

1.5 Balanced and unbalanced

P1 Chapter 1: Forces

Learning objectives

After this topic you will be able to:

- describe the difference between balanced and unbalanced forces
- describe situations that are in equilibrium
- explain why the speed or direction of motion of objects can change.



▲ When the teams pull with the same force the forces are balanced.

Equal and opposite...?

Isaac Newton said, 'For every action there is an equal and opposite reaction'. The forces in an interaction pair are equal and opposite. Is lying in bed an example of this law? No, it is not. Each of the forces acting on you comes from a *different* interaction pair.



Key Words

balanced, equilibrium, unbalanced, driving force, resistive force

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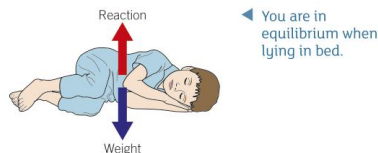
To get out of bed in the morning you need a force to get you moving.

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**.

A State what equilibrium means.

All stationary objects are in equilibrium. There has to be a support force acting on them to balance out their weight.



B Draw a diagram showing the forces acting on a stationary mass hanging on a spring.

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.



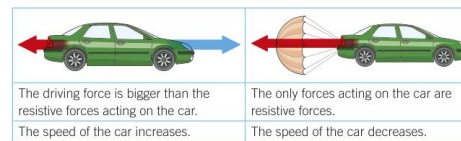
▲ The Thrust SSC was the first car to travel faster than sound.

C State the difference between balanced forces and unbalanced forces.

How do unbalanced forces change speed?

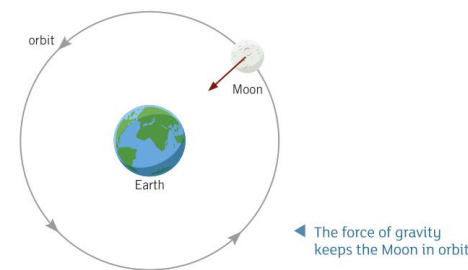
When the car's rocket-powered engine starts up the driving force will become very big very quickly. When the driver wants to stop he will fire a parachute to slow the car down. In both cases the forces on the car are unbalanced.

The driver uses a parachute because this gives a much bigger resistive force on the car than just using the brakes. The speed of the car will change much more quickly. The car will stop in a much shorter time.



How do unbalanced forces change direction?

Isaac Newton worked out that the Earth exerts a force on the Moon. The force of gravity acting on the Moon keeps the Moon in orbit around the Earth. It is this same force that acts on an apple and pulls it to the ground. It changes the *direction* of motion, not the speed.



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

Link

You can learn more about speed in P2 3.1 Speed



▲ Friction changes the direction of a motorbike.

Summary Questions

- 1 Copy and complete the sentences below.
If the forces on an object are the same _____ but act in _____ directions they are balanced. This is called _____. The forces acting on any stationary object are _____. If the forces on an object are unbalanced the _____ will change. If the _____ force is bigger than the _____ force it speeds up. If the _____ force is bigger than the _____ force it slows down. (9 marks)
- 2 A cyclist is slowing down as she is cycling along a road.
a Draw a diagram to show the forces acting on the cyclist. (1 mark)
b Label the forces using the words 'resistive' and 'driving'. (1 mark)
c Explain why her speed is decreasing. (1 mark)
- 3 Design a new ride for a theme park. Describe and explain the motion of people who go on the ride using the ideas on this page. (6 marks)

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