A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: SYNERGY

Higher Tier   Paper 1
Life and Environmental Sciences

H

8465/1H

Tuesday 12 May 2020   Afternoon

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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.**

- **Answer ALL questions in the spaces provided. Do not write 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.**

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 TURN OVER UNTIL TOLD TO DO SO

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0 1

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

0 1 . 1

Which term describes 'E. coli' cells?
[1 mark]

Tick (✓) ONE box.

☐   **Algal cells**

☐   **Fungal cells**

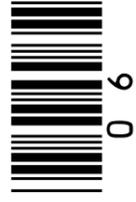☐   **Prokaryotic cells**

[Turn over]

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

TABLE 1 shows the number of infections caused by antibiotic resistant 'E. coli'.

TABLE 1

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

| 0 1 | . | 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 | 1 | . | 3 |

Suggest TWO reasons why research into antibiotics is needed. [2 marks]

1 _____

_____

_____

2 _____

_____

0 1 . 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.**

[Turn over]

0 1 . **5**

A vaccine against 'E. coli' is being trialled.

Suggest what this vaccine contains to cause immunity to 'E. coli'. [1 mark]

_____

_____

8

0	2

This question is about solids and liquids.

0	2 |.| 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 _____

_____

_____

[Turn over]

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 | 2 | . | 2 |

Explain why less ice is formed when salt is spread on roads. [2 marks]

_____

_____

_____

_____

_____

BLANK PAGE

[Turn over]

FIGURE 1, on the opposite page, shows the mass of ice melted by 1 kg of grit at different temperatures.

| 0 | 2 | . | 3 |

Draw a line of best fit on FIGURE 1.
[1 mark]

| 0 | 2 | . | 4 |

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

Use FIGURE 1. [1 mark]

