AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: SYNERGY

F

Foundation Tier Paper 1 Life and Environmental Sciences

Tuesday 12 May 2020 Afternoon Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a protractor
- a scientific calculator
- the periodic table (enclosed)
- the Physics Equations Sheet (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

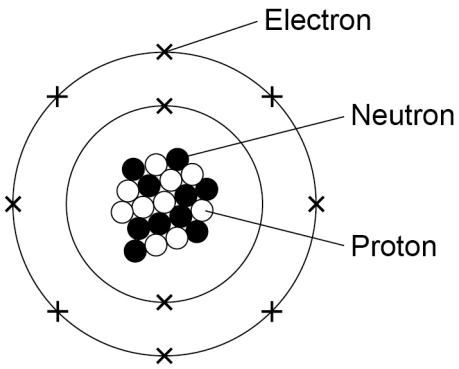
Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 **Figure 1** represents a neon atom.

Figure 1



0 1 . 1 What is the name of the centre of the atom?

[1 mark]

Tick (✓) **one** box.

Energy level ☐

Isotope ☐

Nucleus ☐

0 1 . 2 Which particle has a positive charge?

[1 mark]

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

Do not write outside the box

0 1 . 3 Which particle has the smallest mass?

[1 mark]

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

0 1 . 4 What is the electronic structure of neon?

Use **Figure 1**.

[1 mark]

Tick (✓) **one** box.

2,8 ☐

2,10 ☐

2,8,20 ☐

10,10,10 ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 5 There are 18 particles of neon in every 1 000 000 particles of air.

Which equation shows how to calculate the percentage of neon particles in the air?

[1 mark]

Tick (✓) **one** box.

$$\text{percentage} = \frac{18\,000\,000}{100} \times 100$$ ☐

$$\text{percentage} = \frac{1\,000\,000}{18} \times 100$$ ☐

$$\text{percentage} = \frac{18}{1\,000\,000} \times 100$$ ☐

Do not write outside the box

0 1 . 6 **Figure 2** shows a sign containing neon. The sign is connected to an electrical supply.

The sign glows when the electrical supply is switched on.

Figure 2



What type of electromagnetic radiation is emitted by the neon atoms when the sign is switched on?

[1 mark]

Tick (✓) **one** box.

Gamma rays ☐

Microwaves ☐

Radio waves ☐

Visible light ☐

0 1 . 7 Some elements emit ultraviolet (UV) radiation when electricity is supplied.

Sun tanning beds emit UV radiation.

Give **two** health risks of exposure to UV radiation.

[2 marks]

1 _____

_____

2 _____

_____

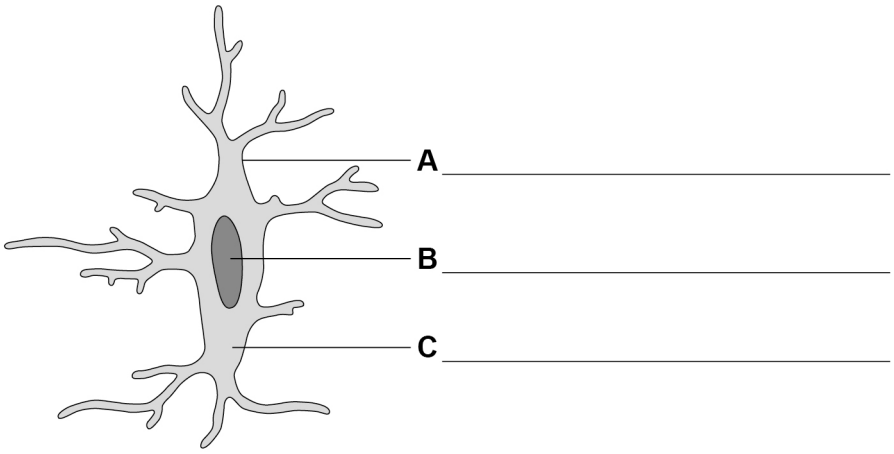
8

Turn over ►

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0 2 **Figure 3** shows a human bone cell.

