

## Chapter 1: Organisms and Life Processes

Textbook pages

2–13

### Chapter overview

This chapter covers the shared characteristics of life and some of the features of eukaryotic organisms (plants, animals, fungi and protoctists), prokaryotic cells (bacteria) and viruses. Named examples of each group are considered along with the concept of pathogens.

### What to expect

Specification areas covered:

1.1 understand how living organisms share certain characteristics:

- they require nutrition
- they respire
- they excrete their waste
- they respond to their surroundings
- they move
- they control their internal conditions
- they reproduce
- they grow and develop.

1.2 describe the common features shown by eukaryotic organisms and describe the features common to plants, animals, fungi and protoctists

1.3 describe the common features shown by prokaryotic organisms such as bacteria

1.4 understand the term pathogen and know that pathogens may include fungi, bacteria, protoctists or viruses

This section of the specification seems to have a lot of content and is very clear on the features that candidates are expected to know. Despite this, no more than two or three lessons should be spent on it; many of the concepts can be revisited when studying different sections of the specification.

For example:

- Plants: Multicellular nature, possession of chloroplasts, cell walls, starch and sucrose can be revisited when studying cell biology and/or plant nutrition.
- Animals: Lack of chloroplasts and cell walls can be revisited when studying cell biology. Possession of a nervous system can be revisited during the co-ordination topic and glycogen when considering insulin.
- Fungi and protoctists: The characteristics of fungi and protoctists will need separate consideration and emphasis should be placed on the key vocabulary.
- Bacteria: Bacterial cell structure will need separate consideration but can be revisited when teaching about white blood cells and immunity, the use of fermenters, yoghurt production and genetic technology.
- Viruses: Virus structure will need separate consideration but can be revisited when studying the section about white blood cells and immunity.

Effective homework tasks can include:

- producing a poster to illustrate the presence or absence of features from each group
- producing a glossary of terms
- worksheet exercise classifying different organisms based on their photographs.

## Teaching notes

### 1.1 Characteristics of life

- This is a very straightforward section. Students need to be able to state the characteristics of living things. They could compare how named animals and plants meet the characteristics of life and why viruses and non-living objects (such as a car) do not.

### 1.2 The variety of living organisms

- Students can make an A3-sized poster summary chart that lists the presence/absence or nutrition modes of each group. This can be differentiated by either giving them the groups and asking them to summarise them (high demand) or by giving them the groups and the features with more scaffolding (lower demand).
- There are terms that many students will not have encountered before, particularly for fungi. Students should make a glossary of terms in their books and if possible add diagrams to help their definitions. Key terms that may not have been encountered include: *mycelium*, *hyphae*, *chitin*, *extracellular secretion of enzymes*, *saprotrophic nutrition*, *plasmid*, *pathogen*, *RNA*.
- Bring examples of each group into the laboratory for students to see. Animals and plants are easy to find. Food that has been left to go mouldy and yeast can be used to demonstrate fungi. Protoctists can often be ordered from some biological suppliers or alternatively pond water can be viewed under the microscope. If none are available, photographs or images projected onto a screen can be used. This topic is best presented visually so that students can associate an image with a name or term.
- Students can be asked to classify a range of organisms that are shown projected onto a screen. Protoctists with animal and plant characteristics make good discussion points.
- Students will need to be familiar with the specific examples listed in the specification and understand which are pathogens. These include: Fungi (yeast, *Mucor*), protoctists (*Amoeba*, *Chlorella*, *Plasmodium*), bacteria (*Lactobacillus bulgaricus*, *Pneumococcus*), viruses (tobacco mosaic virus, influenza virus, HIV).
- Students could be asked to make a dichotomous key to classify any of the examples given. Students could test each other's keys.

### Possible misunderstandings

- Many students are not clear that starch is only found in plants while glycogen is found in animals and fungi.
- Many students are not aware of the structure of fungi – this should be stressed by the teacher and the mode of nutrition explained. There are time-lapse video clips available on the Internet that show the growth of fungi on dead plant material, clearly showing hyphae and mycelia.
- Students often confuse the terminology. Many students are not aware that the fungal cell wall is made of chitin and mix up HIV with AIDS. Producing a glossary of terms along with showing the students the structures and organisms is a useful way for them to learn.
- Students should be clear that pathogens are infectious, disease-causing microbes.

### Differentiation

- When making summary posters of the groups, the amount of scaffolding provided can be adjusted for individual students. More-able students can be asked to produce a summary poster and find example organisms. Less-able students should be given the features, groups and examples of organisms and asked to compare the features.
- When making a glossary, more-able students can be given the required terms and asked to define them. Less-able students can be given the key terms along with mixed up definitions and asked to match them up.
- More-able students could research further examples of each group.

### Practicals

Practicals listed in the textbook

There are no practicals in this chapter.

### Additional practicals and demonstrations

- Demonstrate examples of plants, animals, fungi and bacteria in the laboratory. Fungi may be available from shops (edible mushrooms) or can be observed on food left to decay. Protoctists may be purchased from some scientific suppliers or found in pond water. Students can look at fungi and protoctists using microscopes and, if a mixed sample of protoctists is available, a classification key can be used to identify some of them.
- Nutrient agar plates can be used to demonstrate the presence of fungi and bacteria in substances such as soil and tree bark or on bench surfaces. (The agar plates must not be opened and need to be autoclaved as they may represent a biohazard.)

**Unit 1 Multiple-choice questions****Answers**

1. A – nucleus absent, mitochondria absent
2. B – it is a eukaryote and has a cell wall made of chitin
3. D – protists
4. C – fungi
5. B – glycogen in fungi, starch in plants
6. D – 8
7. C – viruses carry DNA or RNA
8. C – bacteria yes, protists yes, viruses yes
9. D – 4

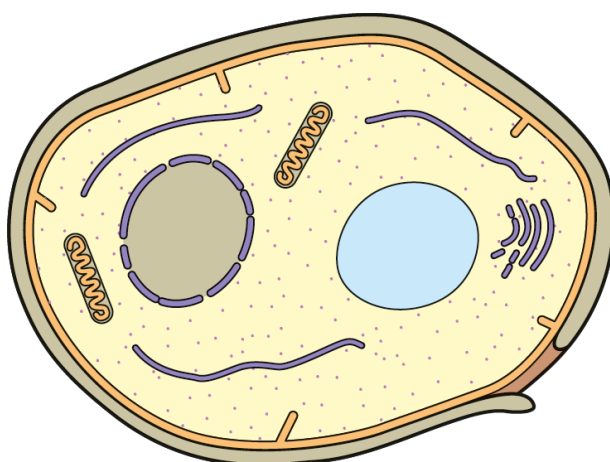


**Unit 1 Multiple-choice questions**

1. Which row correctly identifies a prokaryotic cell?

	nucleus	mitochondria
A	absent	absent
B	absent	present
C	present	absent
D	present	present

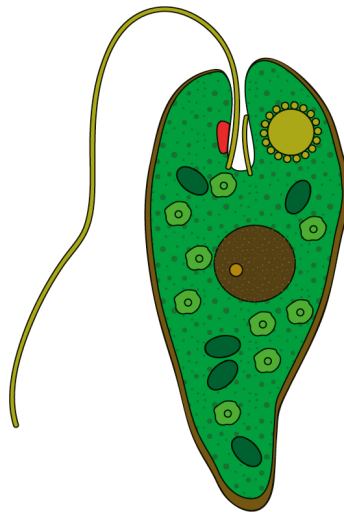
2. The diagram shows a yeast cell.



Which of the following statements about yeast is correct?

- A it is a eukaryote and has a cell wall made of cellulose
- B it is a eukaryote and has a cell wall made of chitin
- C it is a prokaryote and has a cell wall made of cellulose
- D it is a prokaryote and has a cell wall made of chitin

3. The diagram shows a single-celled organism called *Euglena*.



In which kingdom should *Euglena* be placed?

- A animals
- B fungi
- C plants
- D protocists

4. Which of the following can have both multicellular and single-celled organisms?

- A animals
- B bacteria
- C fungi
- D plants

5. Which of the following rows matches the carbohydrate molecule with a correct group?

	glycogen	starch
A	animals	fungi
B	fungi	plants
C	plants	fungi
D	plants	animals

6. Below is a list of the characteristics of life.

- movement
- respiration
- sensitivity
- growth
- reproduction
- excretion
- nutrition
- control

How many of these characteristics of life do bacteria exhibit?

- A 5
- B 6
- C 7
- D 8

7. Which of the following statements about viruses is correct?

- A viruses are made of cells
- B viruses can reproduce outside the body
- C viruses carry DNA or RNA
- D viruses release energy by respiration

8. Which of the following groups contain examples of pathogens?

	<b>bacteria</b>	<b>protocists</b>	<b>viruses</b>
A	no	no	yes
B	no	yes	no
C	yes	yes	yes
D	yes	no	yes

9. Below are some statements about fungi.

    fungal hyphae release enzymes to digest food

    the network of hyphae is called a mycelium

    many fungi use saprophytic nutrition

    examples of fungi include yeast and *Mucor*

How many of the statements are correct?

A     1

B     2

C     3

D     4

# Biology Paper 1 Exam Question

3 A study investigates the effect of training on athletic performance.

In the study, the number of capillaries in the muscle tissue of a person is measured before and after a six-week period of training.

(a) The table shows the results.

Mean number of capillaries per mm <sup>2</sup>	
before training	after training
437	460

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)

# The Mark Scheme

<b>Question number</b>	<b>Answer</b>	<b>Mark</b>
<b>3(a)(i)</b>	<p>An explanation that makes reference to the following five points:</p> <ul style="list-style-type: none"><li>• training improves performance by increasing the number of capillaries (1)</li><li>• better supply of oxygen/aerobic (1)</li><li>• better supply of glucose (1)</li><li>• respiration/energy/ATP (1)</li><li>• muscle contraction (1)</li><li>• better removal of lactic acid/carbon dioxide (1)</li><li>• can run for longer/equivalent (1)</li></ul>	<b>5</b>

# Student Response 1

There are more capillaries after training than before. This means that we can run for longer because more blood can get to the muscles so that they receive more food and can take away wastes. When we exercise, the heart pumps blood around the body so that the body can do work. If we exercise and work hard, the heart begins to pump faster and we also breathe faster. This is important because it can mean that the muscles can work faster and with more blood going to the muscles, we can run for longer.

