Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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10	
11	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Additional Science
Unit 5

AS1HP

H

Tuesday 12 May 2015 1.30 pm to 3.00 pm

For this paper you must have:
- a ruler
- a calculator
- the Chemistry Data Sheet and Physics Equations Sheet Booklet (enclosed).

Time allowed
- 1 hour 30 minutes

A

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 1(b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

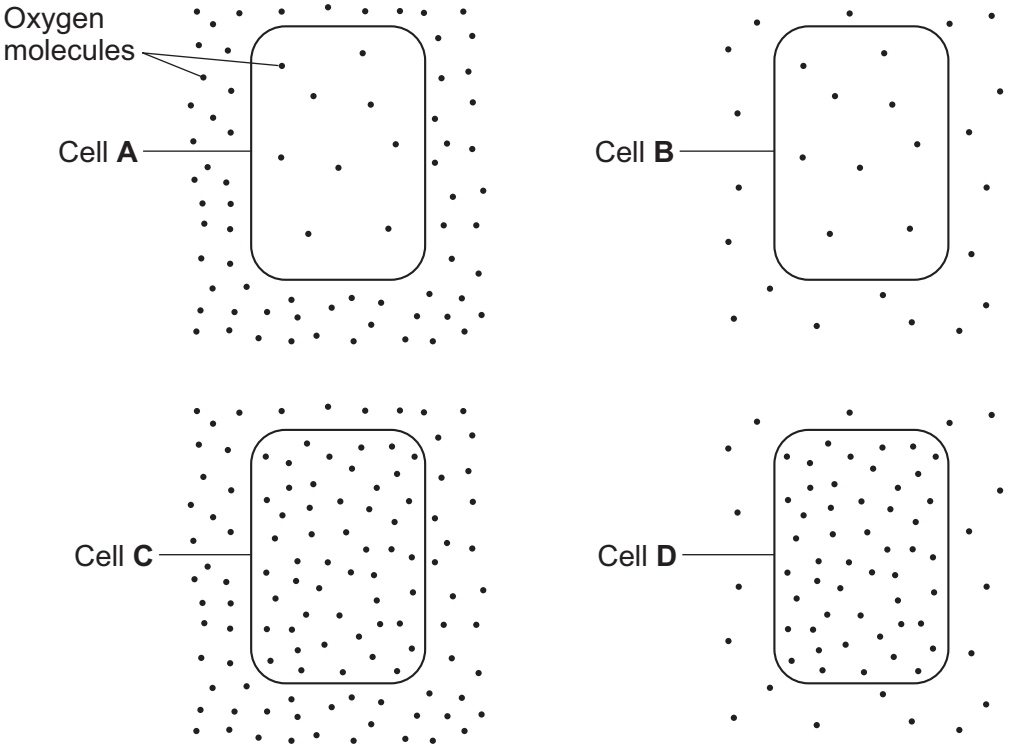
Answer **all** questions in the spaces provided.

Biology Questions

1 (a) **Figure 1** shows four cells, **A**, **B**, **C** and **D**. Each cell is surrounded by oxygen molecules.

Oxygen molecules can move into cells or out of cells.

Figure 1



1 (a) (i) Name the process by which oxygen moves into cells or out of cells.

[1 mark]

.....

1 (a) (ii) Into which cell, **A**, **B**, **C** or **D**, will oxygen move the fastest?

[1 mark]

Cell .....

1 (a) (iii) Give the reason for your answer to part **(a)(ii)**.

[1 mark]

.....

.....

1 (a) (iv) Why do cells need oxygen?

[1 mark]

.....

.....

1 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The cells in large plants and animals are organised into tissues, organs and organ systems.

Describe each level of organisation of cells and give examples of these in plants and animals.

Do **not** refer to the parts of cells.

[6 marks]

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Extra space .....

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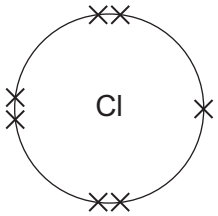
10

Chemistry Questions

2 This question is about chlorine and compounds of chlorine.

Figure 2 represents the outer shell electrons in an atom of chlorine.

Figure 2



2 (a) (i) A chlorine atom contains three different types of particle.

Complete **Table 1** to show the relative mass of each particle.