Figure 3



0 2 . 1 Label the cell structures **A**, **B** and **C** on **Figure 3**.

[3 marks]

0 2 . 2 Which structure in the cell contains DNA?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Do not write outside the box

0 2 . 3 A student used a microscope to view a cell.

The length of the image of the cell was 40 mm

The real length of the cell was 0.25 mm

Calculate the magnification of the image.

Use the equation:

$$\text{magnification} = \frac{\text{length of image}}{\text{length of real object}}$$

[2 marks]

Magnification = ×

0 2 . 4 Root hair cells are found on the roots of plants.

Root hair cells do **not** photosynthesise.

Give **one** structure found in a leaf cell, but **not** in a root hair cell.

[1 mark]

Question 2 continues on the next page

Do not write outside the box

0 2 . 5 Which **two** structures are found in plant cells but **not** in animal cells?

[2 marks]

Tick (✓) **two** boxes.

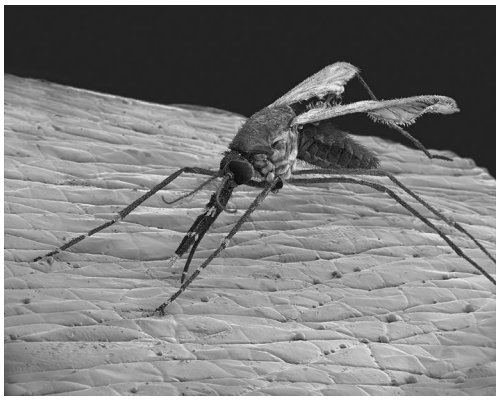
- Cell wall ☐
- Mitochondria ☐
- Permanent vacuole ☐
- Plasmid ☐
- Ribosome ☐

9

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0 3 **Figure 4** shows a mosquito on human skin.

Figure 4



Malaria is a communicable disease.

Mosquitos can transmit malaria when they bite.

0 3 . 1 What is a communicable disease?

[1 mark]

Tick (✓) **one** box.

A disease caused by a faulty allele ☐

A disease caused by a pathogen ☐

A disease caused by obesity ☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 2 Humans have adaptations to defend the body against pathogens.

Draw **one** line from each body part to the adaptation that defends against pathogens.

[3 marks]

Body part	Adaptation
Skin	Has a large surface area
Stomach	Is a physical barrier
Trachea	Produces acid to kill pathogens
	Secretes mucus to trap pathogens

0 3 . 3 What type of chemical is used to kill mosquitos?

[1 mark]

Tick (✓) **one** box.

- Fungicide ☐
- Herbicide ☐
- Pesticide ☐

Scientists are trying to reduce the number of people developing malaria by using genetically modified (GM) mosquitos.

0 3 . 4 Mosquitos have 6 chromosomes in each normal body cell.

How many chromosomes are in each egg cell from a mosquito?

[1 mark]

Tick (✓) **one** box.

3 ☐ 6 ☐ 9 ☐ 12 ☐

Do not write outside the box

0 3 . 5 Which statement describes genetic modification?

[1 mark]

Tick (✓) **one** box.

A species evolving in two different areas ☐

Genes from one organism being transferred to another organism ☐

Male gametes and female gametes fusing during fertilisation ☐

0 3 . 6 GM mosquitos can be produced in large numbers in laboratories.

These GM mosquitos can be released to reduce the population of wild mosquitos.

What is **one** advantage of using GM technology to reduce the population of wild mosquitos?

[1 mark]

Tick (✓) **one** box.

