

## 1 Wave power

**Start here**

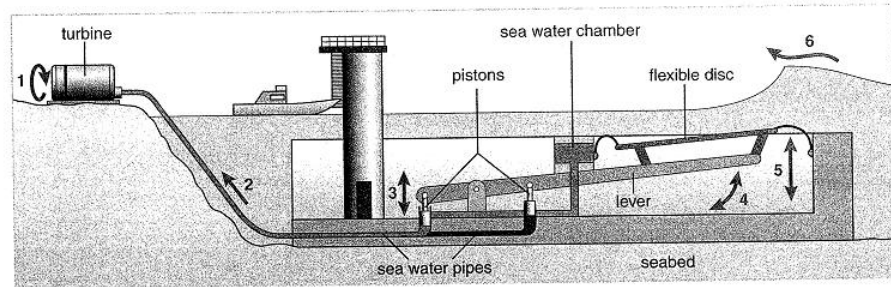
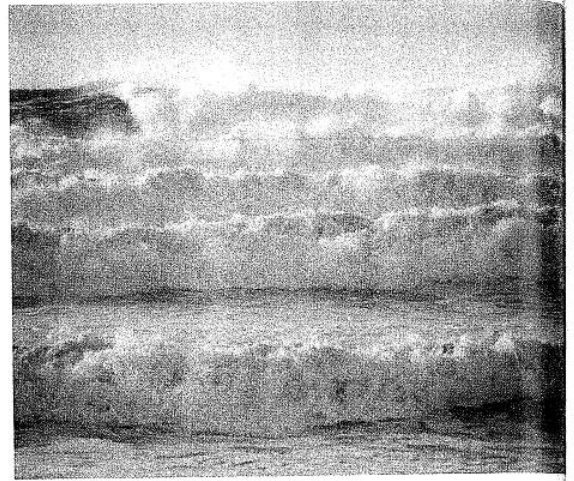
- 1** Brainstorm in small groups. Make notes or draw simple diagrams.

*How can the energy of sea waves be converted into electrical power?*

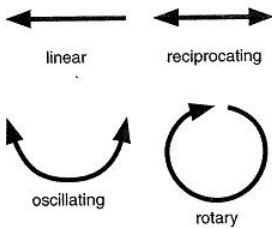
**Task**

- 2** Study this diagram. It shows one method of converting wave energy into electrical power. With your group

- decide how it works
- explain your group's ideas to the rest of the class

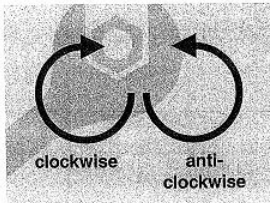


**Vocabulary**



- 3** Complete this text with the correct motion words.

There are four basic motions. First, there is (1) \_\_\_\_\_ motion. This is movement in a straight line, and in one direction. Secondly, there is (2) \_\_\_\_\_ motion, which is two-way movement backwards and forwards or up and down (like a piston) in a straight line. The third type is (3) \_\_\_\_\_ motion, which swings from side to side (like a pendulum). Finally, there is (4) \_\_\_\_\_ motion, which is motion in a circular direction, like the shaft of a wind turbine.



- 4** Match the numbered arrows in the diagram in 2 with the motion words in 3.



- 5** Complete these sentences. Use the present simple of the verbs in the box.

- 1 Propeller shafts \_\_\_\_\_.
- 2 A car engine piston \_\_\_\_\_.
- 3 Pendulums \_\_\_\_\_.
- 4 When you tighten a screw, it \_\_\_\_\_ clockwise.

oscillate   reciprocate  
rotate

**Scanning 6** Practise your speed reading. Look for the information you need on the SPEED SEARCH pages (118–119). Try to be the first to complete the task.

Task: Find out five advantages (or benefits) of the wave energy converter.