[2 marks]

Table 1

Name of particle	Relative mass of particle
proton	
neutron	1
electron	

2 (a) (ii) Atoms of chlorine can have different numbers of neutrons.

Complete the sentence.

[1 mark]

Atoms of chlorine with different numbers of neutrons are called ..... .

2 (a) (iii) Calculate the number of neutrons in an atom of $^{35}_{17}Cl$

[1 mark]

.....

Number of neutrons = ...

2 (b) Two chlorine atoms combine to form a chlorine molecule.

2 (b) (i) Name the type of bonding in a chlorine molecule.

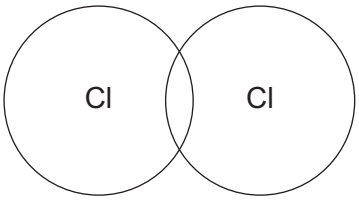
[1 mark]

.....

2 (b) (ii) Complete **Figure 3** to show the arrangement of the outer shell electrons in a chlorine molecule.

[2 marks]

Figure 3



2 (c) Chlorine reacts with sodium to produce sodium chloride.

2 (c) (i) Write the word equation for the reaction to produce sodium chloride.

[1 mark]

.....

2 (c) (ii) Sodium chloride has the formula NaCl.

How does this formula show that sodium chloride is a compound?

[1 mark]

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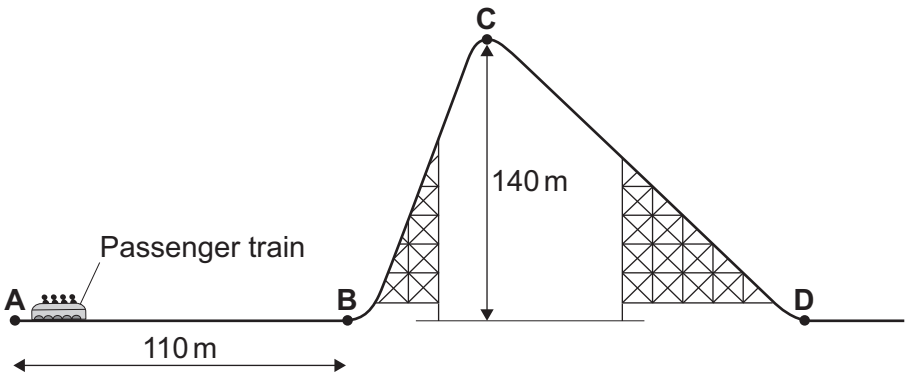
9

Turn over for the next question

Physics Questions

3 **Figure 4** shows the first part of a roller-coaster ride.

Figure 4



3 (a) The passenger train accelerates from point **A** to point **B**, a distance of 110 m.

A constant force of 141 kN acts to accelerate the passenger train between point **A** and point **B**.

3 (a) (i) Calculate the work done to accelerate the passenger train between point **A** and point **B**.
[3 marks]

Use the correct equation from the Physics Equations Sheet. Give the unit.

.....

.....

Work done = ... unit .....

3 (a) (ii) Use the correct answer from the box to complete the sentence.
[1 mark]

chemical	**gravitational potential**	**kinetic**

The work done to accelerate the passenger train from point **A** to point **B** increases the

..... energy of the passenger train.

3 (b) (i) From point **B** to point **C**, shown in **Figure 4**, the passenger train climbs a vertical height of 140 m.

Calculate the increase in gravitational potential energy of the passenger train as it climbs from point **B** to point **C**.

[2 marks]

The mass of the passenger train is 8325 kg.

The gravitational field strength is 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Increase in gravitational potential energy = ... J

3 (b) (ii) The passenger train stops at point **C** and then falls, due to gravity, towards point **D**.

State the maximum increase in kinetic energy of the passenger train as it moves from point **C** to point **D**.

[1 mark]

Maximum increase in kinetic energy = ... J

3 (b) (iii) The actual increase in kinetic energy of the passenger train as it falls from point **C** to point **D** is less than your answer to part **(b)(ii)**.

Why?