Decreases the use of chemicals to kill mosquitos ☐

Genes may spread to other insects ☐

Has unknown impacts on the mosquito food web ☐

The high cost of GM technology ☐

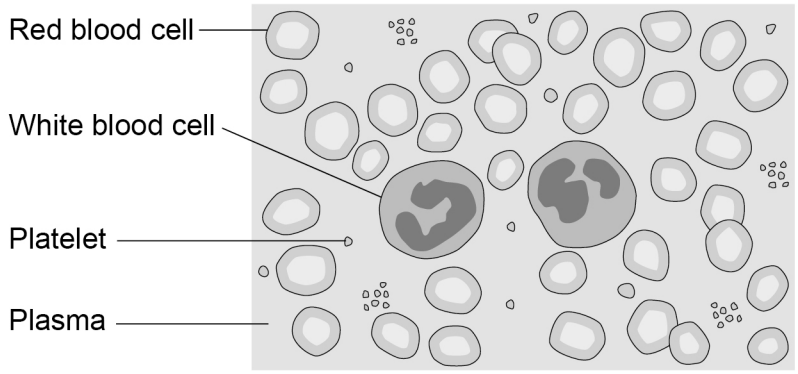
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Turn over for the next question

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0 4 **Figure 5** shows a diagram of blood.

Figure 5



0 4 . 1 Cells in the blood are specialised to have particular functions.

What process produces specialised cells?

[1 mark]

Tick (✓) **one** box.

Classification ☐

Differentiation ☐

Fertilisation ☐

Do not write outside the box

0 4 . 2 Draw **one** line from each blood component to a function of the component.

[3 marks]

Blood component	Function
Platelet	Carries nitrogen
Red blood cell	Carries oxygen
White blood cell	Defends against infection
	Helps blood to clot

0 4 . 3 Some blood cells carry out phagocytosis.

What is phagocytosis?

[1 mark]

Tick (✓) **one** box.

- Engulfing pathogens ☐
- Producing antibodies ☐
- Releasing antitoxins ☐

Question 4 continues on the next page

Do not write outside the box

Cystic fibrosis is an inherited condition.

The allele for **not** having cystic fibrosis is dominant, **R**.

The recessive allele is **r**.

0 4 . 4 What term describes the genotype **Rr**?

[1 mark]

Tick (✓) **one** box.

Genome ☐

Heterozygous ☐

Variation ☐

0 4 . 5 Having symptoms of cystic fibrosis is a person's phenotype.

What does the term 'phenotype' mean?

[1 mark]

Tick (✓) **one** box.

All the genetic material of an organism ☐

The observable characteristics of an organism ☐

The effect of only the environment on an organism ☐

Do not write outside the box

0 4 . 6 Two people are planning to have a child.

Complete **Figure 6** to show the possible genotypes of the child.

[2 marks]

Figure 6

		Mother: R	Mother: r
Father	R		
Father	r	R r	r r

0 4 . 7 Draw a ring around **one** of the offspring in **Figure 6** that would have cystic fibrosis.

[1 mark]

0 4 . 8 What is the percentage chance of the child having cystic fibrosis?

[1 mark]

Tick (✓) **one** box.

25% ☐ 50% ☐ 75% ☐ 100% ☐

0 4 . 9 New drugs are being developed to treat the symptoms of cystic fibrosis.

Trials of new drugs are needed to work out the correct dose of the drug to use.

Give **one** other reason why drugs are trialled before they are used by patients.

Do **not** refer to dosage in your answer.

[1 mark]

_____

_____

12

Do not write outside the box

0 5 **Table 1** shows the concentration of some substances outside a cell and inside a cell.

Table 1

	Concentration in arbitrary units	
Substance	**Outside the cell**	**Inside the cell**
Chloride ions	116	4
Potassium ions	4	120
Sodium ions	145	12

0 5 . 1 Complete the sentences.

Choose answers from the box.

Use information from **Table 1**.

[2 marks]

active transport	**diffusion**	**osmosis**

Chloride ions move into the cell by _____ .

Potassium ions move into the cell by _____ .

0 5 . 2 Why do sodium ions move **into** the cell?

Use information from **Table 1**.

[1 mark]

_____

_____

Do not write outside the box

0 5 . 3 Calculate how many times greater the potassium ion concentration is inside the cell compared with outside the cell.

[1 mark]

Number of times greater = _____

0 5 . 4 Name the process that releases energy in cells.