Is this a good answer?

# Student Response 1: Verdict

There are more capillaries after training than before. This means that we can run for longer because more blood can get to the muscles so that they receive more food and can take away wastes. When we exercise, the heart pumps blood around the body so that the body can do work. If we exercise and work hard, the heart begins to pump faster and we also breathe faster. This is important because it can mean that the muscles can work faster and with more blood going to the muscles, we can run for longer.

## Good

- The student has used the data and states that there are more capillaries after training (1 mark).
- The student has stated that athletes can run for longer (1 mark).

## Could be improved

- The answer generally lacks precision and there are few mentions of specific factors such as oxygen.
- Although the student has stated that more blood reaches the muscles, there is no specific mention of oxygen or glucose transport.
- The student has not referred to respiration or energy.
- Muscle activity is mentioned but contraction has not been mentioned.
- There is no mention of removal of carbon dioxide or lactic acid.
- Much of the answer is irrelevant to the question.



# Student Response 1: Improvements

There are more capillaries after training than before.

The student has correctly identified that training increases the number of capillaries (1 mark).

This means that we can run for longer because more blood can get to the muscles so that they receive more food and can take away wastes.

This lacks precision. The candidate would have gained credit if they had stated that more glucose and oxygen are transported to the muscle and more carbon dioxide is removed.

When we exercise, the heart pumps blood around the body so that the body can do work. If we exercise and work hard, the heart begins to pump faster and we also breathe faster.

This is irrelevant and scores no credit.

This is important because it can mean that the muscles can work faster and with more blood going to the muscles, we can run for longer.

This correctly states that increased blood to the muscles allows means the athlete can run for longer (1 mark).

# Student Response 2

After training, the number of capillaries per  $\text{mm}^2$  increased by 23. This means that more blood can be transported to the muscles so that oxygen and glucose can be transported faster and wastes such as carbon dioxide can be removed. Aerobic respiration can occur faster (there will be less anaerobic respiration), making more ATP and meaning that athletes can run for longer.

# Student Response 2: Commentary

After training, the number of capillaries per  $\text{mm}^2$  increased

Increase in number of capillaries has been correctly identified (1 mark).

by 23.

Although no mark is awarded for it here, it is good practice to quote or manipulate the data.

This means that more blood can be transported to the muscles so that oxygen and glucose can be transported faster

The substances – oxygen and glucose – transported to the muscles in the blood are correctly identified here (2 marks).

and wastes such as carbon dioxide can be removed.

Removal of carbon dioxide correctly identified (1 mark).

Aerobic respiration can occur faster (there will be less anaerobic respiration),

Aerobic respiration correctly identified (1 mark).

making more ATP

This is good use of technical language. Although the mark has already been awarded for respiration, it shows a good depth of knowledge.

and meaning that athletes can run for longer.

Result is that athlete can run for longer correctly stated (1 mark).

## Chapter 1: Organisms and Life Processes – Answers

1.

Kingdom	Single / multi cellular	Chloroplasts present	Cell wall	Carbohydrates	Nutrition
animal	multicellular	no	no	glycogen	(heterotrophic) consume other organisms
plant	multicellular and single-celled	yes	yes (cellulose)	starch/ sucrose	photosynthesis
fungi	multicellular and single-celled	no	yes (chitin)	glycogen	saprotrophic (or parasitic)
protocists	multicellular and single-celled	some	yes ( <i>peptidoglycan</i> / not cellulose or chitin)	starch/ sucrose/ glycogen	consume other organisms and/or photosynthesis

2. (a) Order of words: moulds; yeast; photosynthesis; hyphae; chitin; mycelium; nitrogen; enzymes; glucose; amino acids (previous two may be switched); saprotrophic

(b) Labels, clockwise from top right: cell surface membrane; cell wall; cytoplasm/glycogen/ribosome; nucleus; mitochondrion; vacuole; cytoplasm/glycogen/ribosome

3. (a) Micro-organisms that can cause infections

(b)

Protocists		Bacteria		Viruses	
Organism	Disease	Organism	Disease	Organism	Disease
<i>Plasmodium</i>	malaria	<i>Pneumococcus</i>	pneumonia	HIV	AIDS
				TMV	tobacco mosaic disease
				influenza	flu

(c) Viruses are unable to reproduce, grow, gain nutrition, have sensitivity, coordinate, respire, excrete or move independently.



## Chapter 1: Organisms and Life Processes

1. Complete the table to summarise the features of the different kingdoms.

- State whether organisms are single-celled or multicellular or can be either.
- State whether chloroplasts are present or absent.
- State whether a cell wall is present and if it is, state what it is composed of.
- State the carbohydrate molecules that are present.
- State the method of nutrition.

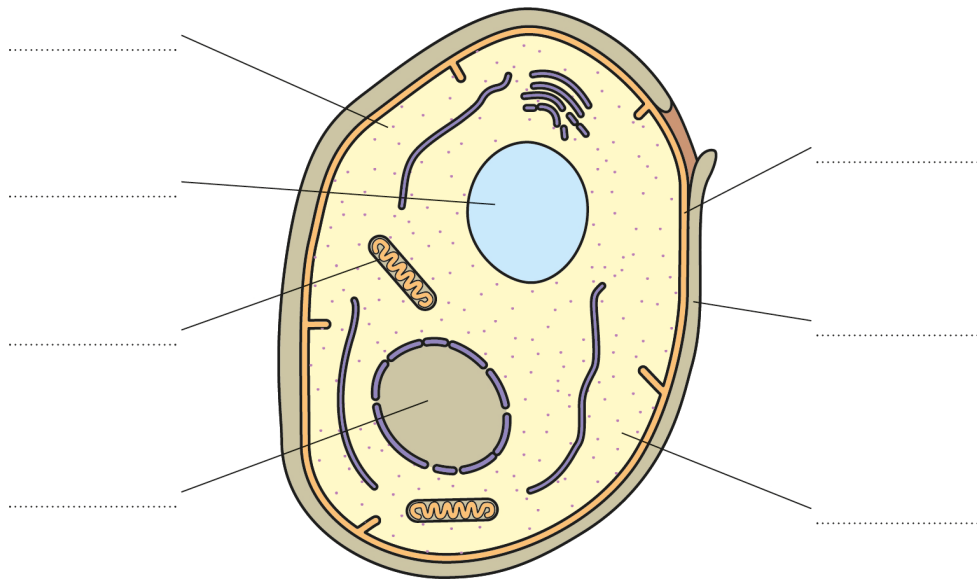
Kingdom	Single / multi cellular	Chloroplasts present	Cell wall	Carbohydrates	Nutrition
animal					
plant					
fungi					
protocists					

2.(a) Complete the following paragraph about fungi by using the words in the box.

saprotrophic	enzymes	moulds	photosynthesise	nitrogen
glucose	hyphae	yeast	amino acids	mycelium
				chitin

Fungi are a very diverse group of organisms. Multicellular fungi include \_\_\_\_\_, mushrooms and toadstools. There are also single-celled fungi, such as \_\_\_\_\_. Fungi do not possess chloroplasts so cannot \_\_\_\_\_. Multicellular fungi, such as moulds, produce many fine threads called \_\_\_\_\_, which are coated in a cell wall made of \_\_\_\_\_. The whole network of hyphae is called a \_\_\_\_\_. Many fungi live on dead material and are very important in ecological cycles such as the carbon and \_\_\_\_\_ cycles. They release \_\_\_\_\_ onto their food which digest it into soluble substances such as \_\_\_\_\_ and \_\_\_\_\_ which they then absorb. This method of nutrition is called \_\_\_\_\_ nutrition.

(b) Label the diagram of the yeast cell.



3.(a) Define the term *pathogen*.

.....

.....

.....

(b) Place each of the listed pathogenic organisms into the correct group in the table and in each case state the disease they cause. Summarise any information you find about each disease.

Try to carry out your own research to add other examples.

- *Pneumococcus*
- *Plasmodium*
- tobacco mosaic virus (TMV)
- HIV
- influenza

Protoctists		Bacteria		Viruses	
Organism	Disease	Organism	Disease	Organism	Disease

(c) Explain why viruses are not classed as living organisms.

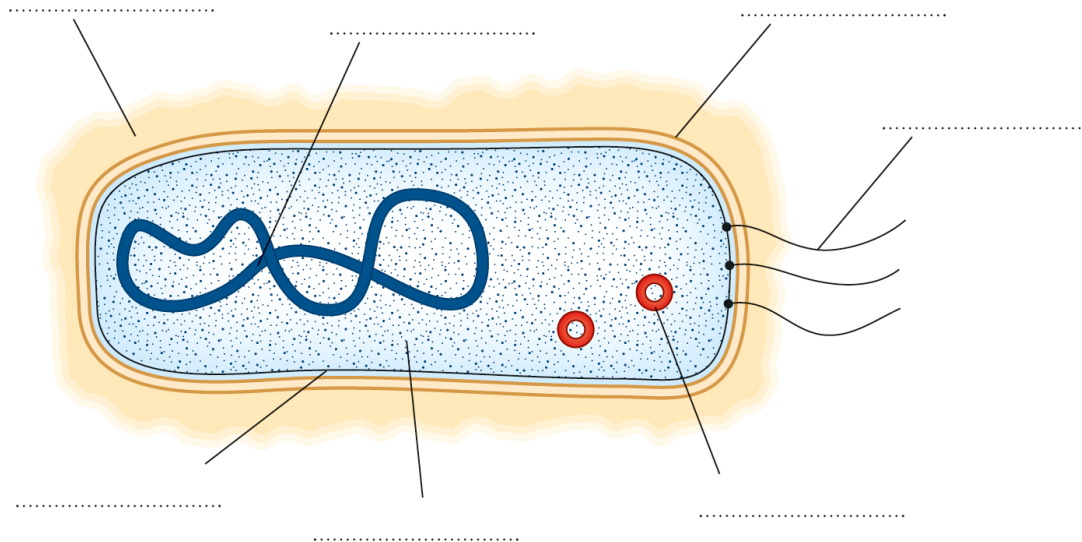
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.....