Mass of ice = _____ kg

FIGURE 1

**Mass
of ice
melted
in kg**
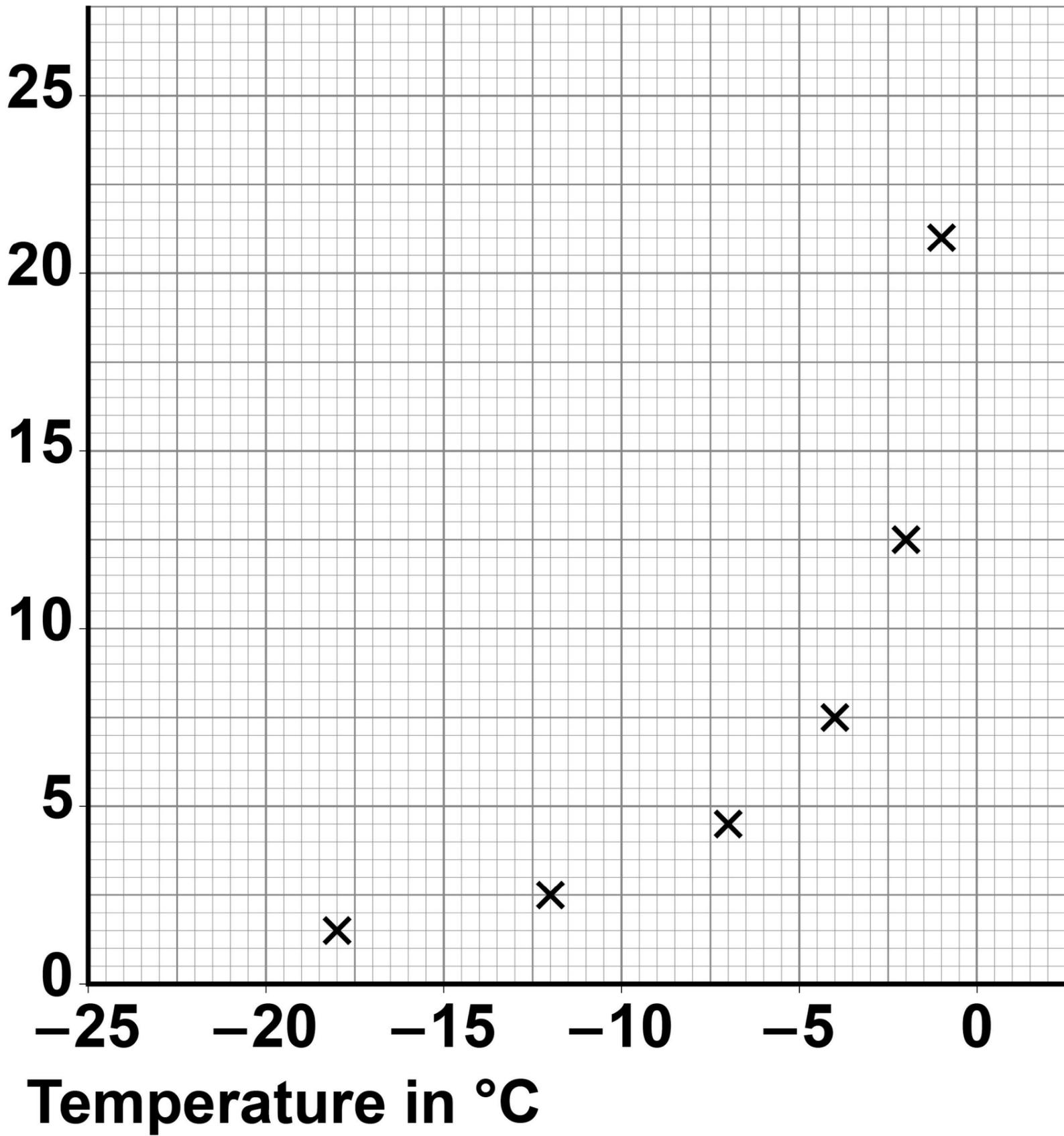
Temperature in °C

BLANK PAGE

0 2 . 5

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

Use FIGURE 1 on page 15. [2 marks]

_____

_____

_____

_____

_____

_____

[Turn over]

| 0 | 2 |. | 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]