[1 mark]

_____

0 5 . 5 Which process needs energy to move a substance into a cell?

[1 mark]

Tick (✓) **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

0 5 . 6 Give **two** factors that affect the rate of diffusion.

[2 marks]

1 _____

2 _____

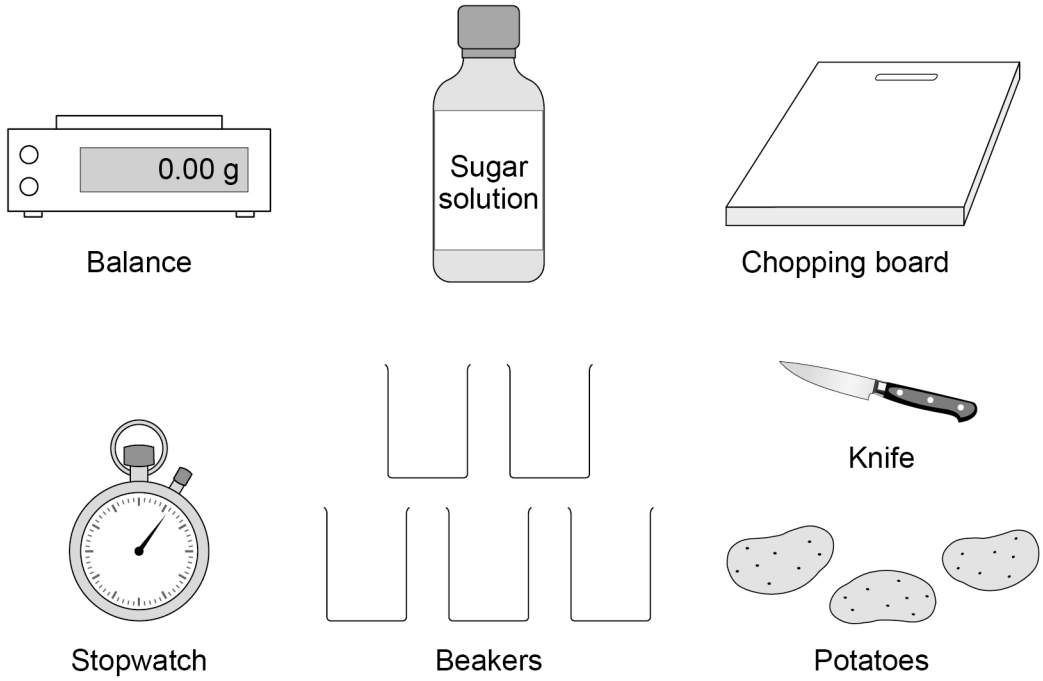
Question 5 continues on the next page

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0 5 . 7 Students investigated the change in mass of potato pieces in different concentrations of sugar solution.

Figure 7 shows some of the equipment used.

Figure 7



Describe a method to investigate the effect of different concentrations of sugar solution on the change in mass of potato pieces.

[6 marks]

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14

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 6 The electromagnetic spectrum is made up of waves with different wavelengths and frequencies.

0 6 . 1 Draw **one** line from each type of electromagnetic wave to a use of that type of wave.

[3 marks]

Electromagnetic wave	Use
Radio waves	Cooking food
Visible light	Detecting broken bones
X-rays	Fibre optic communications
	Transmitting TV programmes

Question 6 continues on the next page

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A student investigated how the type of surface affects the amount of infrared the surface radiates.

The student used a hollow metal cube.

Four of the surfaces of the cube were different.