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.....

4. The diagram shows the general structure of a bacterial cell.



(a) Label the diagram of the bacterial cell.

(b) Bacteria are called prokaryotic cells. Animals, plants, fungi and protocists are made of cells called eukaryotic cells. Place each of the cell structures listed below into the correct columns of the table. Some terms will be included in both columns.

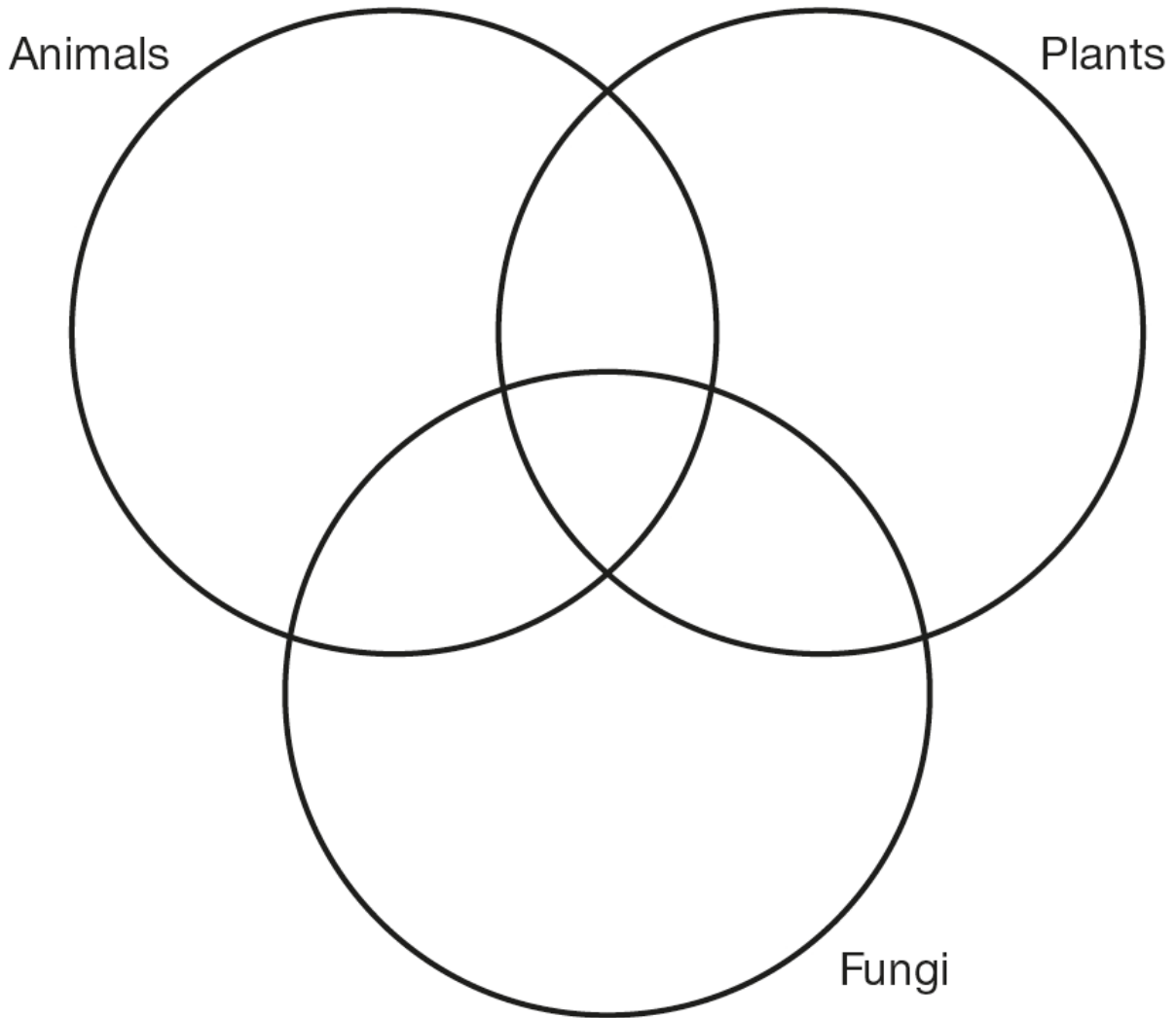
nucleus	nucleoid	cellulose cell wall	chitin cell wall	proteoglycan cell wall	
flagellum	slime capsule	plasmid	chloroplast	mitochondria	ribosome
		cytoplasm	cell membrane		

Prokaryotic cell	Eukaryotic cell



5. Place the labels into the correct places on the Venn diagram to show the similarities and differences between animals, plants and fungi.

- |              |                |             |               |               |                |
|--------------|----------------|-------------|---------------|---------------|----------------|
| sucrose      | starch         | glycogen    | multicellular | single celled | nervous system |
| chloroplasts | photosynthesis | saprophytes | nucleus       | mitochondria  |                |
| cellulose    | chloroplasts   | chitin      | large vacuole |               |                |



6. Match the characteristics of living things with the correct definitions.

Characteristic
movement
respiration
sensitivity
growth
reproduction
excretion
nutrition
control

Definition
release of energy from food
increasing in size and complexity
use of muscles in animals or slow growth in plants
producing offspring
responding to stimuli
maintaining steady internal state
getting rid of waste products
plants make food, animals eat other organisms

## Chapter 1: States of matter

**Alignment with Student Book:** pages 135–141

### Chapter overview

This chapter focuses on the basics of chemistry with an introduction to particles theory. It is assumed that all students will have a working knowledge of solids, liquids and gases. The chapter will explore the properties of each state of matter but limited to the arrangement, movement and energy levels of particles. The physical properties are not explored.

### What to expect

1.1 Understand the three states of matter in terms of the arrangement, movement and energy of the particles.

1.2 Understand the interconversions between the three states of matter in terms of:

- the names of the interconversions
- how they are achieved
- the changes in arrangement, movement and energy of the particles.

1.3 Understand how the results of experiments involving the dilution of coloured solutions and diffusion of gases can be explained.

This chapter is relatively straightforward and builds on much of the work that should have been completed during KS3. As some of the content is likely to be revision, a more practical approach may be undertaken. Time should be allocated to ensure students grasp the definitions of the keywords accurately. A focus on the skill of graph plotting should be encouraged for homework.

### Teaching notes

#### Starter Activities

States of matter modelling – Give students particle diagrams of the three states of matter and get them to physically model and act out how they would appear. (The teacher should use professional judgement as to how appropriate this activity is for a given class.) This activity can also be used to show the interconversions between states.

Changing state card sort – Supply students with cards that have the names of the different states of matter and the names of the interconversions on them. The students must arrange the cards into the correct places. For more able students, add the additional task of giving three examples of each interconversion. For very gifted students, ask them to identify an occasion when each interconversion is helpful and an example of when each interconversion is a problem.

Diffusion activity – Fill seven or eight balloons with air. Give the balloons to students in one corner of the classroom and say the balloons must not touch the ground and must all stay in the air for 30 seconds. Students may only tap the balloons with one hand. Start the activity, then after 30 seconds ask students to catch the balloons. The balloons should have spread out across the class as the students hit them randomly to keep them afloat. Link the demonstration to diffusion.

Demonstration: Diffusion in liquids – Prepare two gas jars or large beakers. Add hot water to one jar and very cold water to the other. Do not tell the students that the water is a different temperature. Ask them to predict what will happen when you add a crystal of potassium permanganate to the containers. Once you have added the crystals and diffusion has taken place, ask the students to suggest what they think has happened and why there is a different amount of diffusion in each tube. Hold a thermometer in each tube to show the temperature difference. This links to energy affecting diffusion.

### Main activities/practical work

Drawing particle diagrams – *Either* give students a description of the arrangement of particles and ask them to draw a diagram of how they think the particles will be arranged. *Or* give students the particle diagrams and ask them to describe how the particles are arranged. This can be completed alone or in pairs.

Practical: Behaviour of states of matter – Students investigate the effect of placing balloons in water at different temperatures. They measure the circumference of the balloon at room temperature and then place it in a water bath containing ice water, warm water, or hot water for five minutes each time. After each water bath, students re-measure the circumference. This practical can be linked with the energy the gas particles have and how much space they take up. A very simple and quick practical to engage students.

Demonstration: Change of state – Heat wax in a boiling tube using a water bath. Record the temperature every minute or so. Then place the wax in a water bath of cool water. Discuss the state change in relation to temperature and therefore energy. This could be completed as a student practical depending on the ability of the class.

Demonstration: Diffusion demonstrations on page 139 of the Student Book – In a fume cupboard, the diffusion of gases can be demonstrated using either bromine, or ammonia and hydrochloric acid. Both demonstrations are hazardous. If it is not possible to complete these demonstrations then they can be discussed or shown using a video.

Practical: Dilution of a coloured solution – Students use pipettes to add 1 cm<sup>3</sup> of food dye to 9 cm<sup>3</sup> of water. They make a dilution series by repeating the procedure of taking 1 cm<sup>3</sup> of solution to 9 cm<sup>3</sup> of water until they can no longer see any dye. Depending on the type of food dye used, the ratio of dye to water may need to be adjusted. More able students may be able to calculate the percentage concentration at each stage. To make the practical more interesting, have a few ready-diluted ‘unknown’ concentration tubes and ask the students to use their dilution series to decide on the concentration of the ‘unknowns’.

### Homework

As plotting graphs can be very time consuming, it is advised that these be set for homework where possible.

The TRP homework sheet will also cover much of the content as will the Student Book questions on pages 140–141.

### Possible misunderstandings

Students often struggle with understanding the difference between boiling and evaporation. They need to learn that boiling occurs when all the particles in a liquid have enough energy to change into a gas, whereas evaporation is when a few particles in a liquid have enough energy to change into a gas. A good analogy to use is a football stadium. During a match, there will always be a few people who leave early. This is evaporation. At the end of the match, when the final whistle blows, everyone leaves in one go. This is boiling.

