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

H

Higher 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	
10	
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.

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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 ☐

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

Do not write outside the box

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 _____

Question 1 continues on the next page

Do not write outside the box

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. ☐

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

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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 _____

_____

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]

_____

_____

_____

_____

Question 2 continues on the next page

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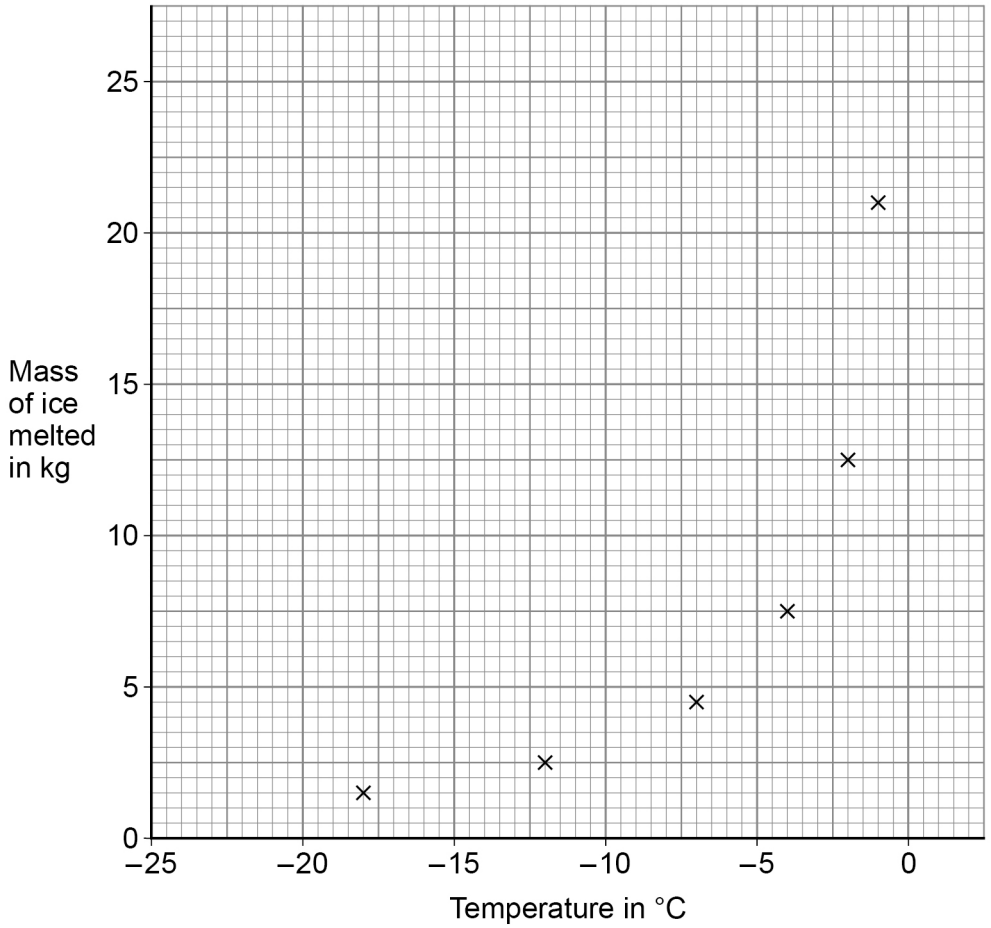
Figure 1 shows the mass of ice melted by 1 kg of grit at different temperatures.

Figure 1



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

Do not write outside the box

0 2 . 5 Describe the effect of changing temperature on the mass of ice that 1 kg of grit can melt.

Use **Figure 1**.

[2 marks]

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

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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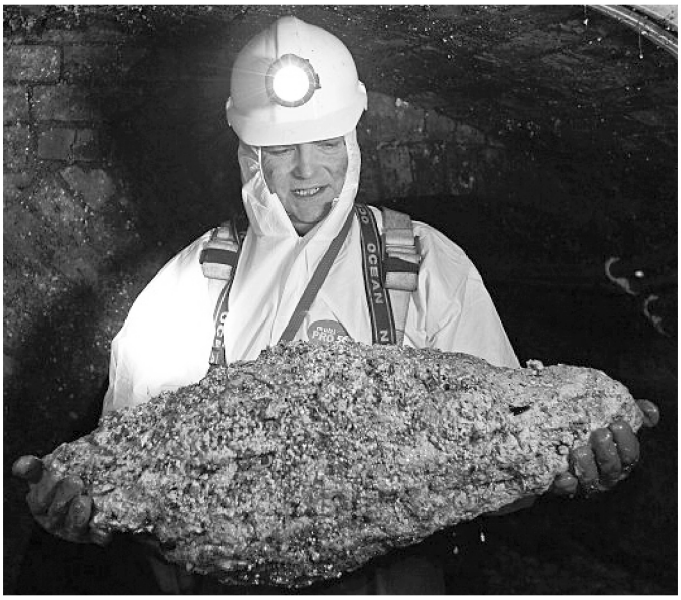
0 3 Sewers are often blocked by 'fatbergs'.

