

# Physics - an introduction

## Before you read

Discuss these questions with your partner.

- What does physics study?
- How old is the science of physics?
- Can you name any famous physicists?



## A Vocabulary

Choose the correct answer A, B or C.

- 1 Scientists use ..... to make measurements.
  - A calculations
  - B estimations
  - C equations
- 2 The molecules are in .....
  - A movement
  - B motion
  - C activity
- 3 A(n) ..... is a mathematical statement that shows two expressions are equal.
  - A estimation
  - B calculation
  - C equation
- 4 A machine is a mechanical .....
  - A gadget
  - B device
  - C appliance

## Reading 1

### Physics A short history

Ever since humankind first looked at the stars moving about the sky, they have wondered how and why they do that. People have always wondered why things behave the way they do. For thousands of years people have been asking questions like why things fall to the ground, not away from it. Why are some types of stone hard and others soft? Why does the Sun come up in the east and go down in the west? These are all questions that physics can answer.

In the beginning, people answered questions like these in philosophical or religious ways. In early descriptions of the world, philosophers such as Aristotle reported what they believed to be true, rather than what they saw to be true. Others, however, such as astronomers from India, Egypt and China, or the Greek thinker, Archimedes, were able to use calculations to predict the movements of the Sun and the Moon or to describe and build machines.

The works of Eastern scholars reached Europe in the 12th and 13th centuries. There were studies of planetary motion by Indian astronomers, the theories of light from Buddhist and Persian thinkers and especially the work of the Persian philosopher Nasir al-Din al-Tusi on the planetary system. Eventually, these ideas pushed Europe into a scientific revolution. Galileo laid the foundations for this with his work on dynamics: that is, how things move. Nicolas Copernicus and then Johannes Kepler described the solar system with the Sun at its centre. Later, building on their work, Isaac Newton set out his Laws of Motion and modern physics was born.

The next great area of investigation was electricity and in the 19th century, Michael Faraday first demonstrated an electromagnetic motor. Later, it was improved by James Clerk Maxwell, whose equations were also used to describe light. In proving Maxwell's equations, Heinrich Hertz discovered radio waves and Wilhelm von Röntgen, X-rays. Maxwell's work was also the starting point for Einstein's Theory of Relativity. At the same time, other scientists were working on thermodynamics: that is, the study of changes of heat in matter. Physicists such as Robert Boyle, James Prescott Joule and many others set out the theories that allow us today to make use of engines and other mechanical devices. Röntgen's discovery of X-rays and the work of Pierre and Marie Curie on radioactivity led to the development of the science of nuclear physics.

In the first half of the 20th century, developments in physics were concerned with the structure of atoms. The parts of the atom were identified – its nucleus, protons and electrons. Eventually in the 1940s, scientists in the USA were able to split a nucleus and the result was the world's first nuclear explosion. Also at that time, scientists such as Max Planck were looking at the relationship between matter and wave motion. The field of quantum mechanics, which explains not only how atomic particles move, but how the universe does, came into being. Without physics to describe the way things behave, we would have none of the technology and machinery we take for granted today.

### Pronunciation guide

- Buddhist** /'budɪst/
- Copernicus** /kəʊ'pɜːnɪkəs/
- Joule** /dʒuːl/
- Nasir al-Dan al Tusi** /nɑːsɪr el dɪn el tusɪ/
- Persian** /pɜːʒən/
- Röntgen** /rɜːntgən/
- thermodynamics** /θɜː'məʊdɑː'næmɪks/

### B Comprehension

Read the text and choose the best title for each paragraph. There is one title which you do not need to use.

- PARAGRAPH 1 .....
- PARAGRAPH 2 .....
- PARAGRAPH 3 .....
- PARAGRAPH 4 .....
- PARAGRAPH 5 .....
- A** Early ideas about physics
- B** Mechanical devices
- C** Ideas that created the modern world
- D** What we can learn from physics
- E** Atomic physics
- F** The origins of modern physics

### Before you listen

Discuss these questions with your partner.

- Have people always believed that the Earth goes round the Sun?
- Why do you think people would doubt this?

### C Listening

Listen to a radio programme about Copernicus. Then listen again and complete these notes.