### Differentiation

This chapter provides many opportunities for students to actually complete experiments and collect data. Equally, where needed, data can be provided to allow students to still complete the analysis required.

### Practicals

**Diffusion demonstrations** – the method can be found here:

<http://www.rsc.org/learn-chemistry/resource/res00000682/diffusion-of-gases-ammonia-and-hydrogen-chloride>

### **Dilution of a coloured solution practical**

Equipment: food dye, water, 8 boiling or test tubes, 8 pipettes, test tube rack, 10 cm<sup>3</sup> measuring cylinder, ‘unknown’ samples (if required).

## Unit 1 Multiple-choice questions

### Answers

1. D – The particles are arranged regularly and are all touching.
2. D – Particles in a liquid start to change into a gas.
3. D – Nitrogen is found as a liquid on Neptune.
4. C – Melting
5. D – The time of day they did the investigation.
6. A – The particles are arranged randomly and none are touching.
7. C – Heating the crude oil.
8. C – Crystallisation
9. C – 121–128°C
10. A – Nitrogen
11. B – Elements contain equal numbers of neutrons and electrons.
12. B – +2
13. D – Ne
14. A – A triple covalent bond.
15. C – A white solid that melts at 750°C and boils at 1360°C.
16. A – In graphite, each carbon atom bonds to three other carbon atoms, forming sheets of hexagons which can slide over each other. In diamond, each carbon atom bonds to four other carbon atoms to give a strong structure in three dimensions.
17. D – SiO<sub>2</sub>
18. A – It has low melting and boiling points.
19. D – 2+
20. D – ZnSO<sub>4</sub>
21. C – Neon
22. D – 159.5

## Unit 1 Multiple-choice questions

- Which of the following best describes the arrangement of particles in a solid?
  - The particles are arranged randomly and none are touching.
  - The particles are arranged randomly and are all touching.
  - The particles are arranged regularly and none are touching.
  - The particles are arranged regularly and are all touching.
  
- Which of the following best describes evaporation?
  - Particles in a solid start to change into a gas.
  - Particles in a solid start to change into a liquid.
  - Particles in a gas start to change into a liquid.
  - Particles in a liquid start to change into a gas.
  
- Nitrogen has a melting point of  $-210^{\circ}\text{C}$  and a boiling point of  $-196^{\circ}\text{C}$ .  
Some scientists are testing a spacecraft in different chambers to simulate the effect of a planet's temperature on nitrogen.  
The Jupiter chamber has a temperature of  $-110^{\circ}\text{C}$ , the Saturn chamber has a temperature of  $-140^{\circ}\text{C}$  and the Neptune chamber has a temperature of  $-205^{\circ}\text{C}$ .  
Assuming that the pressure in all chambers is the same as room pressure on Earth, which of the following statements is true?
  - Nitrogen is found as a liquid on Jupiter.
  - Nitrogen is found as a solid on Neptune.
  - Nitrogen is found as a liquid on Saturn.
  - Nitrogen is found as a liquid on Neptune.
  
- What is the name of the process when a substance changes from a solid to a liquid?
  - Evaporation
  - Boiling
  - Melting
  - Sublimation
  
- Some students were conducting an experiment to investigate how quickly a gas diffused along a tube. They wanted to change a variable to see how it affected the speed at which the gas diffused.  
Which of the following would **not** affect how fast the gas diffused?
  - The concentration of gas they used.
  - The temperature of the room they did the investigation in.
  - The type of gas they used.
  - The time of day they did the investigation.

6. Oxygen is one of the gases that make up the air around us. Which of the following describes the arrangement of the particles inside oxygen?
- A. The particles are arranged randomly and none are touching.
  - B. The particles are arranged randomly and are all touching.
  - C. The particles are arranged regularly and none are touching.
  - D. The particles are arranged regularly and are all touching.
7. In fractional distillation, crude oil is separated into the different compounds that it is made up from. To do this, the compounds must be changed from liquids into gases. Which of the following will help change the liquids into gases?
- A. Cooling the crude oil.
  - B. Keeping the crude oil at room temperature.
  - C. Heating the crude oil.
  - D. Adding water to the crude oil.
8. Which separation technique is most suitable for obtaining a dissolved solid from a solvent?
- A. Chromatography
  - B. Distillation
  - C. Crystallisation
  - D. Filtration
9. Look at the table below and identify the impure substance.

Substance	Melting point / °C
A	45
B	89
C	121–128
D	156

10. Some students were investigating the diffusion of different gases. The relative masses of the gases are shown in the table below.

Gas	Relative mass
Nitrogen	14
Neon	20
Hydrogen chloride	36
Sulfur dioxide	64

Which gas will diffuse most quickly?

- A. Nitrogen
- B. Neon
- C. Hydrogen chloride
- D. Sulfur dioxide



11. Which of the following statements about elements is **not** true?
- A. Elements contain equal numbers of protons and electrons.
  - B. Elements contain equal numbers of neutrons and electrons.
  - C. Elements contain protons and neutrons in their nucleus.
  - D. Elements contain electrons that orbit around the nucleus.
12. A particle has a nucleus that contains 10 protons and around the outside it has 8 electrons. What is the overall charge of the particle?
- A. 0
  - B. +2
  - C. -2
  - D. +18
13. You may need a copy of the Periodic Table to answer this question. Sodium loses an electron to become the ion  $\text{Na}^+$ . Which of the following atoms or ions has the **same** electronic structure as the sodium ion?
- A.  $\text{Mg}^{2+}$
  - B. F
  - C.  $\text{K}^+$
  - D. Ne
14. Two nitrogen atoms are joined together to form the molecule  $\text{N}_2$ . Which statement correctly describes the bond formed?
- A. A triple covalent bond.
  - B. A single covalent bond.
  - C. A double covalent bond.
  - D. An ionic bond.
15. Which of the following substances is most likely to be a giant covalent structure?
- A. A green gas.
  - B. A brown solid that melts at  $120^\circ\text{C}$  and boils at  $185^\circ\text{C}$ .
  - C. A white solid that melts at  $750^\circ\text{C}$  and boils at  $1360^\circ\text{C}$ .
  - D. A clear liquid that boils at  $78^\circ\text{C}$ .

16. Which one of the following statements best describes the difference between graphite and diamond?
- A. In graphite, each carbon atom bonds to three other carbon atoms, forming sheets of hexagons which can slide over each other. In diamond, each carbon atom bonds to four other carbon atoms to give a strong structure in three dimensions.
  - B. In diamond, each carbon atom bonds to three other carbon atoms, forming sheets of hexagons which can slide over each other. In graphite, each carbon atom bonds to four other carbon atoms to give a strong structure in three dimensions.
  - C. In graphite, each carbon atom bonds to three oxygen atoms, forming sheets of hexagons which can slide over each other. In diamond, each carbon atom bonds to four other carbon atoms to give a strong structure in three dimensions.
  - D. In graphite, each carbon atom bonds to one other carbon atom, forming sheets of hexagons which can slide over each other. In diamond, each carbon atom bonds to one other carbon atom to give a strong structure in three dimensions.
17. Which of the following covalent compounds does not have a simple molecular structure?
- A.  $\text{H}_2\text{O}$
  - B.  $\text{CO}_2$
  - C.  $\text{CH}_4$
  - D.  $\text{SiO}_2$
18. Propane ( $\text{C}_3\text{H}_8$ ) is often used as a fuel. It is a covalent compound with a simple molecular structure.  
Which of the following statements is likely to be true?
- A. Propane has low melting and boiling points.
  - B. Propane is a solid at room temperature.
  - C. Propane is a good conductor of electricity.
  - D. Propane has a strong attraction between its molecules.
19. You may need a copy of the Periodic Table to answer this question.  
What charge does a magnesium ion have?
- A. 2-
  - B. 0
  - C. 1+
  - D. 2+

20. Zinc can be added to sulfuric acid to form zinc sulfate.  
What is the chemical formula for zinc sulfate?
- A.  $\text{ZnSO}_2$
  - B.  $\text{ZnH}_2\text{SO}_4$
  - C.  $\text{Zn}_2\text{SO}_4$
  - D.  $\text{ZnSO}_4$
21. Which of the following elements does **not** form a diatomic molecule?
- A. Chlorine
  - B. Nitrogen
  - C. Neon
  - D. Hydrogen
22. What is the correct relative formula mass for copper(II) sulfate?  
( $A_r$ : oxygen: 16; sulfur: 32; copper: 63.5)
- A. 48
  - B. 111.5
  - C. 146
  - D. 159.5

# Chemistry paper 1

## Exam question

- Coal is a type of fossil fuel often used in power stations to help generate electricity. The coal contains impurities such as sulfur compounds. Explain how the use of coal in power stations leads to acid rain.

(5)

# Student response 1

- When coal is used in a power station it makes sulfur oxide. The sulfur oxide gas is very hot so it rises high into the air. As the sulfur oxide cools down it starts to condense into sulfuric acid. The sulfuric acid falls from the air as acid rain.
  
- Is it a good answer?

# Is it a good answer?

## **Good**

- The student states the product of the reaction.
- There is an explanation of how the sulfur compounds in coal lead to acid rain falling from the sky.

## **Could be improved**

- The student needs to state the reactants and type of reaction clearly.
- Sulfur compounds form sulfur dioxide.
- Sulfur dioxide reacts with water vapour to form sulfuric acid.

# Student response 1: Commentary

- When coal is used in a power station it **makes sulfur oxide. (1)**  
The sulfur oxide gas is very hot so it rises high into the air. As the sulfur oxide cools down it starts to condense into sulfuric acid.  
**The sulfuric acid falls from the air as acid rain. (1)**

The lack of reactants means that it not possible to give this student full marks. They also fail to describe the reaction between sulfur dioxide and water (vapour) to form sulfuric acid.

# Student response 2

- Coal is a fossil fuel that contains sulfur compounds. When coal undergoes combustion the sulfur compounds react with the oxygen in the air to form sulfur dioxide. The sulfur dioxide then reacts with water vapour in the atmosphere to form sulfuric acid. When the water vapour condenses the rain produced is acidic.