_____

_____

_____
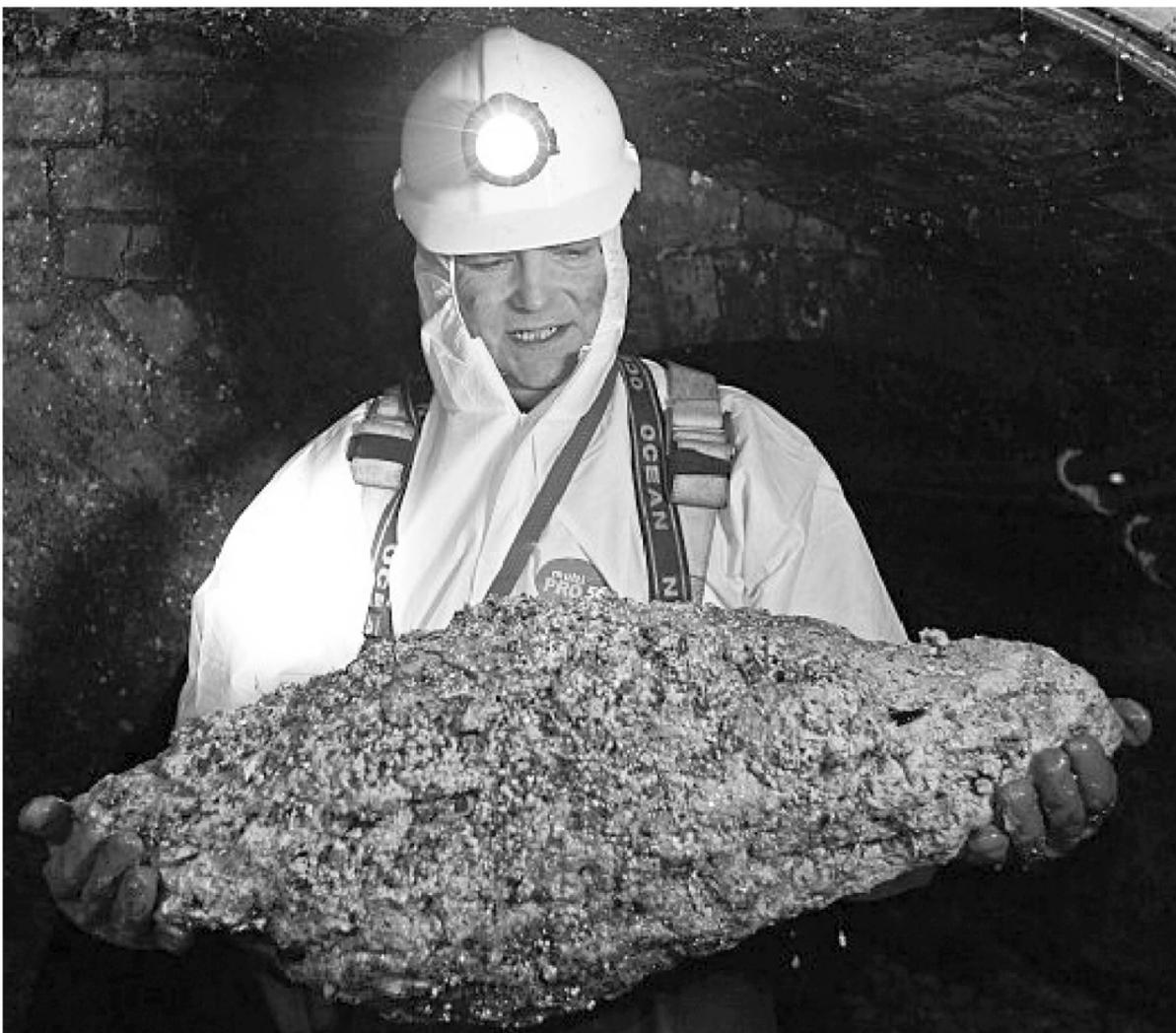
9

0	3

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 2 shows a person holding a small fatberg.

FIGURE 2

[Turn over]

0 3 . 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 _____

_____

| 0 | 3 | . | 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_____

_____

[Turn over]

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

| 0 | 3 |.| 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**

[Turn over]

0 3 . 4

Evaluate burning fatbergs in power stations compared with burning coal in power stations. [6 marks]