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



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 _____

Question 3 continues on the next page

Do not write outside the box

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 _____

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

Do not write outside the box

0 3 . 4 Evaluate burning fatbergs in power stations compared with burning coal in power stations.

[6 marks]

15

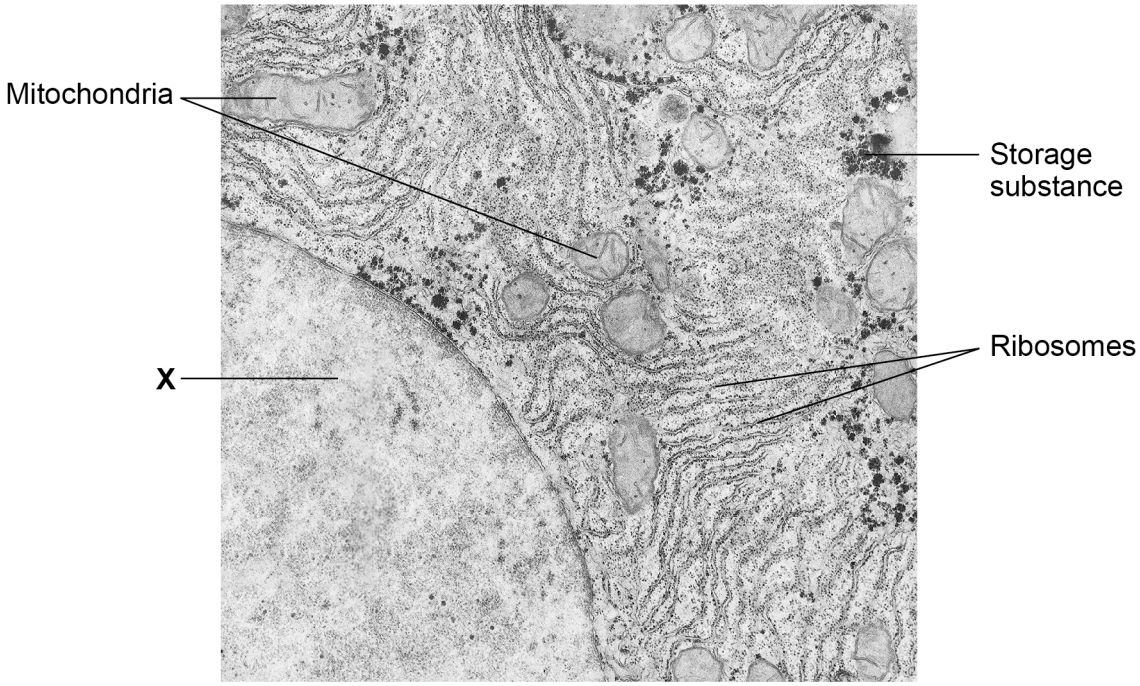
Turn over for the next question

Do not write outside the box

0 4 **Figure 3** shows part of one liver cell.

The photograph was taken with an electron microscope.

Figure 3



0 4 . 1 Name structure **X**.

[1 mark]

Do not write outside the box

0 4 . 2 Describe the function of mitochondria.

[3 marks]

0 4 . 3 Protein synthesis occurs at ribosomes.

Describe the structure of a protein molecule.

[2 marks]

0 4 . 4 The storage substance in liver cells is a carbohydrate.

Name the carbohydrate storage substance found in liver cells.

[1 mark]

Question 4 continues on the next page

Do not write outside the box

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 ☐

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

12

Do not write outside the box

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

Question 5 continues on the next page

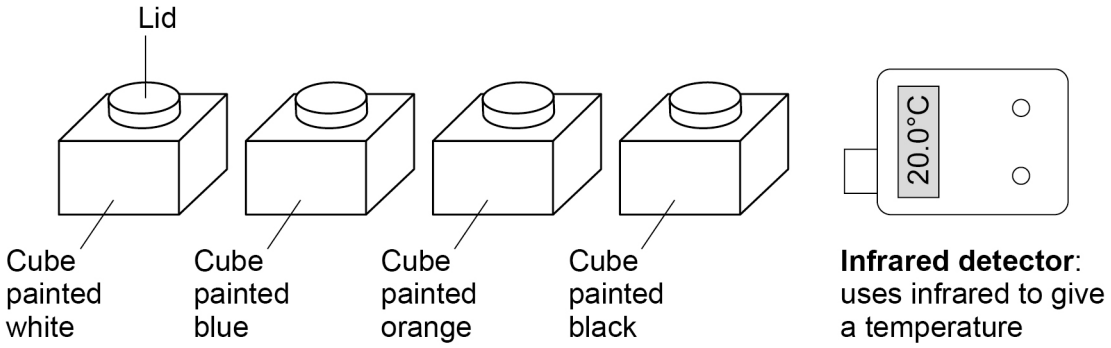
Do not write outside the box

0 5 . 3 **Figure 4** 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.