# Student response 2: Commentary

- Coal is a fossil fuel that contains sulfur compounds. When coal undergoes **combustion (1)** the **sulfur compounds react with the oxygen (1)** in the air to form **sulfur dioxide. (1)**

The first sentence repeats information from the question which will not gain any marks. However, the student has identified the reactants, the type of reaction, and the product formed, so they gain 3 marks.

# Student response 2: Commentary

- The sulfur dioxide then **reacts with water vapour (1)** in the atmosphere to form sulfuric acid.

The student has explained how sulfuric acid is formed from sulfur dioxide.

- When the **water vapour condenses the rain produced is acidic. (1)**

The link between the sulfuric acid formed and acid rain is made.

This student would achieve full marks on this question.

# Mark scheme

Answer	Marks
<p>A description that refers to the following five points:</p> <ol style="list-style-type: none"><li>1. Coal undergoes combustion / is burned / heated to a high temperature.</li><li>2. Sulfur compounds react with <u>oxygen</u> in the air.</li><li>3. Sulfur dioxide formed (accept sulfur oxide).</li><li>4. Sulfur dioxide reacts with water (vapour) in the air to form sulfuric acid.</li><li>5. Sulfuric acid falls as acid rain.</li></ol>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>

## Chapter 1: States of Matter – Answers

### Solids liquids and gases

1. Use the words in the box to complete the gaps below. Use each word only once.

contact energy gases liquids more move particles space vibrate

There are three states of matter: solids, liquids and **gases**. Solids have a regular arrangement of particles with each particle in **contact** with the others. The particles in a solid do not move but they do **vibrate**. In **liquids**, the particles are able to move and slide over one another. The particles are still touching but, as they have **more** energy, they are able to move around. In a gas, the particles have lots of **energy**. This means that they are able to **move** very quickly and so they are not touching other **particles**. As the particles in a gas move lots, they take up a lot of **space**.

### Changing state

2. Draw a line from each description to the correct name for the interconversion.

Description	Interconversion
Changing from a gas to a liquid	Freezing
Changing from a solid to a liquid	Melting
Changing from a liquid to a gas	Condensing
Changing from a liquid to a solid	Boiling

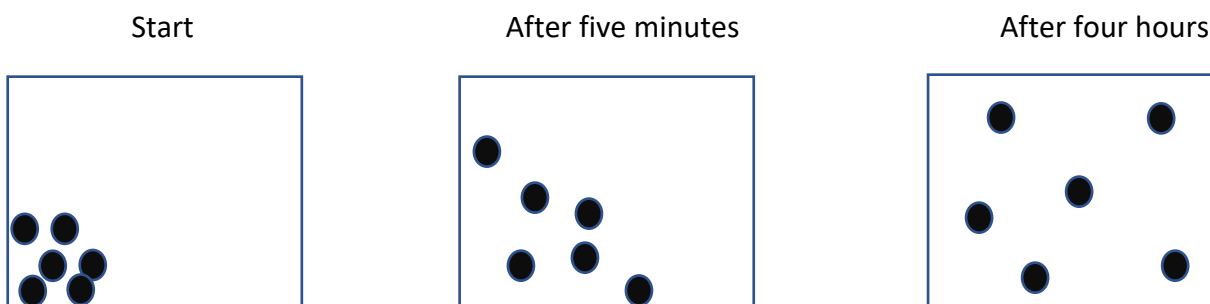
Diagram showing connections between descriptions and interconversion names:

- Changing from a gas to a liquid → Freezing
- Changing from a solid to a liquid → Melting
- Changing from a liquid to a gas → Boiling
- Changing from a liquid to a solid → Condensing

### Diffusion

3. Draw particle diagrams in the boxes to show how a soluble solid would diffuse from one corner of a container over time.

Start                      After five minutes                      After four hours



## Chapter 1: States of Matter

### Solids liquids and gases

1. Use the words in the box to complete the gaps below. Use each word only once.

contact energy gases liquids more move particles space vibrate
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There are three states of matter: solids, liquids and \_\_\_\_\_. Solids have a regular arrangement of particles with each particle in \_\_\_\_\_ with the others. The particles in a solid do not move but they do \_\_\_\_\_. In \_\_\_\_\_, the particles are able to move and slide over one another. The particles are still touching but, as they have \_\_\_\_\_ energy, they are able to move around. In a gas, the particles have lots of \_\_\_\_\_. This means that they are able to \_\_\_\_\_ very quickly and so they are not touching other \_\_\_\_\_. As the particles in a gas move lots, they take up a lot of \_\_\_\_\_.

### Changing state

2. Draw a line from each description to the correct name for the interconversion.

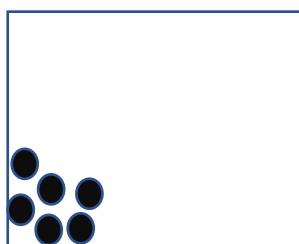
Description
Changing from a gas to a liquid
Changing from a solid to a liquid
Changing from a liquid to a gas
Changing from a liquid to a solid

Interconversion
Freezing
Melting
Condensing
Boiling

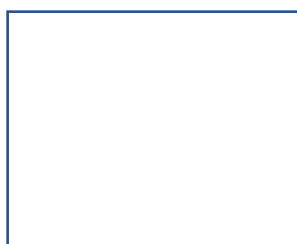
### Diffusion

3. Draw particle diagrams in the boxes to show how a soluble solid would diffuse from one corner of a container over time.

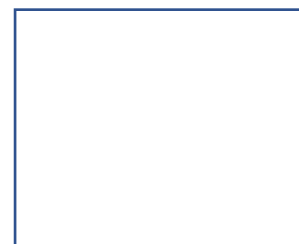
Start



After five minutes



After four hours



## Chapter 1: Movement and Position

Alignment with Student Book: pages 295–307

### Chapter overview

This chapter covers the basics of movement in physics terms. It outlines key definitions in relation to motion, the equations of motion, plotting graphs (distance travelled against time, velocity against time) and using graphs to determine the acceleration and distance travelled.

Students will have come across motion in KS3. This section builds on what they have already learned by incorporating gradient to find acceleration and area to find distance travelled. The graph skills required for this section will have been covered in other sciences and in maths but it is worth giving students the guidelines for drawing graphs in physics as there are some differences between subjects. Students will be introduced to rearranging equations and are given alternative methods for rearranging for those who find this maths skill more challenging. It is worth taking this section slowly as the majority will find equation rearrangement difficult to grasp.

### What to expect

- 1.1 use the following units: metre/second (m/s), metre/second<sup>2</sup> (m/s<sup>2</sup>), second (s)
- 1.3 plot and explain distance–time graphs
- 1.4 know and use the relationship between average speed, distance moved and time taken:  
average speed = distance moved/time taken
- 1.5 practical: investigate the motion of everyday objects such as toy cars or tennis balls
- 1.6 know and use the relationship between acceleration, change in velocity and time taken:  
acceleration = change in velocity/time taken,  $a = (v - u)/t$
- 1.7 plot and explain velocity–time graphs
- 1.8 determine acceleration from the gradient of a velocity–time graph
- 1.9 determine the distance travelled from the area between a velocity–time graph and the time axis

Students will have already met the majority of this topic in KS3 so it should be relatively straightforward. Time should be taken on calculating gradients and rearrangement of equations. This could be done by working through examples as a class and reinforcing with homework questions. Students will benefit from gaining experience in finding different variables within the equations of uniform motion. They will find identifying  $v$  and  $u$  correctly in a question tricky. Time spent working on topical questions will be of significant benefit.

## Teaching notes

### Start activities

Exemplar calculations: Students can be given example calculations with all workings shown that are incorrect. In pairs, students can work through and correct. This can be a discussion with the class as to why the calculations are wrong and how they can be corrected.

Graph analysis: Place a number of distance–time graphs or velocity–time graphs on the board and give students a description of one of the graphs. They have to correctly identify the graph that represents the situation described. This can be repeated for different scenarios.

Introducing the Galileo bells demonstration: Have four or five students stand in a line with either balloons or bells (something that will make a noise when struck). Equally space the students. Ask students what would happen to the sounds if a student walked at a constant speed / ran at a constant speed / increased their speed / decreased their speed. Ask students how they could adapt the demonstration to make sure the sounds rang out at regular intervals for a faster object. Leads into Galileo's experiment.

Peer marking: Ask students to create a mark scheme for a graph plot and gradient calculation. At the beginning of the next lesson, students peer mark their graph homework from previous lesson. Highlights to students the importance of using correct scales and lines of best fit.

### Main activities

Speed trap students: Students can calculate their average speed over 10-metre sections of the 100 m and then the 100 m overall. This can be done as a class or group activity. The distances can be altered to suit the space available. As a class activity, space students with stopwatches 10 m apart. Select two students to run the 100 m. Timers stop the stopwatch as the runner passes. Students can calculate average speed over each 10-metre section (subtract previous 10 m, 20 m, 30 m times etc.) to see which section is the fastest. The average speed across 100 m can then be calculated for each runner. Students can sketch a distance–time graph of the result and, assuming constant velocity, can calculate the gradient of the graph for each runner. Comments can be made on the steepness of the graph, etc.

Worked examples – groups: Split class into groups of three and give each group an example question. Each student has a copy of all the example questions. Each group comes to the front and teaches their worked example to the class. Allows for open conversation about units and how to tackle the more challenging questions.

Investigating the motion of tennis balls or toy cars practical: Students will measure the height from the bench to a constant specified point on the ramp (i.e. bottom of the ramp / top of the ramp). Students will then record the average speed down the ramp by measuring the distance of the trolley between two points and recording the time taken between the points. Consistency in measurement is key here to ensure accurate results. Students should always take readings from one end of a car, i.e. as the front of the car crosses the line. Questioning around why this is important. Opens up for discussion on accuracy and how to take accurate measurements such as reading instruments in line of sight.

Practical key word terminology match-up: Provide students with key word cards for practical (i.e. accuracy, error, anomaly, average) and ask them to match up definitions to words. Students can then link words in a mind map. Students can formulate an exam-style response that incorporates the key words matched up.