_____

_____

_____

_____

_____

_____

_____
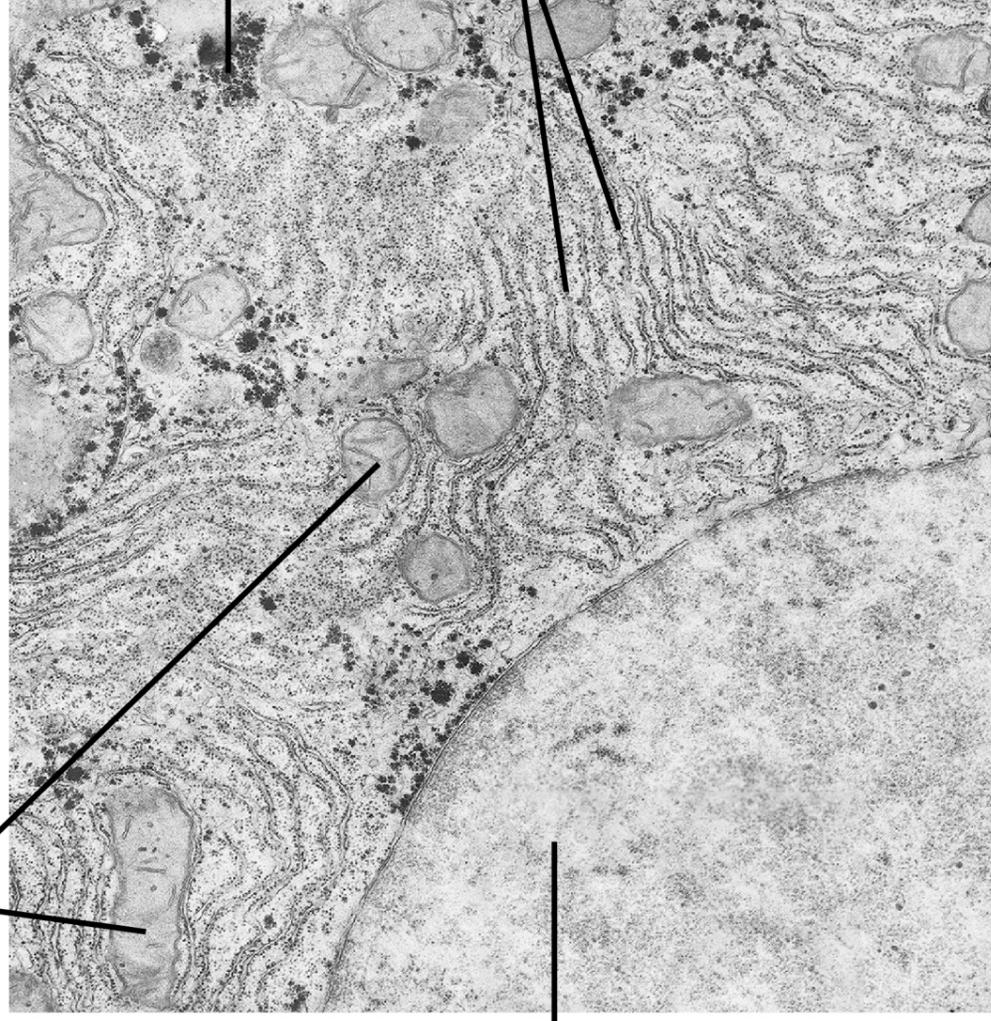
_____

_____

_____

[Turn over]

15

0 4

FIGURE 3 shows part of one liver cell.

The photograph was taken with an electron microscope.

FIGURE 3

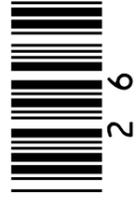**Mitochondria**

Storage substance

Ribosomes

X

| 0 | 4 | . | 1 |

Name structure X. [1 mark]

_____

[Turn over]

| 0 | 4 | . | 2 |

Describe the function of mitochondria.
[3 marks]

_____

_____

_____

_____

_____

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_____

_____

_____

0 4 . 3

Protein synthesis occurs at ribosomes.

Describe the structure of a protein molecule. [2 marks]

_____

_____

_____

_____

_____

[Turn over]

| 0 | 4 | . | 4 |

The storage substance in liver cells is a carbohydrate.

Name the carbohydrate storage substance found in liver cells. [1 mark]

_____

_____

Electron microscopes have higher resolving power than light microscopes.

| 0 | 4 | . | 5 |

What is the resolving power of a microscope? [1 mark]

Tick (✓) ONE box.

☐ **How far the focusing knob has to be adjusted to form a clear image**

☐ **The number of times larger than real life the image appears**

☐ **The shortest distance between two points that can be seen as separate points**

[Turn over]

| 0 | 4 | . | 6 |

An electron microscope has a magnification of × 650 000

The length of a cell structure in an image from the electron microscope was 27 mm

Calculate the real length of this cell structure in mm

Give your answer to 2 significant figures.
[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Real length of cell structure (2 significant figures) = _____ mm

[Turn over]

12

0 5

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

0 5 . 1

Give the type of electromagnetic wave with the lowest frequency. [1 mark]

_____

_____

0 5 . 2

A wave has a wavelength of 2.5 km and a velocity of 300 000 000 m/s

Calculate the frequency of the wave.
[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

Frequency = _____ Hz

[Turn over]

0	5	.	3

FIGURE 4, on page 38, shows equipment that is used to investigate the emission of infrared radiation from different colours of surface.

The four hollow metal cubes are each painted a different colour.

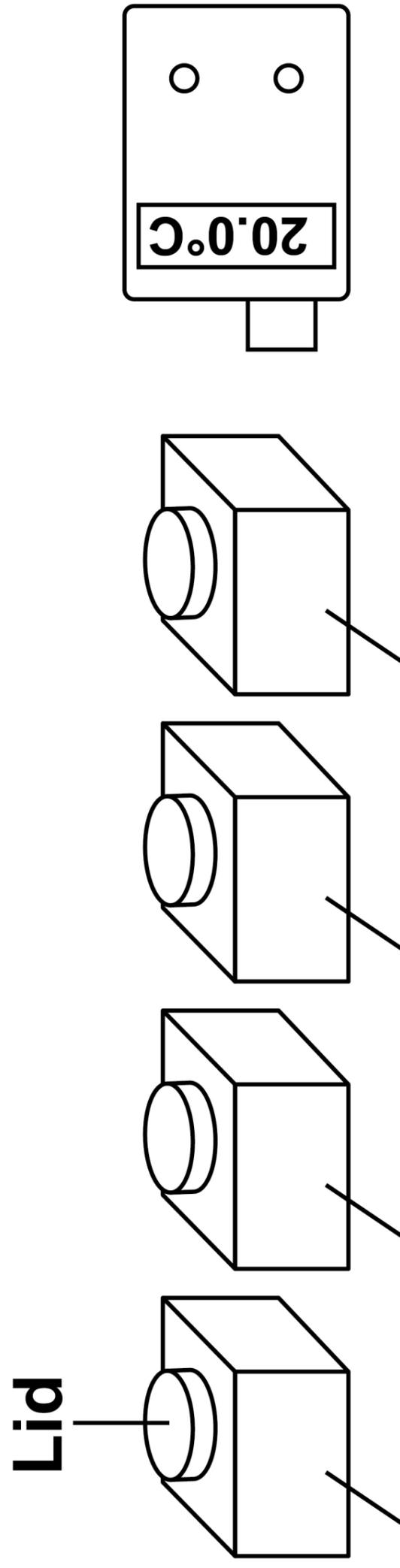The cubes can be filled with hot water before the lid is put on.