- Copernicus provided a heliocentric (1) ..... theory of the solar system.
- People used to believe the Sun went round the (2) .....
- Copernicus led the way for science to (3) ..... existing theories.
- Copernicus held that the Earth is not the centre of the (4) .....
- He also explained the phenomenon of (5) ..... and gave the correct order of the planets.

## Before you read

Discuss these questions with your partner.

- What is lightning?
- When do you see it?
- Which travels faster, sound or light?

### D Vocabulary

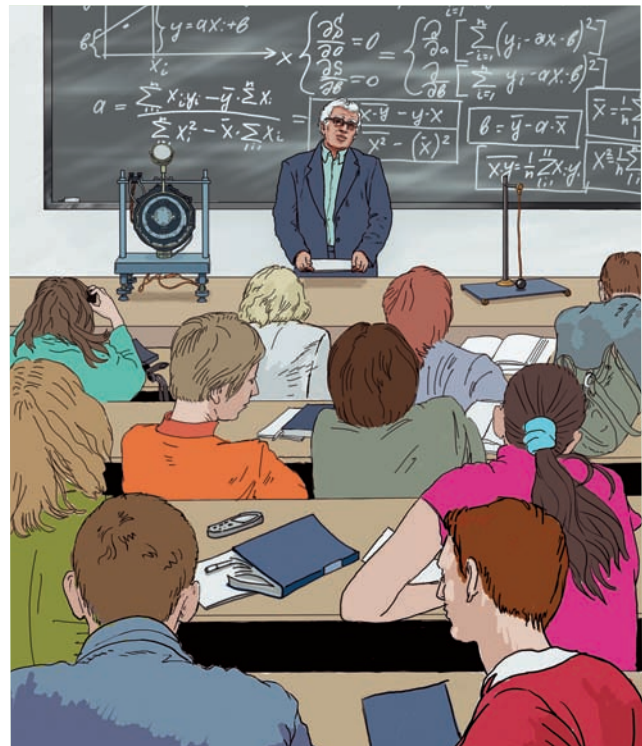
a. Match these words with their definitions.

- |                     |   |
|---------------------|---|
| 1 dark matter       | A carry out   |
| 2 survey            | B show  |
| 3 reveal            | C increase in speed   |
| 4 spark             | D investigation   |
| 5 accelerate        | E quick flash   |
| 6 three-dimensional | F best  |
| 7 leading           | G having height, width and depth  |
| 8 perform           | H hypothetical, invisible material which does not take in or give out light |

b. Complete the sentences with words from the box.

- |                     |           |
|---------------------|-----------|
| ■ dark matter       | ■ leading |
| ■ accelerate        | ■ perform |
| ■ three-dimensional | ■ survey  |
| ■ spark             | ■ reveal  |

- 1 The scientist wanted to ..... a dangerous experiment in the laboratory.
- 2 You have to wear these ..... glasses to watch this film.
- 3 He's a ..... heart surgeon; the operation is bound to be successful.
- 4 Usually trains ..... after pulling out from the station.
- 5 The company carried out a very interesting ....., the results of which were published in the newspaper.
- 6 Rub the two stones together until there is a .....
- 7 What do you know about .....? It's difficult to explain.
- 8 He's innocent and I'll do whatever it takes to ..... the truth.



### Reading 2

## Physics – the new science fiction

A speech by Professor Martin Brimble, who is retiring from his post as Professor of Physics at the University of Solihull after more than 30 years, has revealed not what we know about the universe, but what we still don't know.

*Science reporter Bob Hatton reports.*

You would expect that after 30 years as Professor of Physics at one of the country's leading research centres, Professor Brimble would know quite a lot about the way the universe works. So what was most surprising was his detailed survey of the great unsolved problems facing physicists today.

For simplicity, he divided his talk into three parts. First, he talked about those things which happen in the world – and they happen every day – but for which there is no scientific explanation. He wasn't talking about ghosts or magic, naturally, but there are events which physicists have observed and which their theories and experiments have not yet been able to explain. Then, there are theories and ideas which scientists haven't been able to prove right or

wrong because no one has been able to perform an experiment to test the theory. And as if that weren't enough, there are ideas which they know work and the science is right, but they are still waiting for the technology to be invented.