[1 mark]

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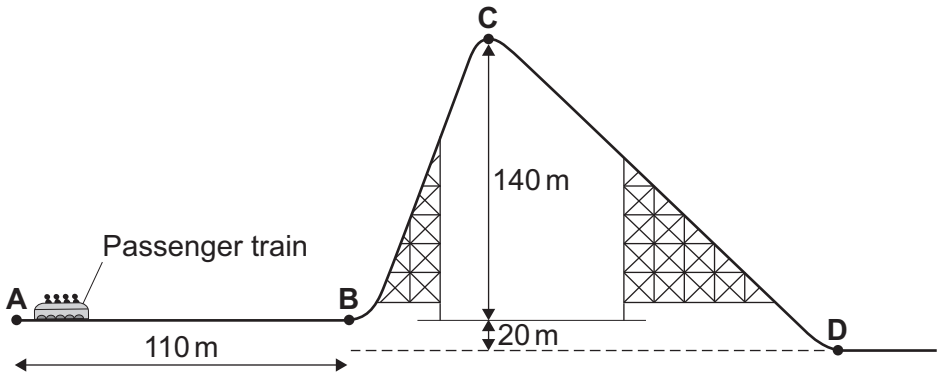
Question 3 continues on the next page

3 (c) **Figure 5** shows a different roller-coaster design.

Figure 5



What effect will the change in design have on the velocity of the passenger train at point **D**?

[1 mark]

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3 (d) On many roller-coaster rides the passengers feel the effect of large accelerations on their bodies.

Table 2 shows some of the effects that can occur.

Table 2

Acceleration in m/s^2	Possible effect
10	Feeling of heaviness
20	Difficulty in moving arms and legs
30	Limited eyesight
40	Unconsciousness

In the United Kingdom there is no legal limit on the maximum acceleration a passenger should experience during a roller-coaster ride.

Do you think there should be a legal limit?

Give a reason for your answer.

[1 mark]

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10

Turn over for the next question

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Biology Questions

4 Green plants use light energy to make their own food in the process of photosynthesis.

4 (a) (i) Complete the word equation for photosynthesis.

[2 marks]

carbon dioxide + water ⟶ ..... + ...

4 (a) (ii) One product of photosynthesis can be used by plants to make other useful substances.

Complete **Table 3** to name these substances.

[3 marks]

Table 3

Information about the substance	Name of substance
Used to strengthen cell walls	
Used for storage	
Made using nitrate ions	

4 (a) (iii) Name **one** tissue used to transport substances around a plant.

[1 mark]

.....

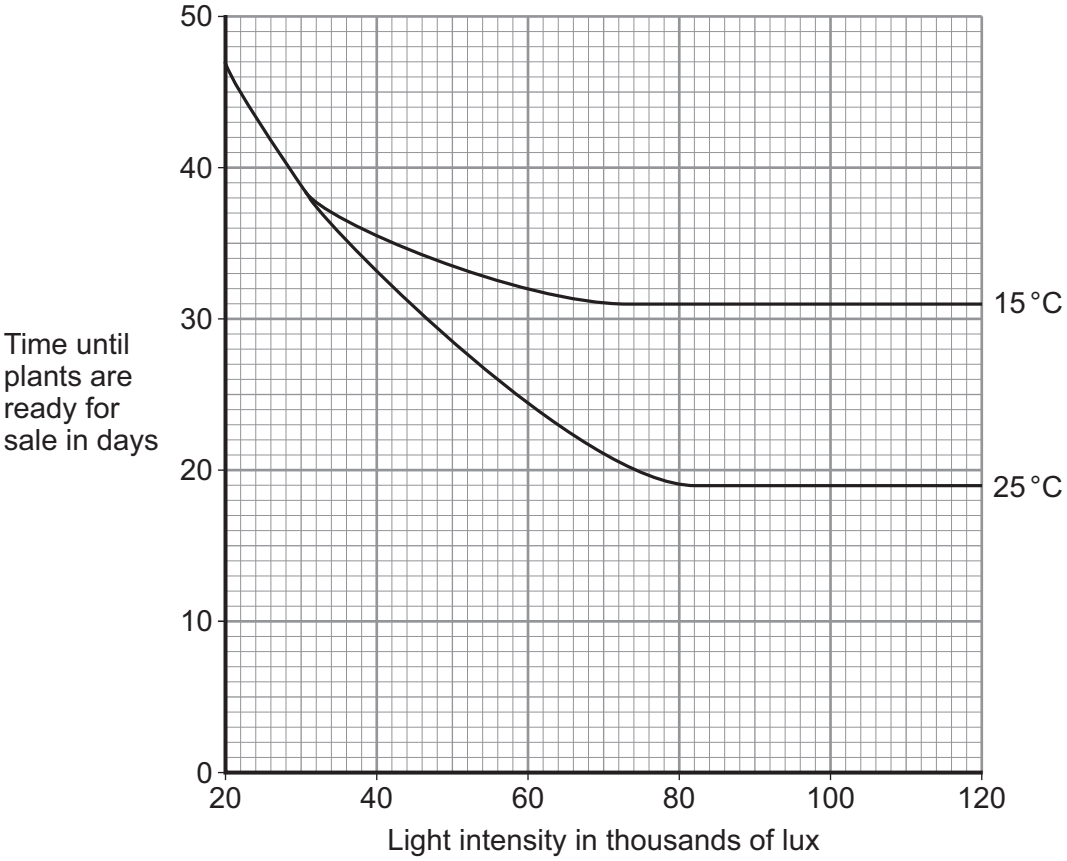
4 (b) Marigold plants can be bought from garden centres in the spring.
The owner of a garden centre needs the plants to grow as quickly as possible.