Distance–time and velocity–time graph using ticker tapes and trolleys: This is a lengthy practical, but it gives a good visual for those who struggle with how the distance covered by a car that is accelerating will increase in a fixed time interval. It is also good to show the transition between a distance–time graph and a velocity–time graph. Similar to the activity mentioned on pages 298–299. Set up the apparatus as shown. Connect the trolley to a ticker tape that is running through a ticker timer. Allow the trolley to roll freely down the slope (ensure it is steep enough to allow acceleration). The ticker tape should be cut into sections of ten spaces (count ten spaces and cut through the dot that closes the tenth space). Each section represents 0.02 seconds (if electricity supply is 50 Hz). Using distance–time graph axes, students stick down the cut sections in the order they were cut (smallest spaces first). This shows a distance–time graph including acceleration. Students can then calculate the velocity of each strip ( $\text{length}/0.02$ ). This can be used to plot a velocity–time graph on graph paper and the acceleration calculated through the gradient.

### Differentiation

For students who are finding the calculations more difficult, using formula triangles is a big help. For added time in the classroom setting, provide students with example data from the practical sessions so they can be working through these without the time pressure.

### Homework

Plotting graphs for experiments done in class is an effective homework that will reduce time pressure in the classroom. Analysis can then be consolidated as a starter for the next lesson. This can be done as a peer marking session.

Suggested questions on pages 305–307 for end of chapter homework.

### Possible misunderstandings

For students struggling with calculations, it is worth discussing with the maths department how they teach rearrangement of equations. This cross-curricular connection and support can benefit weaker students.

### Practicals

Investigating the motion of tennis balls or toy cars practical: toy cars/trolleys/tennis balls, ramp, ruler, stopwatch, books or stand to alter height, catch tray. Alternative methods: data logger, light gate and interrupt card; video recorder; stroboscope.



Distance–time and velocity–time graph using ticker tapes and trolleys: ramp, recording tape, ruler, trolley, power supply, ticker timer.

## Unit 1 Multiple-choice questions

### Answers

- 1 A
- 2 B – On the distance–time graph, it shows time increasing as the vehicle stays still.
- 3 C
- 4 D – As time goes on, the car is maintaining its velocity.
- 5 A –  $2/5$  gives 0.4 acceleration.
- 6 C – Time in the same units gives 1.25 hours.
- 7 C – The change in  $y$ /change in  $x$  gives a value of 65 = speed.
- 8 B – Negative implies a deceleration.
- 9 D – The area underneath the graph represents distance travelled.
- 10 C – Straight line represents a constant increase.
- 11 A – Average speed, so her top speed will be greater.
- 12 A
- 13 B – If all forces are balanced then the box will not move.
- 14 B
- 15 B – Kinetic is a type of energy NOT a force.
- 16 B – An unbalanced force will cause a box to change its motion.
- 17 D
- 18 C – As soon as the ball is travelling, the air resistance will counter the weight of the ball.
- 19 A – If they are equal and opposite in direction the resultant will equal 0 so there will be no acceleration.
- 20 C – Water resistance is the resistance from the water as a person pushes through it when they are swimming. Upthrust is the effective buoyancy.
- 21 B – Friction is a force that prevents motion.
- 22 A – Friction acts as the centripetal force which keeps the car in a circular motion.
- 23 C – This provides a smoother surface thus reducing the friction.
- 24 C
- 25 B – Balanced forces will leave an object in a steady state.
- 26 B – The momentum equation shows that if momentum = mass  $\times$  velocity then if one doubles the other halves.
- 27 C
- 28 C – This will change dramatically if the speed is increased.
- 29 A and B – The icy road will increase the stopping distance.
- 30 A and C – Both impact the speed of the thought processes of the driver, causing them to slow.
- 31 B
- 32 D – Weight is a force so must be in N.
- 33 D
- 34 B – Need to multiply by 10 N/kg for gravitational pull.
- 35 A – From the equation  $F = ma$ , if  $F$  increases  $a$  will too.
- 36 C
- 37 B
- 38 B
- 39 C – The further from the surface the weaker the gravitational pull.

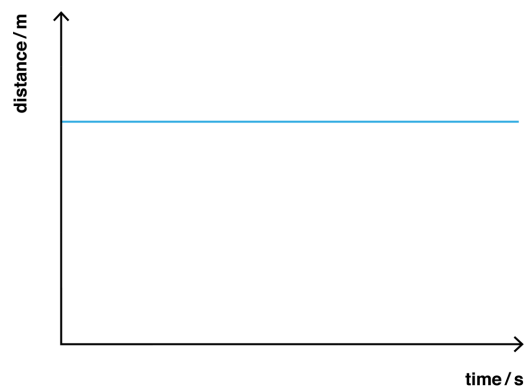
- 40 C
- 41 C
- 42 C
- 43 D

## Unit 1 Multiple-choice questions

1 Identify the correct units for speed.

- A m/s
- B  $\text{m/s}^2$
- C s
- D  $\text{m}^2$

2 The graph shows a car's motion. What is the car doing at this point?

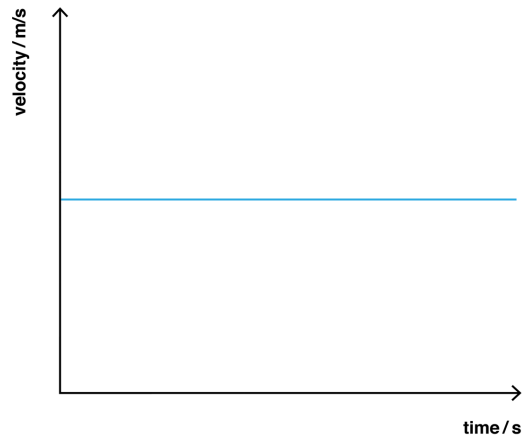


- A accelerating
- B stationary
- C decelerating
- D travelling at a constant speed

3 Which of the equations below shows the correct relationship between speed, distance and time?

- A  $\text{speed}^2 = \text{distance}/\text{time}$
- B  $\text{distance} \times \text{speed} = \text{time}$
- C  $\text{speed} \times \text{time} = \text{distance}$
- D  $\text{speed} = \text{distance} \times \text{time}$

4 The graph shows a car's motion. What is the car doing at this point?



- A accelerating
- B stationary
- C decelerating
- D travelling at a constant speed

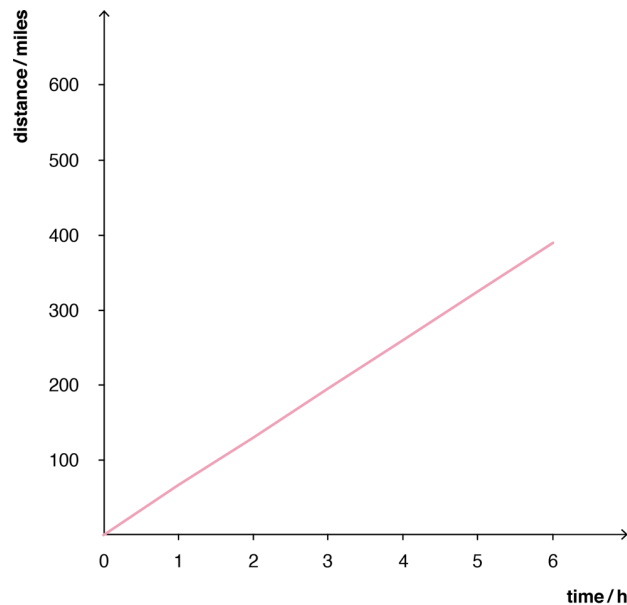
5 A speed skater is travelling at 2 m/s and accelerates uniformly to 4 m/s in 5 seconds. What is her acceleration?

- A  $0.4 \text{ m/s}^2$
- B  $0.75 \text{ m/s}^2$
- C  $0.8 \text{ m/s}$
- D  $0.4 \text{ m/s}$

6 A car travels 20 miles in 1 hour 15 minutes. What is its average speed?

- A 16 m/s
- B 25 mph
- C 16 mph
- D  $6.25 \text{ m/s}$

7 The graph shows a car journey. What is the maximum speed of the car?

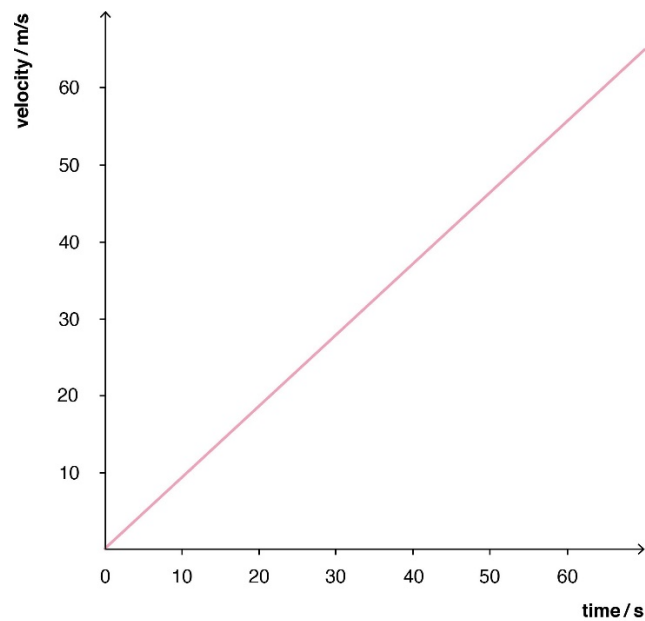


- A 50 mph
- B 50 m/s
- C 65 mph
- D 60 mph

8 A cyclist is travelling at 12 m/s and decelerates uniformly to come to a stop in 4 seconds. What is his acceleration?

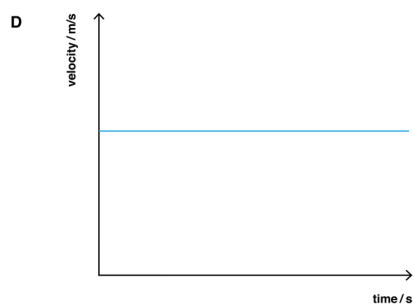
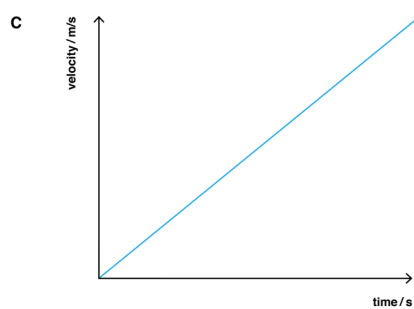
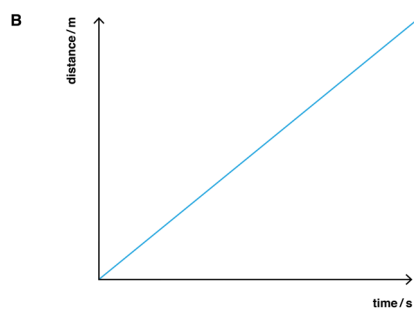
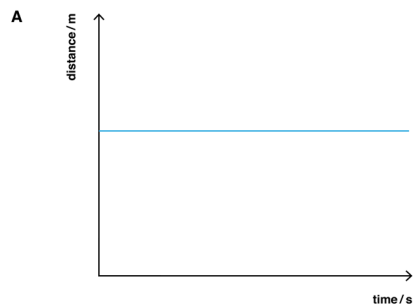
- A  $3 \text{ m/s}^2$
- B  $-3 \text{ m/s}^2$
- C  $0.6 \text{ m/s}$
- D he is decelerating not accelerating