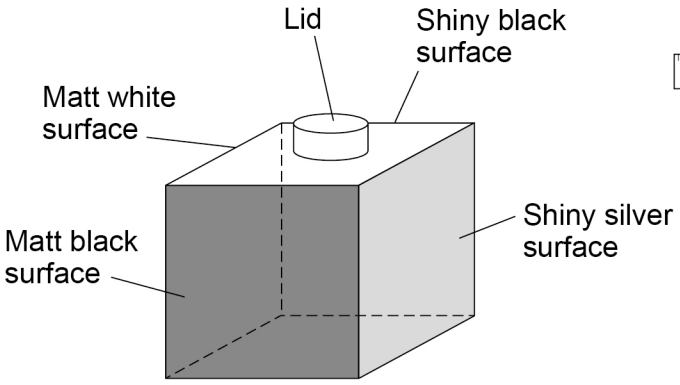
This is the method used.

1. Fill the cube with hot water and seal it with a lid.

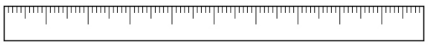
2. Measure the infrared radiation emitted from each surface using an infrared detector.

Figure 8 shows the equipment used.

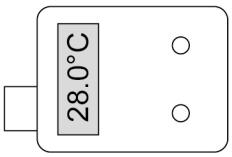
Figure 8



Hollow metal cube



Ruler



Infrared detector: uses infrared to give a temperature

Do not write outside the box

0 6 . 2 **Table 2** shows some of the variables in this investigation.

Table 2

Variable	Independent	Dependent	Control
Distance between infrared detector and surface of cube			✓
Starting temperature of water inside cube			
Temperature measured by infrared detector			
Type of surface			

Identify each variable as an independent, dependent or control variable.

Tick (✓) **one** box in each row on **Table 2**.

One row has been completed for you.

[3 marks]

Question 6 continues on the next page

Do not write outside the box

Table 3 shows the results.

Table 3

Type of surface	Temperature in °C
Shiny black	66.5
Matt white	61.0
Matt black	69.0
Shiny silver	26.0

0 6 . 3 What was the resolution of the infrared detector?

[1 mark]

Tick (✓) **one** box.

0.5 °C ☐

1.0 °C ☐

26.0 °C ☐

66.5 °C ☐

0 6 . 4 What was the range of temperatures recorded?

[1 mark]

Range = _____ °C to _____ °C

Do not write outside the box

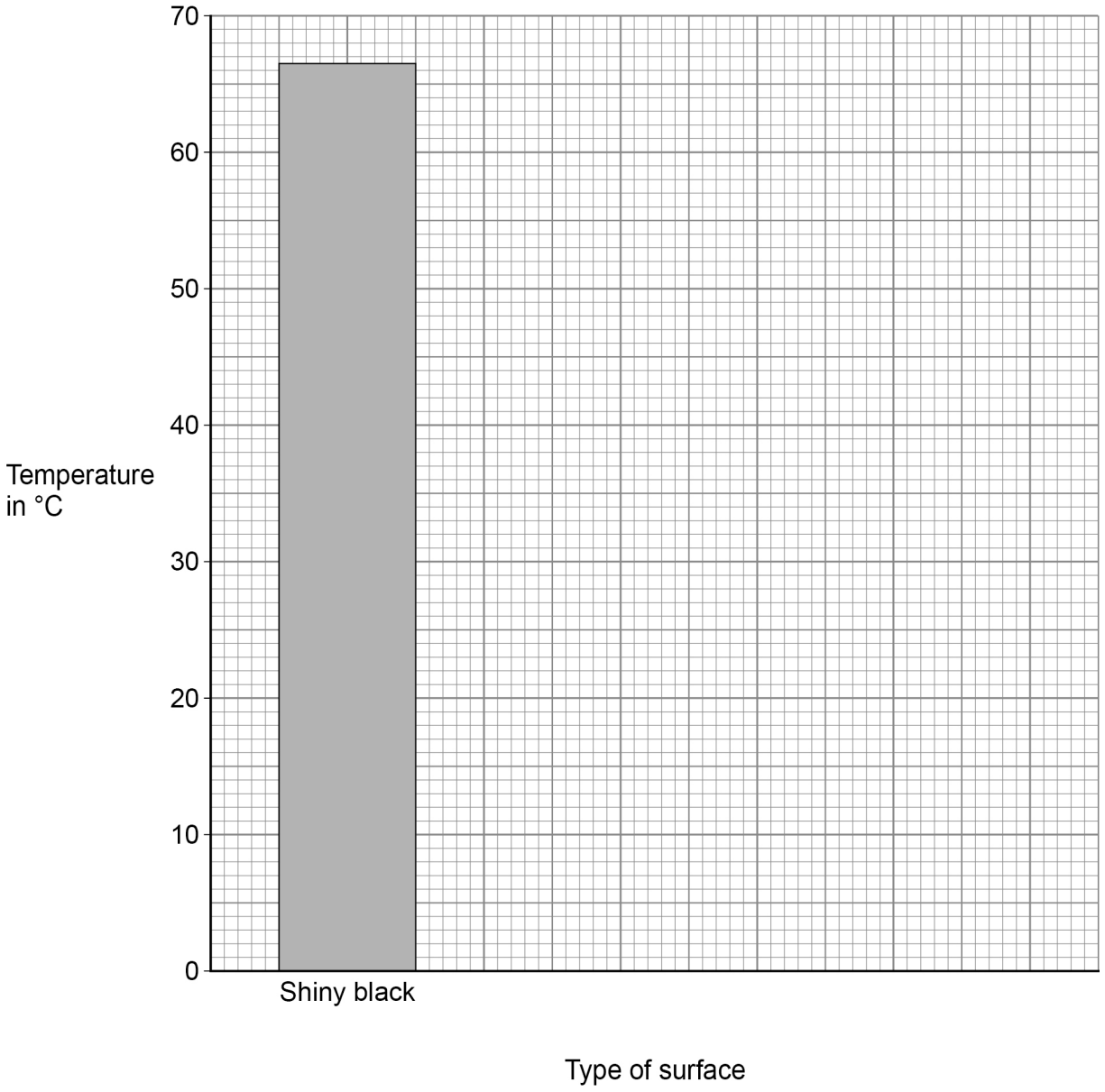
0 6 . 5 Complete **Figure 9**.