Scientists investigated the effect of changing the light intensity and the temperature in the greenhouses where marigolds are grown.

Question 4 continues on the next page

Figure 6 shows the results.

Figure 6



4 (b) (i) The rate of photosynthesis is affected by limiting factors.
What is meant by 'limiting factors'?

[1 mark]

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.....

4 (b) (ii) What was the lowest light intensity to produce the fastest growth rate of the marigold plants at 25 °C?
Use information from **Figure 6**.

[1 mark]

Light intensity = ... thousand lux

4 (b) (iii) Suggest why the owners of the garden centre might decide **not** to use 25 °C and the light intensity you gave in part **(b)(ii)**, when growing marigolds for sale in greenhouses.

[1 mark]

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.....

4 (b) (iv) The data on the graph was collected at a carbon dioxide concentration of 0.04%.

On **Figure 6**, draw a line to show what you would expect to happen if the marigolds were grown at 25 °C and a carbon dioxide concentration of 0.4%.

Justify where you have drawn your line.

[3 marks]

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12

Turn over for the next question

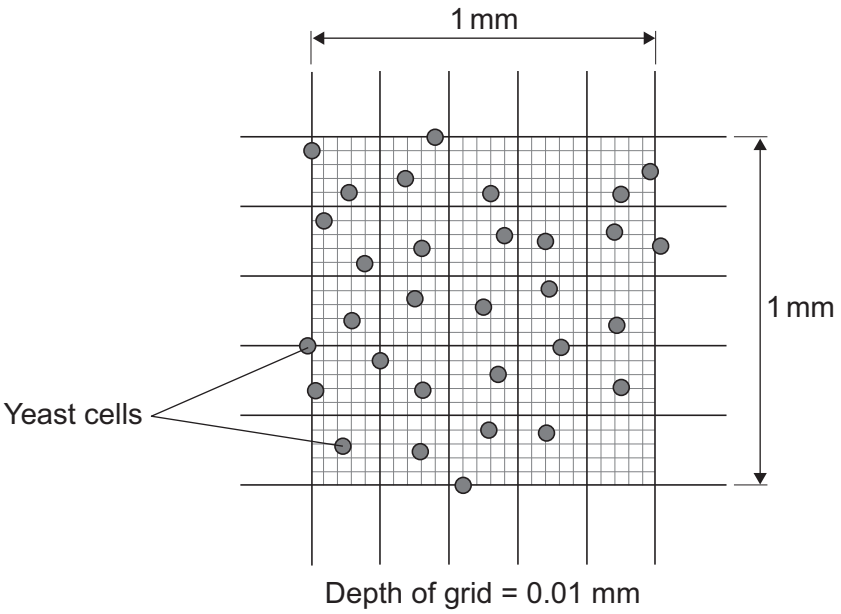
5 For 7 days students investigated changes in the population of yeast cells in a flask containing sugar solution.
The students used a counting chamber to estimate the number of the yeast cells in the sugar solution each day.

A counting chamber has a grid 1 mm × 1 mm and has a depth of 0.01 mm.

Four days after the start of the investigation, a sample was put into the counting chamber.

Figure 7 shows the view of the counting chamber through a microscope.

Figure 7



5 (a) (i) The students decided to:

- include in the count all the yeast cells partly inside the upper and left sides of the grid
- **not** count all the yeast cells partly inside the lower and right sides of the grid.