9 The graph shows the journey of a lorry. How could you use the graph to calculate the distance the lorry has travelled?



- A divide the maximum speed by the time
- B multiply the maximum speed by the time
- C the gradient of the line
- D the area underneath the graph

10 Which sketch shows a cyclist accelerating?



11 A skier is heading for the finish line of the Olympic downhill. Her average speed down the course is 60 mph. What is her speed in m/s?

A 26.7 m/s

B  $3.45 \times 10^6$  m/s

C 1600 m/s

D 0.44 m/s



**12** A student wants to reduce the errors in her results. Which of the suggestions would reduce the experimental error in her results?

- A repeating each reading three times and averaging the results
- B taking readings from eye level
- C measuring from the same point each time
- D all of the above

**13** A woman tries to push a heavy box. The box remains stationary. Which answer best describes the forces acting on the box?

- A The weight of the box is balanced by the forward force of friction.
- B All forces acting on the box are balanced.
- C The forward force on the box is greater than the friction between the box and the floor.
- D The forces acting on the box are unbalanced.

**14** What is the unit of force measured in?

- A Kg
- B N
- C m/s
- D grams

**15** Which of the following is **not** a type of force?

- A gravitational pull
- B kinetic
- C friction
- D upthrust

**16** Finish the following statement:

Unbalanced forces ...

- A can keep an object at constant speed.
- B can change the movement of an object.
- C can keep an object balanced.

D always act in opposite directions.

**17** Why does a car engine need a forward force to keep it moving at a constant speed?

A The reaction force from the car would slow it down.

B The force from the engine is needed to overcome friction.

C Gravity would make the car come to a stop.

D The force from the engine is needed to balance the force of friction and the drag forces.

**18** A ball has fallen from a cliff edge. What are the forces acting on the ball?

A just its weight

B the reaction force from the floor

C its weight and air resistance

D only air resistance

**19** A ball bearing is falling at constant speed through oil. What can be said about the forces acting on it?

A The weight of the ball bearing and drag forces are equal and opposite in direction.

B The weight and the drag of the ball bearing are acting in the same direction.

C Only the weight of the ball bearing is acting.

D The drag force of the oil is greater than the weight.

**20** Name the force that keeps a person afloat in a swimming pool.

A water resistance

B gravitational pull

C upthrust

D air resistance

**21** Complete the following statement:

Friction can cause an object to ...

A speed up.

- B slow down.
- C move backwards.
- D move downwards.

**22** Which of the following things would **not** be able to happen without friction?

- A a car travelling around a roundabout
- B an ice skater gliding on ice
- C clapping hands
- D a swimmer racing front crawl

**23** Which of the following is a way to reduce friction?

- A increase surface area
- B create a rougher surface
- C lubricate surface with oil
- D heat the surface up

**24** Finish the following statement:

The resultant force is ...

- A the sum of the forces on an object going to the left.
- B the sum of the vertical forces on an object.
- C the sum of all the forces acting on an object.
- D when the forces equal zero.

**25** Which of the following statements is **not** correct?

- A An unbalanced force can accelerate an object.
- B An unbalanced force can keep an object at a constant speed.
- C An unbalanced force can decelerate an object.
- D An unbalanced force can change the direction of an object.

26 If you maintain the same force on a train carriage but double the carriage's mass, what will happen to the carriage?

- A It will double its speed.
- B It will halve its speed.
- C It will maintain the same speed.
- D It will come to a stop.

27 If you increase the forward force on an object but keep its mass the same, what will happen to the object?

- A Its speed will decrease.
- B Its speed will stay the same.
- C Its speed will increase.
- D It will come to a stop.

28 The stopping distance of a car depends on?

- A the thinking distance
- B the braking distance
- C the thinking distance and the braking distance
- D none of the above

29 Which **two** factors affect the braking distance of a car?

- A an icy road
- B the speed of the vehicle
- C the driver is sleepy
- D the thinking distance
- E the stopping distance

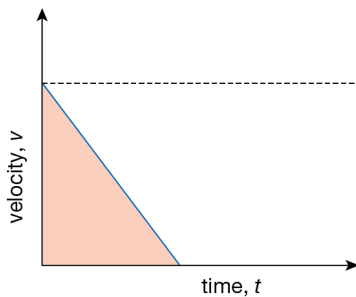
30 Which **two** factors affect the thinking distance?

- A the driver is tired

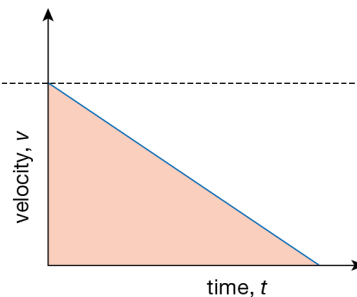
- B the stopping distance
- C the driver has had alcohol
- D the braking distance
- E the weather conditions

31 Compare the two graphs. Which statement is correct?

Graph A



Graph B



- A Graph B has a steeper gradient.
- B Graph A has the greatest deceleration.
- C Graph A has travelled the furthest distance.
- D Graph B has travelled the shortest distance.

32 Weight is measured in which unit?

- A kilograms
- B  $\text{m/s}^2$

- C grams
- D newtons

33 Which is the correct equation that links mass, weight and gravitational field strength?

- A  $g = W \times m$
- B  $m = W \times g$
- C  $m = g/W$
- D  $W/g = m$

**34** An astronaut in a space suit with a life support pack has a mass of 150 kg. How much will the astronaut weigh on the Earth?

- A 1500 kg
- B 1500 N
- C 15 N
- D 1.5 N

**35** Which statement about force, mass and acceleration is true?

- A Force is directly proportional to acceleration.
- B Force is inversely proportional to mass.
- C Acceleration is directly proportional to mass.
- D  $F = m/a$

**36** A ball with a mass of 0.5 kg is moving at 2 m/s. It hits a wall and comes to a stop in 0.1 s. What was the force on the ball?

- A  $10 \text{ m/s}^2$
- B  $0.4 \text{ m/s}^2$
- C 10 N
- D 0.1 N

**37** A cyclist pulls the brake lever on the handlebars when she wants to stop. Which statement is correct?

- A The brakes increase the friction between the bike and the road.
- B The brakes increase the friction between the bike and the wheels.
- C The brakes will only work if the wheels are in good condition.
- D Friction is maximum when the tyres are skidding on the road.

**38** The gravitational field strength on the Moon is 1.6 N/kg. What would the weight of an object of 100 kg be on the Moon?

- A 160 kg
- B 160 N
- C 62.5 kg

D 62.5 N

**39** A climber reaches the summit of Mount Everest. His weight at the summit is 728 N. He has a mass of 75 kg. What is the gravitational field strength at the top of Mount Everest?

A 10 N

B 54 000 N

C 9.7 m/s<sup>2</sup>

D 9.7 N

**40** A car is travelling at 60 mph. The stopping distance of a car at this speed is 73 m. Given the thinking distance is 18 m, what is the braking distance?

A 91 m

B 4 m

C 55 m

D 1300 m

**41** A braking force of 2000 N is applied to a car travelling at 20 m/s. The mass of the car is 1500 kg. What is the deceleration of the car?

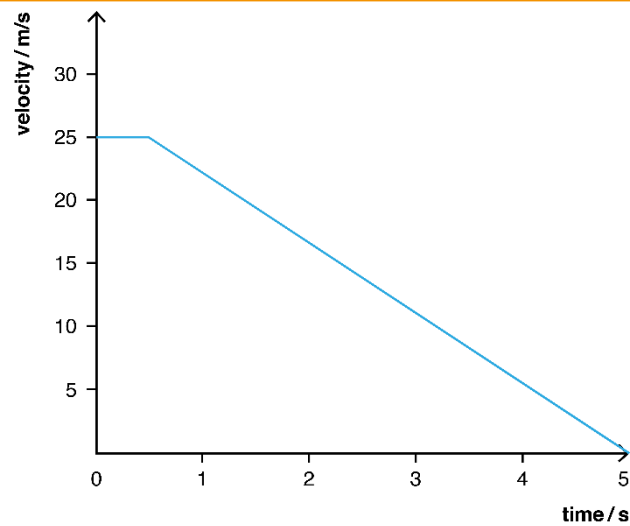
A 1.3 N

B 0.75 m/s

C 1.3 m/s<sup>2</sup>

D 0.75 m/s<sup>2</sup>

**42** The graph shows the velocity–time graph of a vehicle from the moment the driver reacts to an obstruction in the road. What is the reaction time of the driver?



- A 5.5 s
- B 2.5 s
- C 0.5 s
- D You need more information than provided.

**43** Using the graph above, calculate the total distance travelled by the driver in bringing the car to a complete stop.