**Listening 7**   Listen to this presentation about the Wave Energy Converter, and complete the listener's notes.

### WAVE ENERGY CONVERTER

DEFINITION: system for converting (1) \_\_\_\_\_ from sea waves into electrical power

LOCATION: fixed to the (2) \_\_\_\_\_

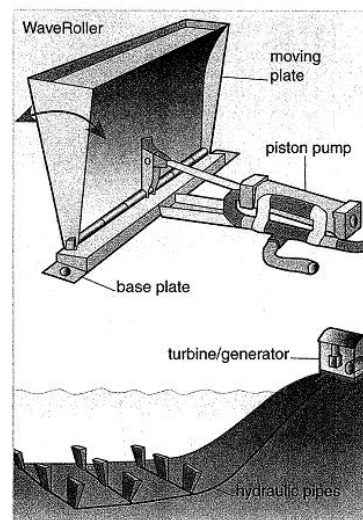
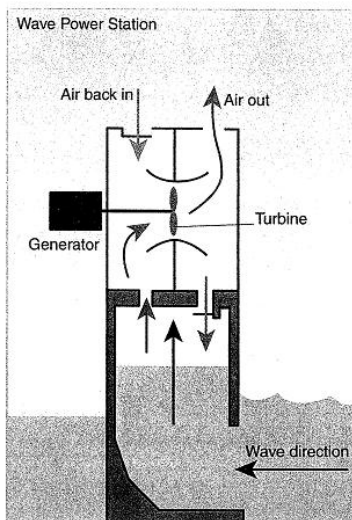
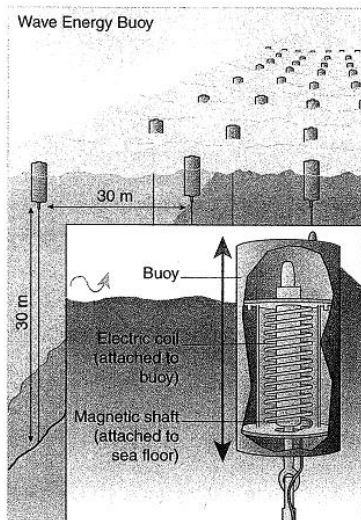
MAIN COMPONENTS: a flexible disc, a lever, a (3) \_\_\_\_\_ which takes in sea water, a set of (4) \_\_\_\_\_, many sea water pipes, a (5) \_\_\_\_\_ on the land

MAIN SPECIFICATIONS: 4.6 m (H) x (6) \_\_\_\_\_ m (L); pipe (7) \_\_\_\_\_ mm (W); pressure (8) \_\_\_\_\_ kPa (1000 psi); can generate (9) \_\_\_\_\_ kW of electricity

OPERATION: wave oscillates → pushes disc (10) \_\_\_\_\_ → lever oscillates → reciprocating pumps push water through pipe at (11) \_\_\_\_\_ pressure → turbine (12) \_\_\_\_\_ → generates electricity

BENEFITS: Wave energy is a (13) \_\_\_\_\_ energy resource; uses no fossil fuels

**Task 8** Work in small groups. Find out about one of these wave energy systems. Prepare a presentation about your system.



Group 1. Turn to page 112 for your notes about the *Wave Energy Buoy*. (1)  
 Group 2. Turn to page 114 for your notes about the *Wave Power Station*. (2)  
 Group 3. Turn to page 116 for your notes about the *WaveRoller*. (3)

**9** With your group, give a presentation about your system to the class. Answer questions from the class.

**Writing 10** Write a description of your group's system, explaining how it works.

## 2 Engines

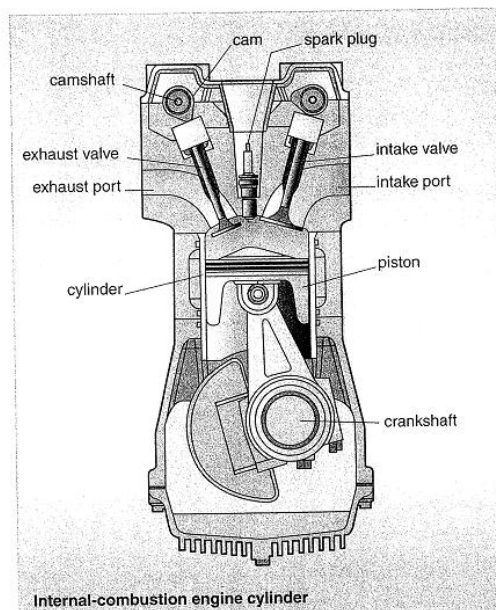
**Start here** 1 Work with a partner or in small groups. Draw arrows to show all the movements in this diagram of an internal-combustion engine cylinder.