Suggest a different method of overcoming the problem of yeast cells partly inside the grid.

[1 mark]

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5 (a) (ii) The number of yeast cells per mm^3 of solution can be found using the formula:

$$\text{Number} = \frac{\text{actual number counted}}{\text{volume of liquid in } mm^3}$$

Using the **students'** method, calculate the number of the yeast cells per mm^3 of solution.
Show clearly how you work out your answer.

[3 marks]

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Number of yeast cells per mm^3 of solution = ...

5 (b) **Table 4** shows the results collected by the students.

Table 4

Time in days	0	1	2	3	4	5	6	7
Number of yeast cells per mm^3 of solution	11	44	176	704		11 200	2100	0

5 (b) (i) Describe the pattern of increase in the population of yeast cells between day 0 and day 3.

[2 marks]

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5 (b) (ii) Suggest **two** possible reasons for the rapid decrease in the population of yeast cells after day 5.

[2 marks]

1 .....

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2 .....

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8

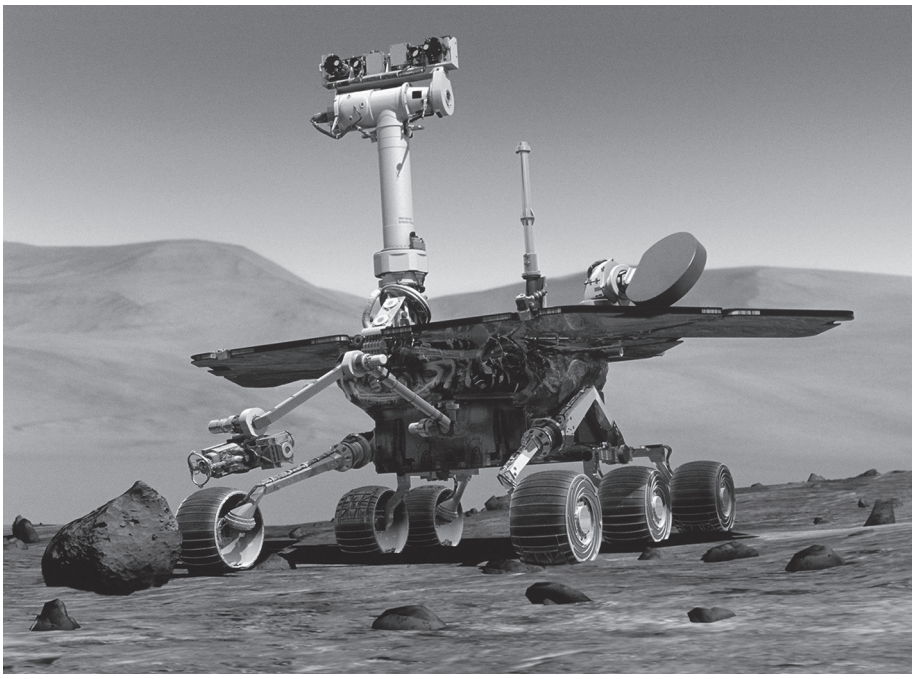
Chemistry Questions

6 Space probes are used to investigate the atmosphere of Mars.

95.3% of the atmosphere of Mars is carbon dioxide.

Figure 8 shows a space probe.

Figure 8



6 (a) The space probes analyse the atmosphere of Mars using an instrumental method known as GC-MS.

GC-MS identifies substances very quickly.

Give **one** other advantage of using GC-MS to identify substances.

[1 mark]

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6 (b) Describe how a gas chromatography column separates the substances in a mixture.

[2 marks]