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FIGURE 4

Lid

Cube painted white

Cube painted blue

Cube painted orange

Cube painted black

20.0°C

Infrared detector: uses infrared to give a temperature

Describe a method to investigate which colour of surface emits infrared radiation at the greatest rate. [4 marks]

0 5 . **4**

Which colour of surface will emit infrared radiation at the greatest rate? [1 mark]

Tick (✓) ONE box.

☐ **Black**

☐ **Blue**

☐ **Orange**

☐ **White**

0 5 . 5

It is important to identify people at airports who may have infectious diseases, such as measles.

**Explain how cameras that detect the rate of infrared emission can identify people with infectious diseases such as measles.
[2 marks]**

_____

_____

_____

_____

_____

_____

[Turn over]

12

0 6

Plant leaves contain chlorophyll.

Nitrate ions are needed to produce chlorophyll.

0 6 . 1

Name ONE other mineral ion needed to produce chlorophyll.

Do NOT refer to nitrate in your answer.
[1 mark]

_____

_____

0 6 . 2

Some mineral ions are in a lower concentration in the soil compared with inside plant root hair cells.

Name the process that moves mineral ions from a lower concentration in the soil into plant root hair cells. [1 mark]

_____

_____

[Turn over]

0 6 . 3

Explain how mineral ions move from root hair cells to the leaves. [4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

0 6 . 4

Which TWO factors increase the rate of movement of mineral ions through the plant? [2 marks]

Tick (✓) TWO boxes.

☐ **A decrease in the amount of water in the soil**

☐ **A decrease in the concentration of water vapour in the air**

☐ **A decrease in the wind speed of the air around the leaves**

☐ **An increase in light intensity causing guard cells to curve more**

☐ **An increase in the humidity of the air around the stomata**

8

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07

Cystic fibrosis is an inherited condition.

The allele for having cystic fibrosis is recessive, r.

The dominant allele is R.

A person who has the genotype Rr is a 'carrier' of cystic fibrosis.

07 . 1

Carriers do NOT have symptoms of cystic fibrosis.

What scientific term describes the carrier's genotype, Rr? [1 mark]

_____

_____

[Turn over]

| 0 | 7 | . | 2 |

Person 6 and person 7 plan to have another child.

Draw a Punnett square diagram to show the probability of the child having cystic fibrosis.