You should:

- plot the data from **Table 3** as a bar chart
- label each bar.

[3 marks]

Figure 9



0 6 . 6 Give **one** conclusion that can be made from the results in **Table 3**.

[1 mark]

Do not write outside the box

0 6 . 7 Which equation links frequency (f), wavelength (λ) and wave speed (v)?

[1 mark]

Tick (✓) **one** box.

$f = v \times \lambda$ ☐

$v = f \times \lambda$ ☐

$v = \frac{f}{\lambda}$ ☐

0 6 . 8 A radio wave has:

- a speed of 300 000 000 m/s
- a wavelength of 500 m

Calculate the frequency of the radio wave.

Give the unit.

Choose the unit from the box.

[4 marks]

hertz	**kilograms**	**metres**	**seconds**

Frequency = _____ Unit _____

17

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 7 *Escherichia coli* (*E. coli*) is a species of bacteria that can cause food poisoning.

0 7 . 1 Which term describes *E. coli* cells?

[1 mark]

Tick (✓) **one** box.

Algal cells ☐

Fungal cells ☐

Prokaryotic cells ☐

Some strains of *E. coli* are resistant to antibiotics.

Table 4 shows the number of infections caused by antibiotic resistant *E. coli*.

Table 4

Year	Number of infections
2014	9 000
2015	10 800
2016	11 400
2017	12 100
2018	13 500

Do not write outside the box

0 7 . 2 Calculate the percentage increase in the number of infections caused by antibiotic resistant *E. coli* between 2014 and 2018.

Use the equation:

$$\text{percentage increase} = \frac{\text{number of infections in 2018} - \text{number of infections in 2014}}{\text{number of infections in 2014}} \times 100$$

[2 marks]

Percentage increase = _____ %

Antibiotics are used to treat many different bacterial infections.

The government wants scientists to research and develop a new 'antibiotic test' that:

- takes less than 30 minutes
- shows doctors if an antibiotic is needed for an infection
- shows doctors which antibiotic to use.