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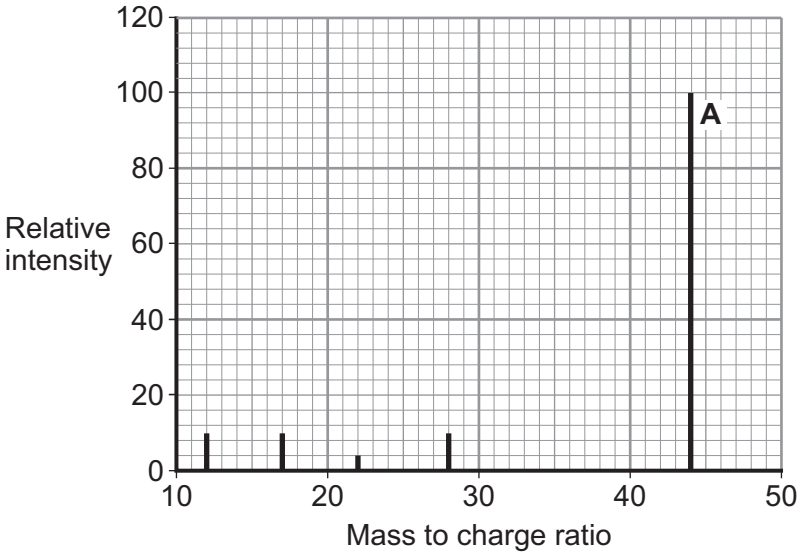
6 (c) **Figure 9** shows part of the results obtained when GC-MS was used to identify substances in a mixture. The peak labelled **A** is the molecular ion peak for carbon dioxide.

Figure 9



What conclusion about carbon dioxide can be made from the molecular ion peak in **Figure 9**?

[2 marks]

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Question 6 continues on the next page

6 (d) Carbon dioxide is a simple molecule.

6 (d) (i) Explain why simple molecules have low melting and boiling points.

[2 marks]

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6 (d) (ii) Substances made of simple molecules do **not** conduct electricity at room temperature.

Why?

[1 mark]

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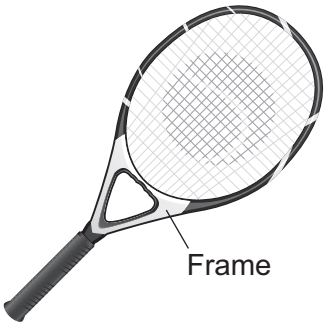
8

7 **Figure 10** shows a tennis racket.

Figure 10



7 (a) The properties of some of the materials used to make tennis racket frames are shown in **Table 5**.

Table 5

Material	Density in g/cm^3	Relative strength
Wood	0.71	0.103
Carbon fibre	2.0	3.0
Carbon nanotube	1.5	60

Use the information in **Table 5** to evaluate the use of the materials in tennis racket frames.

[3 marks]

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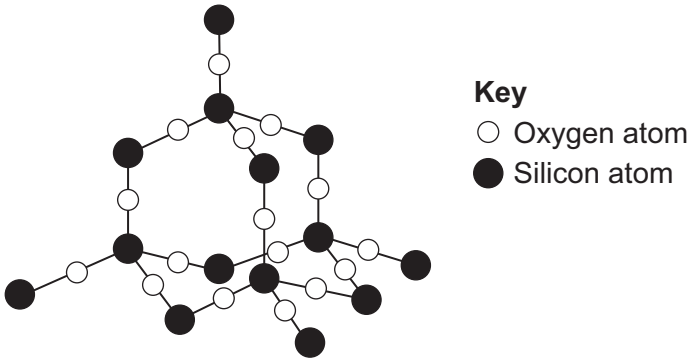
Question 7 continues on the next page

7 (b) Some carbon fibre rackets are made with nano-sized silicon dioxide crystals in the frame. The structure of silicon dioxide (SiO_2) is shown in **Figure 11**.

Figure 11



Describe the structure and bonding of silicon dioxide.

[3 marks]

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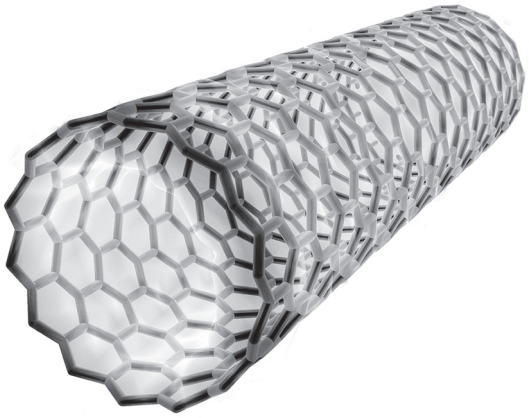
7 (c) Some tennis rackets are made with carbon nanotubes in the frame.

Figure 12 shows the structure of a carbon nanotube.

Figure 12



Use **Figure 12** to give **one** similarity and **one** difference between the structure of a carbon nanotube and the structure of graphite.