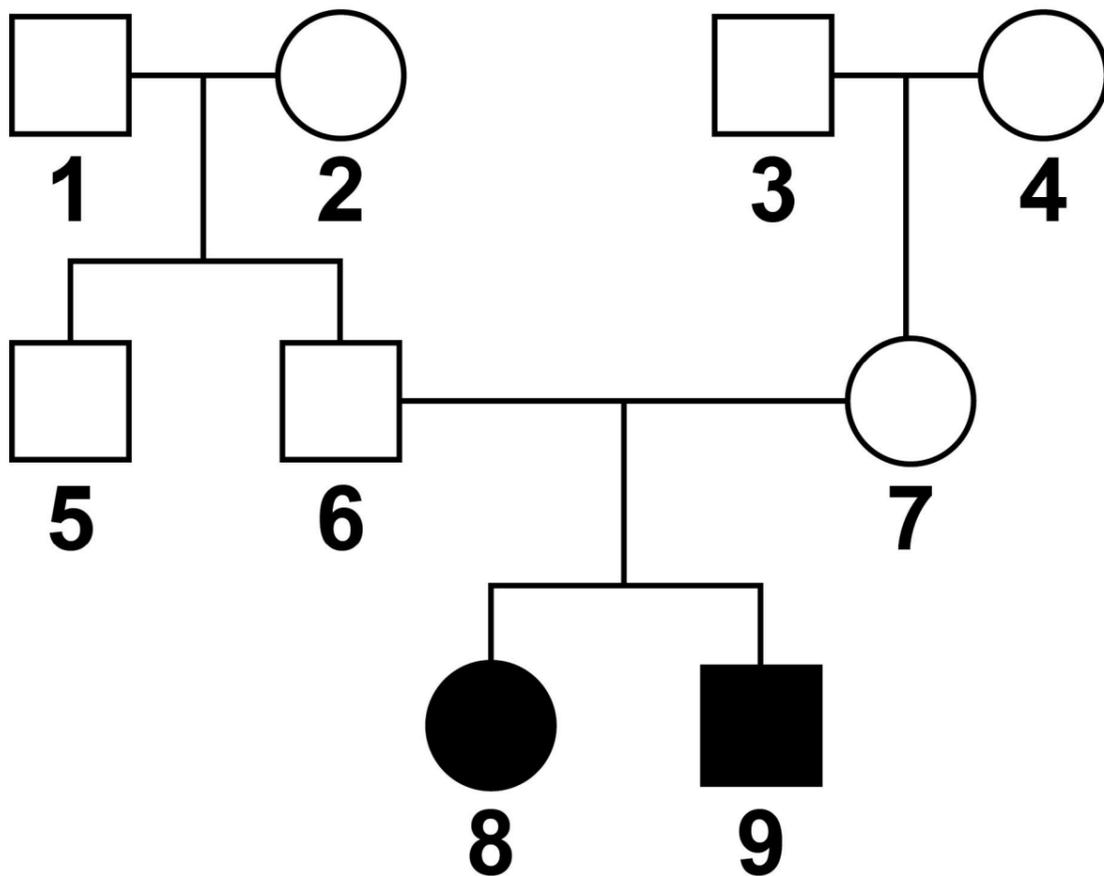**Identify the genotypes of any offspring with cystic fibrosis.**

Use FIGURE 5, on the opposite page. [5 marks]

Probability of the child having cystic

fibrosis = _____

FIGURE 5 shows the inheritance of cystic fibrosis in one family.

FIGURE 5

KEY

○ Female who does NOT have cystic fibrosis

● Female who has cystic fibrosis

☐ Male who does NOT have cystic fibrosis

■ Male who has cystic fibrosis

| 0 | 7 | . | 3 |

Mucus is produced in the breathing system.

In people with cystic fibrosis the mucus is thicker than the mucus produced in an unaffected person.

Explain why a person with cystic fibrosis has an increased risk of lung infections.
[4 marks]

_____

_____

_____

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[Turn over]

Some medical products are produced by genetically modified (GM) organisms.

| 0 | 7 | . | 4 |

Hamsters are small mammals.

GM hamster cells are used to produce drugs to treat some human genetic disorders.

Describe how a human allele can be transferred into the genome of a hamster cell. [2 marks]

_____

_____

_____

_____

_____

0 7 . 5

Name a medical product that can be produced by GM bacteria.

Give the name of the disorder the product is used to treat. [2 marks]

Medical product _____

_____

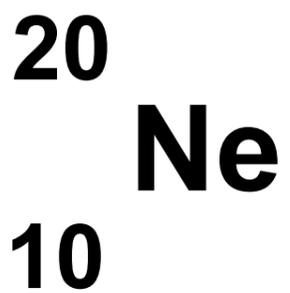**Disorder** _____

_____

[Turn over]

14

0 8

FIGURE 6 shows two isotopes of neon.

FIGURE 6

Neon-20

Neon-21

$^{20}_{10}\text{Ne}$

$^{21}_{10}\text{Ne}$
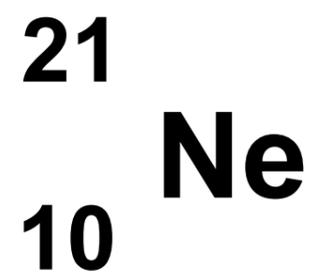
0 8 . 1

Compare the number of sub-atomic particles in an atom of neon-20 and an atom of neon-21 [2 marks]

_____

_____

_____

_____

_____

[Turn over]

0 8.**2**

There are 18 neon atoms in every million particles of air.