Well, what happens that can't be explained? One phenomenon is ball lightning. This is said to be just like ordinary lightning, but instead of being a spark jumping from point A to B, it forms a ball of light, about the size of a basketball. Scientists have been trying to explain it since 1904, but without success. Their efforts have been unsuccessful partly because of the fact that some physicists don't even believe the phenomenon exists. Another such phenomenon is the accelerating universe. Physicists know that everything in the universe is moving away from everything else faster and faster. They've even measured the acceleration. But what they don't know is why it's happening. One idea is that it's something to do with dark matter, but that's another problem. Because it is dark matter, we can't see it and many physicists will say they don't even know where to look for it – if it exists at all. The truth is there just isn't enough matter in the universe to keep it in one piece. Research is going ahead, but answers may take a long time to come.

Some things cannot be tested because they're just too big to test. These are ideas that sound like science fiction, but are actually theories that may be true because other theories could be wrong. For example, time travel: some say it's possible, but to do it would need more energy than there is in the universe.

And we'll have to wait for a three-dimensional microchip to be made before we can build the fastest possible computer. So according to Professor Brimble we've got a lot to look forward to in the future!

### Pronunciation guide

**microchip** /maɪkrəʊtʃɪp/

**Solihull** /səʊlɪhʌl/

## E Comprehension

Read the text and decide if the following statements are true or false.

- 1 Professor Brimble spoke about how much physics has taught us. T  F
- 2 The universe is moving fast in one direction. T  F
- 3 There are theories in physics which have not been tested. T  F
- 4 Some physicists say there is no such thing as ball lightning. T  F
- 5 Physicists are very close to finding dark matter. T  F

## Before you listen

Discuss these questions with your partner.

- What do you know about the Big Bang?
- Does it seem like a good explanation to you for the creation of the universe?

## F Listening

Listen to a teacher and a student discussing her project about the Big Bang. Then listen again and answer the questions.

- 1 When did the Big Bang occur?
- 2 In what two ways is the phrase Big Bang used?
- 3 In which direction is all matter moving nowadays?
- 4 At one time in the distant past, in what form was all matter?
- 5 What chain of events did the Big Bang set off?
- 6 After the Big Bang, why did hydrogen atoms fuse together?
- 7 Can you describe the beginnings of simple galaxies?



## G Speaking

Discuss these questions with your partner.

- What do you find the most fascinating about physics?
- Which areas would you like to know more about?

### Task

Discuss with your partner whether you think physics will be able to find answers to the unsolved problems in text 2. Say what you think and find out if your partner agrees or disagrees with you.

Talk about:

- ball lightning
- the accelerating universe
- time travel

Read text 2 again and use these notes to help you.

Ball lightning: Prove it is real? Possible causes (electromagnetism and air temperature?)

Accelerating universe: Find dark matter, find another possibility, check measurements

Time travel: New source of energy, impossible for philosophical / religious reasons, theory is wrong

Test theories? Find new theories?

Remember to:

- explain your ideas
- give reasons for your ideas
- listen to other points of view

Speaking tips

- ✓ Ask questions to find out reasons.
- ✓ Give your partner time to speak.
- ✓ Be prepared to change your mind.
- ✓ Useful words and phrases:  
primarily; without a doubt; it cannot be denied; quite probably; there's a slight possibility; highly unlikely; would you agree?; I'd have to disagree with you there.

## H Writing

Write a short essay to answer this question:

'What are the main differences in theories of physics before and after the scientific revolution?'

Read text 1 again and use these notes to write four paragraphs.

### PARAGRAPH 1

**Introduction** Scientific revolution changed way of looking at the world. First describe way of thinking before science. Then look at what modern scientists have achieved.

**Vocabulary:** first, then, explain, reasons

### PARAGRAPH 2

Ancient world. Thinkers affected by religion and superstition. Believed ideas without analyzing them. Others found proof in calculation and observation. Some found right answers for wrong reasons. Thinkers described world they lived in.

**Vocabulary:** philosophy, religion, mathematics, ideas moved slowly, description

### PARAGRAPH 3

Modern world more open to change. Accept what they see, not what they want to see. Modern physicists had advantage of knowing about mistakes of the past. Scientists look for answers to problems. Aim is to improve the world.

**Vocabulary:** proof, building on ideas, development

### PARAGRAPH 4

**Conclusion** Same in need for observation and proof. Different in acceptance of belief and wish to change world.

**Vocabulary:** finally, summary, analysis, belief

Write 200-250 words.