[2 marks]

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8

Turn over for the next question

8 Rubies are used in jewellery.

8 (a) Rubies are mainly aluminium oxide (Al_2O_3).

The relative formula mass (M_r) of aluminium oxide is 102.

Relative atomic masses (A_r): Al = 27; O = 16

What is the percentage of aluminium in aluminium oxide?

Draw a ring around the correct answer.

[1 mark]

16% **26%** **42%** **53%**

8 (b) Synthetic rubies are coloured red by an oxide of chromium.

A sample of the oxide of chromium contains 13 g of chromium and 24 g of oxygen.

Relative atomic masses (A_r): Cr = 52; O = 16

Calculate the empirical formula of this oxide of chromium.

You must show your working in your answer.

[4 marks]

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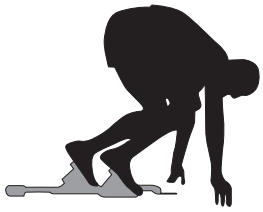
Turn over for the next question

Physics Questions

9 **Figure 13** shows a sprinter on the starting blocks just before the start of a 100 m race.

Figure 13



9 (a) (i) The starting gun is fired.

The sprinter accelerates from rest at 4.8 m/s^2 for 2.5 s.

Calculate the velocity of the sprinter after 2.5 s.

[2 marks]

Use the correct equation from the Physics Equations Sheet.

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Velocity = ... m/s

9 (a) (ii) **Figure 14** shows the distance–time graph of a sprinter.

The graph starts from when the gun is fired.

Figure 14

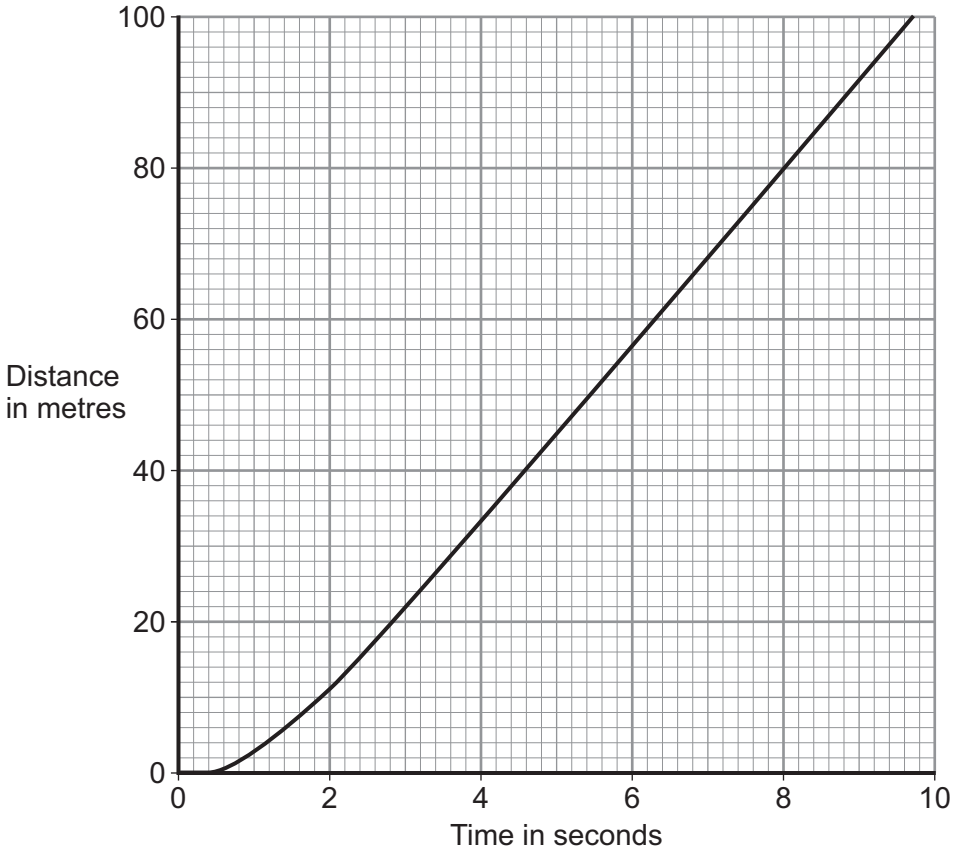

Figure 14 shows that the sprinter does not move until 0.5 seconds after the gun has been fired.

Suggest why.