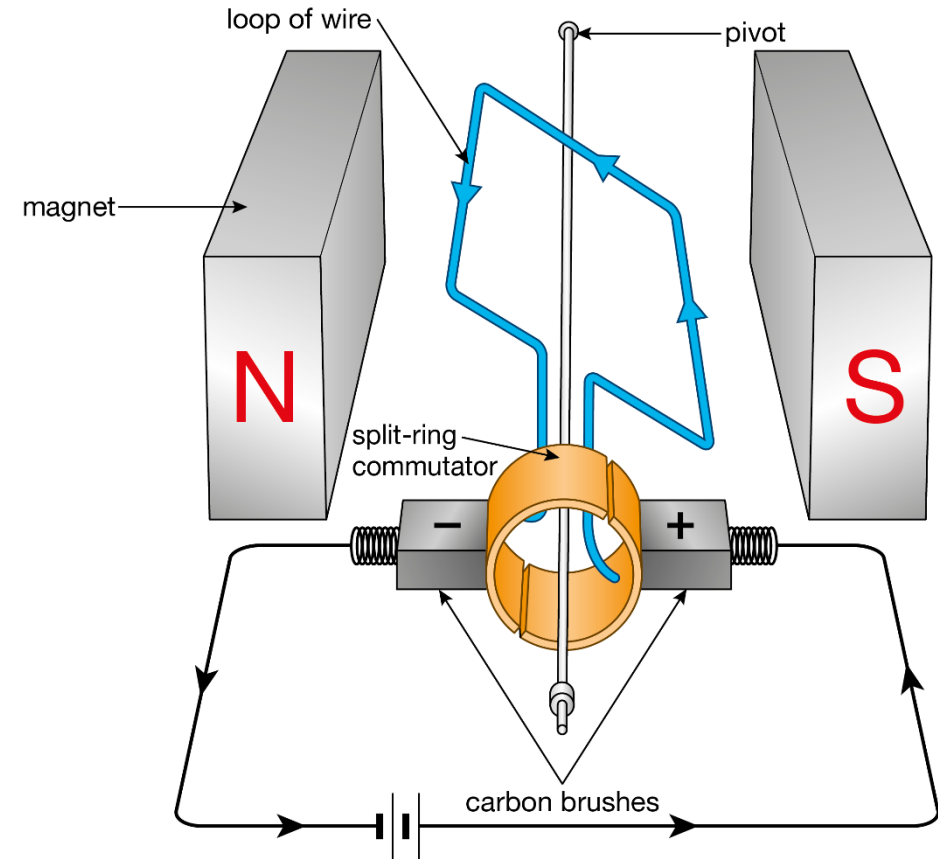
- A 62.5 m
- B 12.5 m
- C 5 m
- D 75 m



# Physics Paper 1 Exam Question – Electromagnetism

The diagram shows the set-up of a simple motor used in a motorised bicycle. Describe how the simple motor works to drive the bicycle up a hill.

(5)



# Student Response 1

When the switch is closed a current flows in the wire and it becomes an electromagnet. The motor then spins and drives the bike up the hill so the cyclist doesn't need to do any work.

Is this a good answer?

# Student Response 1: Verdict

When the switch is closed a current flows in the wire and it becomes an electromagnet. The motor then spins and drives the bike up the hill so the cyclist doesn't need to do any work.

This answer is very basic and would have scored a possible 2/5. They have made two good statements but these require more detail to gain higher marks.

# Student Response 1: Improvements

When the switch is closed a current flows in the wire

The student needs to be more specific and identify that the current flows through the coil.  
and it becomes an electromagnet.

Correct idea.

More detail is now required in order to score higher marks. The student would need to identify that the magnetic field around the coil interacts with the permanent magnetic field surrounding the coil.

This then results in a force acting on the wire causing the coil to spin.

The student could comment on how Fleming's left-hand rule could be used to identify how it might rotate.

The motor then spins and drives the bike up the hill so the cyclist doesn't need to do any work.

The student should explain that the motor spins due to the turning effect created by the force being applied.

## Student Response 2

If the switch is closed the current flows around the coil of wire and creates a magnetic field around it. This magnetic field interacts with the external magnetic field provided by the permanent magnets. This provides a force that acts in opposite directions on either side of the coil causing it to spin.

Is this a good answer?

# Student Response 2: Commentary

If the switch is closed the current flows around the coil of wire and [1]

Need to say flows around the coil of wire to get a mark.

creates a magnetic field around it. [1]

What is the consequence of the current in the wire? the magnetic field

This magnetic field interacts with the external magnetic field provided by the permanent magnets. [1]

Why is the magnetic field around the wire important? Because it acts like another magnet and will respond to the external magnetic field.

This provides a force [1] that acts in opposite directions [1] on either side of the coil causing it to spin.

The effect of the two magnets interacting is the movement of the coil.

The examiner needs to see that you understand the cause and effect of each of the steps above.

**Chapter 1 Answers****1**

Quantity	Units
distance	m
displacement	m
speed	m/s
velocity	m/s
acceleration	m/s <sup>2</sup>

**2** Stephen's speed = distance/time;  $1500/270 = 5.6$  m/s (2 sf)

Claire's speed = distance/time; time to be converted to seconds;

4 mins x 60 seconds = 240 + 35 = 275 s;

speed = distance/time;  $1500/275 = 5.45$  m/s

Therefore, Claire is slower than Stephen, which means that Maisie is correct.

**3** Velocity is the change in displacement divided by time; acceleration is change in velocity/time.

**4 a** He is accelerating

**b** average speed = total distance/total time taken; av. speed =  $100/9.75$  seconds = 10.3 m/s

**c** Max speed: gradient of graph at the steepest point;

Largest triangle: change in y/change in X;  $(90 - 20)/(9 - 3) = 12$  m/s (2 sf)

**d** The average speed considers all of the changes of speed for Usain whereas the maximum is just taking the fastest speed at a given point.

**5 a** Well-plotted graph

**b** Student uses gradient of the graph to calculate the acceleration.

**c** Student uses the area under their graph to calculate the distance travelled.

6 a

Engine	Final velocity/m/s	Final acceleration / m/s/s/
A	264	13.2
B	288	14.4
C	296	14.8
D	272	13.6

b Repeat the measurements and take an average of the results for each engine type.



## Chapter 1: Movement and Position

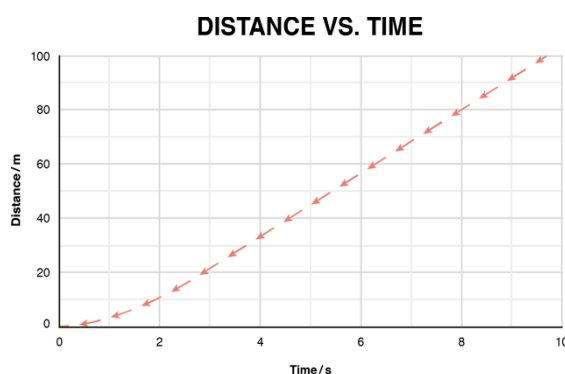
1 Complete the table below with the correct corresponding quantities and units.

Quantity	Units
	m
displacement	
speed	
velocity	
	$\text{m/s}^2$

2 Sarah and Maisie are analysing data from their school sports day. Looking at the 1500 m results for Stephen and Claire, Maisie believes that Stephen's speed is faster because he completes the race in 270 seconds whereas Claire completes it in 4 minutes 35s. Sarah says that Maisie is incorrect and that it is Claire who is quicker. Which of the students is correct? Give reasoning for your answer.

3 Velocity and acceleration are different quantities. Describe the difference between velocity and acceleration.

4 Usain Bolt has been credited as the fastest man in the world over 100 m. Below is a distance–time graph of one of his fastest training runs.



a Describe Usain's motion during the first 2 seconds.

b Using the graph above, calculate Usain Bolt's average speed for the race.

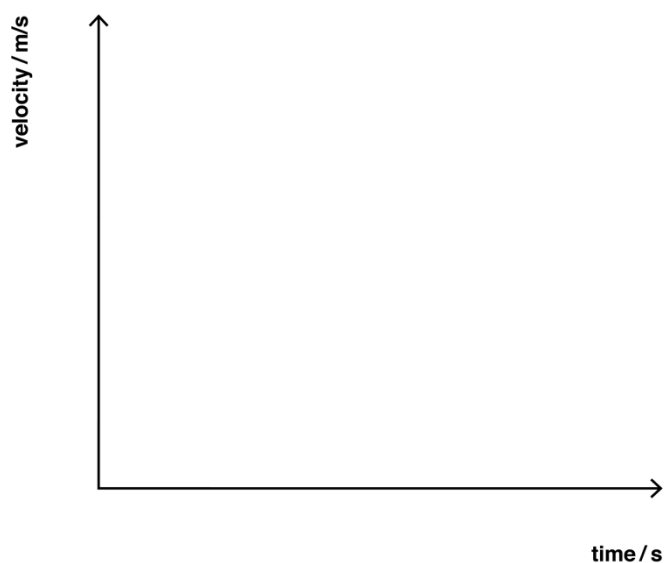
c Now calculate his maximum speed.

d Suggest one reason why these results differ.

5 Paul was asked to investigate the velocity of a ball as it rolled down a tilted ramp. He used a data logger at five equally spaced intervals along the ramp to record its velocity at particular points. The results he recorded are in the table below.

Data logger position	A	B	C	D	E
Velocity/m/s	0.9	2.9	6.0	9.8	14.8
Time/s	0.5	1	1.5	2.0	2.5

a Using the data, plot a velocity–time graph for Paul's results.



b Calculate the acceleration of the trolley down the ramp. Include the units in your answer.

c If data logger E is at the end of the ramp, calculate the length of the ramp Paul used.

6 McFarlane racing engineers are testing a variety of new engines in their latest model F1 car. They are testing which engine has the greatest top speed from rest. The engines all accelerate on average for 20 s. The resulting distances are recorded in the table below.

Engine	Final velocity/m/s	Final acceleration / m/s/s/
A	264	
B	288	
C	296	
D	272	

a Using the data in the table and the equation  $a = (v - u)/t$ , calculate the acceleration of the cars in the first 20 seconds.

b One of the engineers noted that each engine's results were recorded only once. How could any errors in the recording of results be reduced?