A List three things that forces do.

Describing forces

You can't see forces but you can see the effect of them. When you draw a diagram you add arrows to show the 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.



▲ These force arrows show the forces acting on a tennis ball.

Different types of force

Some forces act when you are touching something. This is a **contact force**. **Friction** and **air resistance** are contact forces. Support forces, like upthrust, are also contact forces.

The force of **gravity** acts on a tennis ball travelling through the air. The 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 Describe the difference between a contact force and a non-contact force.

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.

Pairing up

A girl and her sister are hanging from a bar in a playground. Think about the forces acting on the girls.

▲ Forces act on the girls hanging from a bar.

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

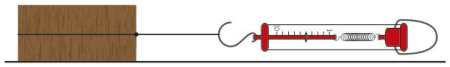
Forces always come in pairs. The pairs are called **interaction pairs**.

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

- The bar supports the girls. *This is the force of the bar on the girls.*
- The girls pull on the bar. *This is the force of the girls on the bar.*

How do you measure forces?

You can measure force with a **newtonmeter** (sometimes called a spring balance). All forces are measured in **newtons** (N).



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

C State the unit of force.

Newton predicts...

In the 1600s, Isaac Newton first explained how gravity affects objects. Scientists later used his ideas to predict that there was a planet beyond Uranus. In 1846 they discovered Neptune. A good explanation means that you can make predictions and test them.

▲ Upthrust supports you when you float.

Link

You can learn more about non-contact forces in P1 1.4 Forces at a distance

Key Words

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

Summary Questions

1 Copy and complete the sentences below.

A force is a _____ or a _____. We can show the forces acting on an object using force _____. Forces come in pairs, called _____ pairs. To measure forces you use a _____.

(5 marks)

2 Describe one of the interaction pairs for an apple hanging from the branch of a tree.

(2 marks)

3 You are probably sitting on a chair as you read this book. Explain in detail why the two forces acting on you are not two forces in the same interaction pair.

(6 marks)