Figure 4



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

[4 marks]

Do not write outside the box

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]

_____

_____

_____

_____

12

Turn over for the next question

Do not write outside the box

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]

0 6 . 3 Explain how mineral ions move from root hair cells to the leaves.

[4 marks]

Do not write outside the box

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

Turn over for the next question

Do not write outside the box

0 7 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.

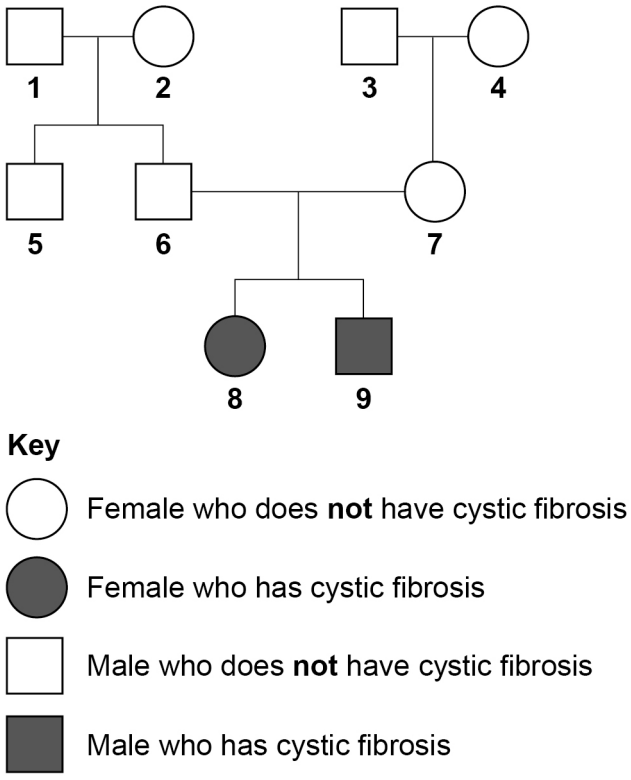
0 7 . 1 Carriers do **not** have symptoms of cystic fibrosis.

What scientific term describes the carrier's genotype, **Rr**?

[1 mark]

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

Figure 5



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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**.

[5 marks]

Probability of the child having cystic fibrosis = _____

Question 7 continues on the next page

Do not write outside the box

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]

Do not write outside the box

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 _____

14

Turn over for the next question

Do not write outside the box

0 8 **Figure 6** shows two isotopes of neon.

Figure 6

Neon-20	**Neon-21**
$^{20}_{10}Ne$	$^{21}_{10}Ne$

0 8 . 1 Compare the number of sub-atomic particles in an atom of neon-20 and an atom of neon-21

[2 marks]

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 = _____ %

Do not write outside the box

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]

8

Turn over for the next question

Do not write outside the box

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]

Do not write outside the box

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]

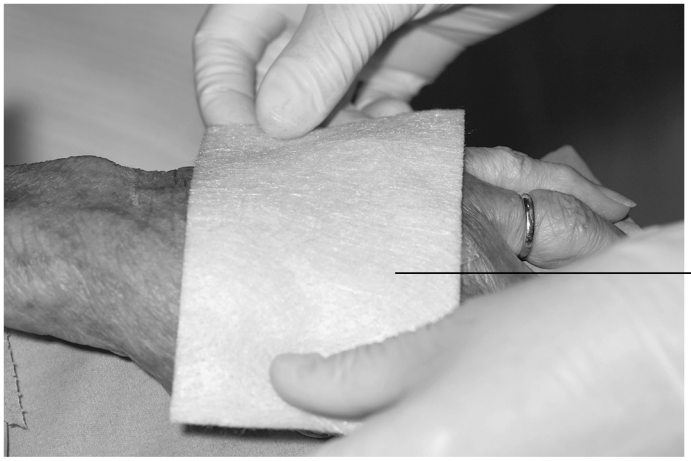
8

Turn over for the next question

Do not write outside the box

1 0 **Figure 8** shows a wound dressing put over a cut on a person's hand.

Figure 8



'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]

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6

END OF QUESTIONS

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