[1 mark]

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9 (a) (iii) What does the gradient of the graph in **Figure 14** represent?

[1 mark]

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Question 9 continues on the next page

9 (b) To accelerate at 4.8 m/s^2, the sprinter produces a resultant force of 450 N.

Calculate the mass of the sprinter.

[3 marks]

Use the correct equation from the Physics Equations Sheet.

Give your answer to **two** significant figures.

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Mass = ... kg

9 (c) **Table 6** shows the 100 m sprint world record times from four different years and the wind speed during each race.

Table 6

Year of the race	Wind speed in m/s	World record time in seconds
1964	1.3	10.06
1988	1.1	9.92
1999	0.1	9.79
2009	0.0	9.58

The data in **Table 6** suggests that there is a pattern between wind speed and the world record time for 100 m.

9 (c) (i) Describe the pattern suggested by the data.

[1 mark]

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9 (c) (ii) It is **not** possible to be certain that there is a relationship between the wind speed and the world record time.

Suggest **one** reason why.

[1 mark]

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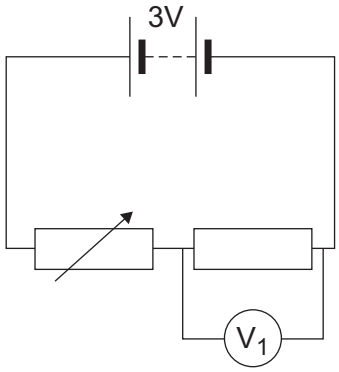
9

Turn over for the next question

10 In an electrical circuit, resistors may be connected in series or in parallel.

10 (a) **Figure 15** shows a variable resistor and a fixed resistor connected in a circuit in series.

Figure 15



The resistance of the variable resistor in **Figure 15** is increased.

What is the effect, if any, on the reading on voltmeter $\mathbf{V_1}$?

[1 mark]

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Give **one** reason for your answer.

[1 mark]

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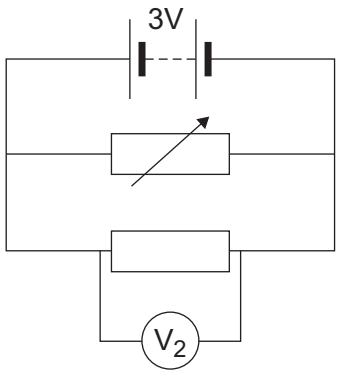
10 (b) **Figure 16** shows a variable resistor and a fixed resistor connected in a circuit in parallel.

Figure 16



The resistance of the variable resistor in **Figure 16** is increased.

What is the effect, if any, on the reading on voltmeter $\mathbf{V_2}$?

[1 mark]

.....

Give **one** reason for your answer.

[1 mark]

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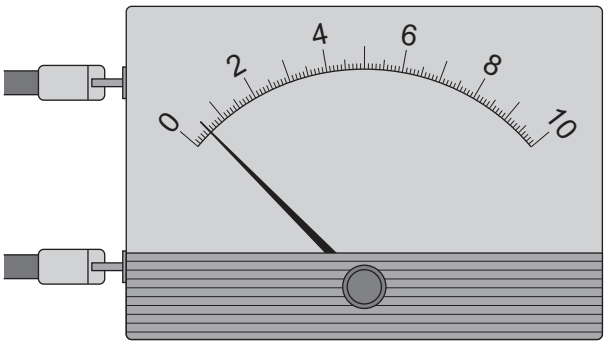
10 (c) The circuit shown in **Figure 15** was disconnected. **Figure 17** shows the voltmeter after the circuit was disconnected.

Figure 17



What type of error is shown by the voltmeter in **Figure 17**?

[1 mark]

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5

Turn over for the next question

11 **Figure 18** shows an astronaut walking on the Moon.

Figure 18

11 (a) (i) The gravitational field strength on the Moon is less than it is on the Earth.

How does the amount of force needed to lift a mass on the Moon compare with the amount of force needed to lift the same mass on the Earth?

[2 marks]

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Give the reason for your answer.

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11 (a) (ii) Give **one** benefit for the astronaut of the lower gravitational field strength.

[1 mark]

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11 (b) When an astronaut walks on the Moon, a negative electrostatic charge builds up on the astronaut's boots.

Explain why.

[3 marks]

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6

END OF QUESTIONS

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