0 7 . 3 Suggest **two** reasons why research into antibiotics is needed.

[2 marks]

1 _____

2 _____

Question 7 continues on the next page

Do not write outside the box

0 7 . 4 The new test should mean that fewer people take antibiotics.

What are **two** effects of fewer people taking antibiotics?

[2 marks]

Tick (✓) **two** boxes.

Antibiotic resistant bacteria are less likely to evolve. ☐

Bacteria will be killed by all types of antibiotic. ☐

Fewer bacteria will be exposed to antibiotics. ☐

Fungi and viruses will **not** be killed by antibiotics. ☐

Natural selection in bacteria will be faster. ☐

0 7 . 5 A vaccine against *E. coli* is being trialled.

Suggest what this vaccine contains to cause immunity to *E. coli*.

[1 mark]

_____

8

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0 8 This question is about solids and liquids.

0 8 . 1 Describe **two** ways the arrangement of particles in a solid is different from the arrangement of particles in a liquid.

You should answer in terms of the particle model.

[2 marks]

1 _____

_____

2 _____

_____

Liquid water can freeze to form solid ice.

Grit is spread on roads to reduce the formation of ice.

Grit contains a mixture of salt and sand.

0 8 . 2 Explain why less ice is formed when salt is spread on roads.

[2 marks]

_____

_____

_____

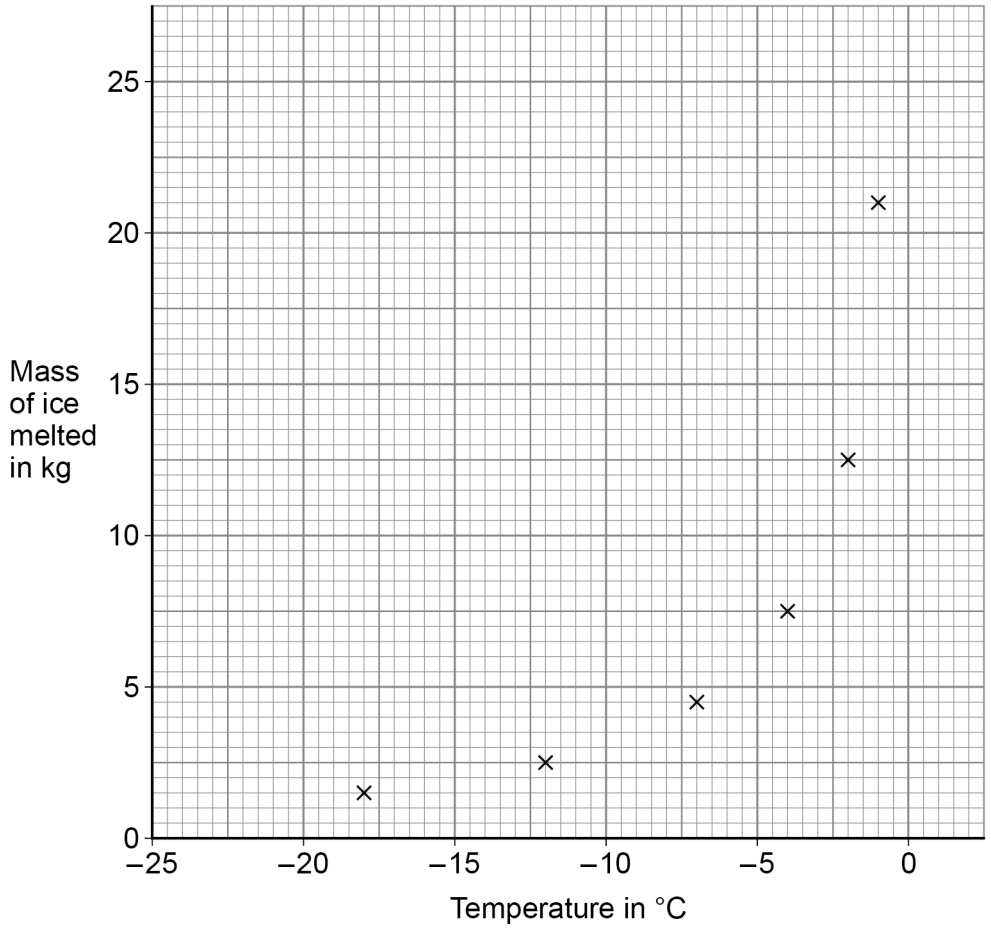
_____

Question 8 continues on the next page

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Figure 10 shows the mass of ice melted by 1 kg of grit at different temperatures.