2 Describe the motion of all the moving parts in the diagram. Use the words in the box.

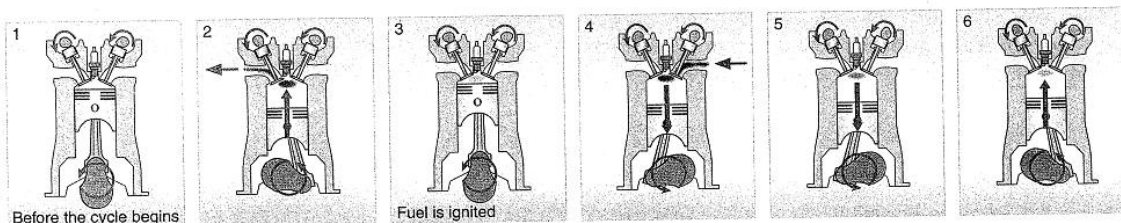
linear oscillating reciprocating  
rotary

3 Explain what causes the movements of

- the valves
- the piston
- the crankshaft



**Task** 4 With your partner or group, number these diagrams in the correct order.



**Reading** 5 Read this description of the four-stroke cycle. Check your answers to 4.

### The four-stroke internal combustion cycle

**BEFORE THE CYCLE BEGINS.** The cycle begins at *top dead centre* (TDC). Here the piston is furthest away from the crankshaft. There are four *strokes* of the piston.

**INTAKE STROKE.** The crankshaft rotates. This makes the piston move down the cylinder, away from the valves. At the same time, the cam above the intake valve rotates. This makes the valve move downwards, which opens the intake port. As the piston moves down, fuel is sucked into the cylinder through this inlet.

**COMPRESSION STROKE.** As the crankshaft rotates, it makes the piston move up the chamber towards the valves. Simultaneously, the cam above the intake valve rotates and allows it to close. Both valves are now closed. As the piston moves up towards the valves, it compresses the fuel.

**IGNITION.** Now the piston is once again at TDC. The compressed fuel is ignited by the spark plug, and there is a small explosion at the top of the cylinder.

**POWER STROKE.** Immediately after this, the gases expand in the cylinder, which pushes the piston downwards. This makes the crankshaft rotate and provides torsion to drive the wheels of the vehicle.

**EXHAUST STROKE.** As the crankshaft rotates, it pushes the piston up the cylinder. At the same time, the cam above the exhaust valve pushes the valve downwards. This opens the exhaust port, and the burnt gases are pushed out.

The cycle is repeated thousands of times per minute.

6 What do these words refer to?

- 1 *which* (line 5) a) the valve b) the rotation of the cam  
c) the movement of the valve
- 2 *it* (line 7) a) the cam b) the intake valve c) the rotation of the cam
- 3 *this* (line 11) a) the small explosion b) the top of the cylinder
- 4 *which* (line 11) a) the cylinder b) the expansion of the gases
- 5 *This* (line 14) a) the cam b) the valve c) the movement of the valve

7 Find words in the text that mean the same as these phrases.

- 1 at the same time (one word)
- 2 twisting force (one word)
- 3 inlet which allows fuel to enter the cylinder (two words)
- 4 device which moves to allow gases to escape (two words)

Language

*When* often indicates that two actions happen in sequence, i.e. immediately after the other, e.g. *When the spark plug ignites, the gases explode.*

*As* often indicates that two actions happen simultaneously, i.e. both at the same time, e.g. *As the piston moves up, it compresses the fuel.*

*When* or *as* can sometimes be used with the same meaning when it's difficult to decide if two actions are simultaneous or in rapid sequence, e.g. *When/As the brake pedal is pressed, the piston pushes the oil along the brake pipe.*

8 Join each group of sentences into a single sentence. Use **when/as** and **which**. Do not use the words in italics.

- 1 The piston moves up. *At the same time*, the exhaust valve opens. This lets the burnt gases escape.
- 2 The spark plug ignites the fuel. *Immediately afterwards*, there is an explosion. This makes the piston move down with great force.
- 3 The camshaft rotates. *Simultaneously*, the cam pushes the intake valve downwards. This allows the fuel to enter the cylinder.
- 4 The piston moves away from the valves. *Immediately after this*, it creates a vacuum in the cylinder. This sucks the fuel in.
- 5 The piston moves up towards the valves. *Soon afterwards*, it puts the fuel under high pressure. This helps the gases to expand rapidly after ignition.
- 6 The cam pushes the exhaust valve down. *At the same time*, the piston moves up towards it. This forces the burnt gases out of the engine.

*Example: 1 As the piston moves up, the exhaust valve opens, which lets the burnt gases escape.*

- Writing 9 This is a diagram of an internal combustion engine that uses hydrogen as a fuel. Describe this engine and explain how it works. Explain the benefits of this kind of engine.