Of these 18 neon atoms, 0.27% are neon-21 atoms.

Calculate the percentage of particles in air that are neon-21 atoms. [2 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Percentage = _____ %

BLANK PAGE

[Turn over]

0	8	.	3

FIGURE 7 shows a sign containing neon.

The sign is connected to an electrical supply.

FIGURE 7

The neon atoms gain energy when the sign is switched on.

Explain why the sign glows when the electrical supply is switched on.
[4 marks]

_____

_____

_____

[Turn over]

8

0 9

HIV infection can prevent the body's immune system from destroying pathogens.

0 9 . 1

Explain the roles of white blood cells when a pathogen enters the body.
[6 marks]

_____

_____

_____

_____

_____

_____

_____

0 9 . 2

Name the type of drug that can be used to treat HIV. [1 mark]

_____

_____

0 9 . 3

Describe how AIDS is different from HIV infection. [1 mark]
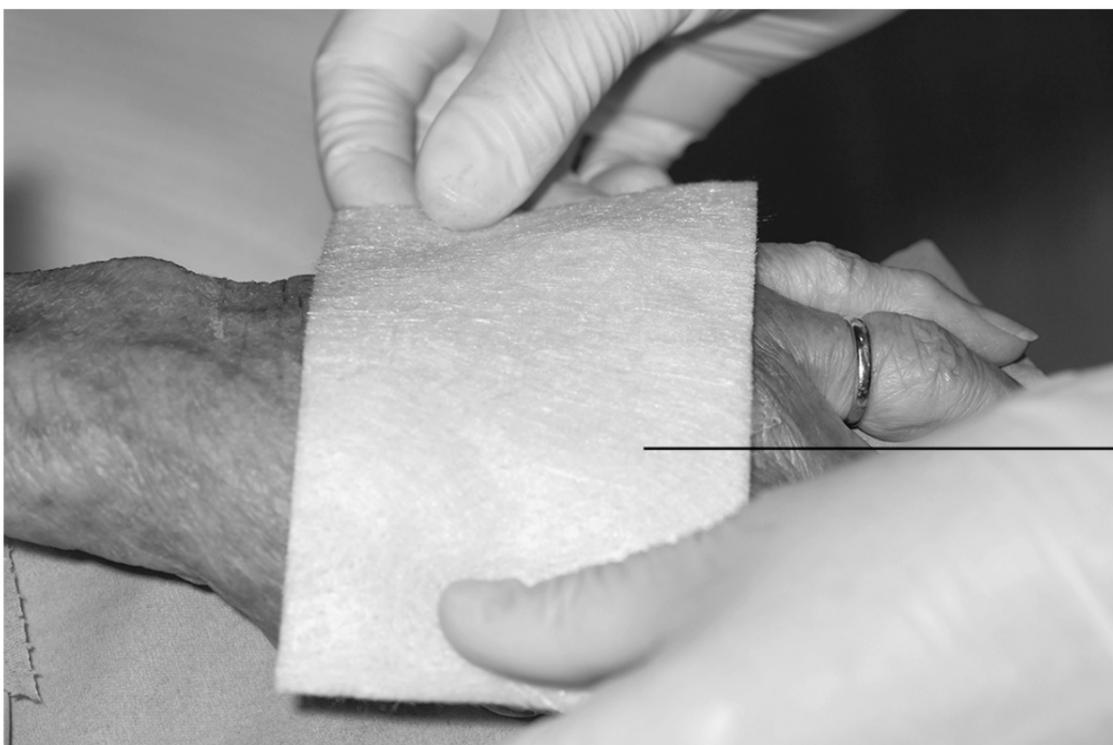
_____

_____

_____

_____

8

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[Turn over]

1 0

FIGURE 8 shows a wound dressing put over a cut on a person's hand.

FIGURE 8

Wound dressing

'Smart' wound dressings contain tiny electronics and sensors.

Smart dressings constantly monitor the wound to show if the wound is infected.

The information from the smart dressing can be sent wirelessly to the mobile phones of the patient and their doctor.

Smart dressings can release antibiotics if needed.

Evaluate the use of smart dressings compared with the use of the wound dressing shown in FIGURE 8. [6 marks]

_____

_____

_____

_____

_____

_____

_____

_____

[Turn over]

6

END OF QUESTIONS

6

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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