Figure 10



0 8 . 3 Draw a line of best fit on **Figure 10**.

[1 mark]

0 8 . 4 Predict the mass of ice that 1 kg of grit would melt at −20 °C

Use **Figure 10**.

[1 mark]

Mass of ice = _____ kg

Do not write outside the box

0 8 . 5 Describe the effect of changing temperature on the mass of ice that 1 kg of grit can melt.

Use **Figure 10**.

[2 marks]

0 8 . 6 Grit is spread on roads when low temperatures are expected.

Some roads are built with temperature sensors in the surface.

The sensors indicate when to spread grit on the roads.

Suggest **one** advantage of having temperature sensors in roads rather than relying on weather forecasts.

[1 mark]

9

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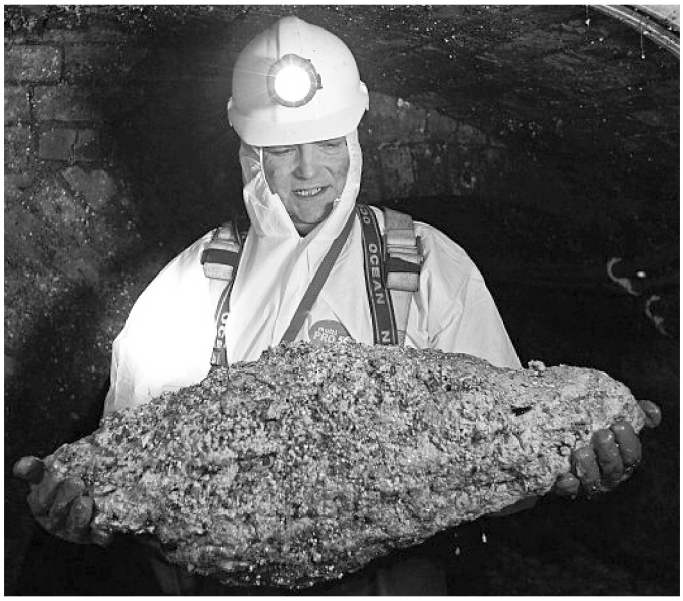
0 9 Sewers are often blocked by 'fatbergs'.

Fatbergs are made of very large lumps of fat and other solids.

The fat and solids come from waste being washed down drains and flushed down toilets.

Figure 11 shows a person holding a small fatberg.

Figure 11



0 9 . 1 The chemical composition of fatbergs can be tested.

Describe how a sample from a fatberg could be tested for fat and for protein.

[4 marks]

Test for fat _____

_____

Positive result for fat _____

Test for protein _____

_____

Positive result for protein _____

Question 9 continues on the next page

Do not write outside the box

0 9 . 2 Some fats in fatbergs come from undigested food in faeces.

Most fat that humans eat is digested.

Give the **two** products of fat digestion.

[2 marks]

1 _____

2 _____

It may be possible to use fatbergs as a fuel in power stations.

0 9 . 3 Burning 1.0 kg of fatbergs transfers 40 MJ of energy.

A power station could burn 1250 kg of fatbergs each hour.

Calculate the energy output from the power station in 1 year.

1 year = 8760 hours

[3 marks]

_____

_____

_____

_____

_____

_____

Energy output in 1 year = _____ MJ

Do not write outside the box

0 9 . 4 Evaluate burning fatbergs in power stations compared with burning coal in power stations.

[6 marks]

END OF QUESTIONS

15

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**
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