Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: SYNERGY

F

Foundation Tier Paper 2 Life and environmental sciences

Wednesday 23 May 2018 Afternoon Time allowed: 1 hour 45 minutes

Materials

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

Instructions
- Use black ink or black ball-point pen.
- 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.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Do not write outside the box

0 1 An argon atom can be represented as $^{40}_{18}Ar$

0 1 . 1 What does the number 40 represent in $^{40}_{18}Ar$?

[1 mark]

0 1 . 2 How many protons does this atom of argon have?

[1 mark]

Tick **one** box.

18 ☐

22 ☐

40 ☐

58 ☐

0 1 . 3 How many neutrons does this atom of argon have?

[1 mark]

Tick **one** box.

18 ☐

22 ☐

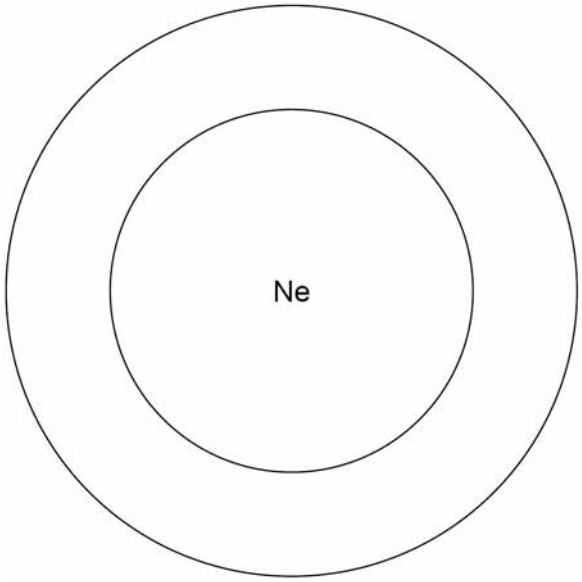
40 ☐

58 ☐

Do not write outside the box

Figure 1 shows the energy levels (shells) in a neon atom.

Figure 1



0 1 . 4 A neon atom has 10 electrons.

Complete **Figure 1** to show the electronic structure of a neon atom.

Use **x** to represent an electron.

[1 mark]

0 1 . 5 The nucleus of a neon atom has a charge.

What is the charge?

[1 mark]

Tick **one** box.

Negative ☐

Neutral ☐

Positive ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 6 A neon atom has 10 protons, 10 electrons and 10 neutrons.

Explain why there is no overall charge on a neon atom.

[2 marks]

0 1 . 7 There are two different types of neon atom.

What are these different types of atom called?

[1 mark]

Tick **one** box.

Compounds ☐

Ions ☐

Isotopes ☐

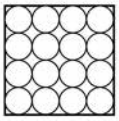
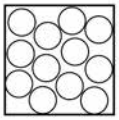
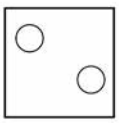
Molecules ☐

0 1 . 8 Neon is a gas.

The states of matter can be shown by a simple particle model.

Draw **one** line from each state of matter to the correct particle model.

[2 marks]

State of matter	Particle model
Gas	
Liquid	
Solid	

10

Do not write outside the box

0 2 Muscle cells divide to form new muscle cells.

0 2 . 1 Which **two** cell components are copied before the muscle cells start to divide?

[2 marks]

Tick **two** boxes.

- Cytoplasm ☐
- Mitochondria ☐
- Plasmids ☐
- Ribosomes ☐
- Vacuole ☐

0 2 . 2 Why do muscle cells need to divide by mitosis more often than most other cells?

[1 mark]

Tick **one** box.

- To contract the muscles ☐
- To repair the muscles ☐
- To supply more oxygen to the muscles ☐
- To transmit nerve impulses ☐

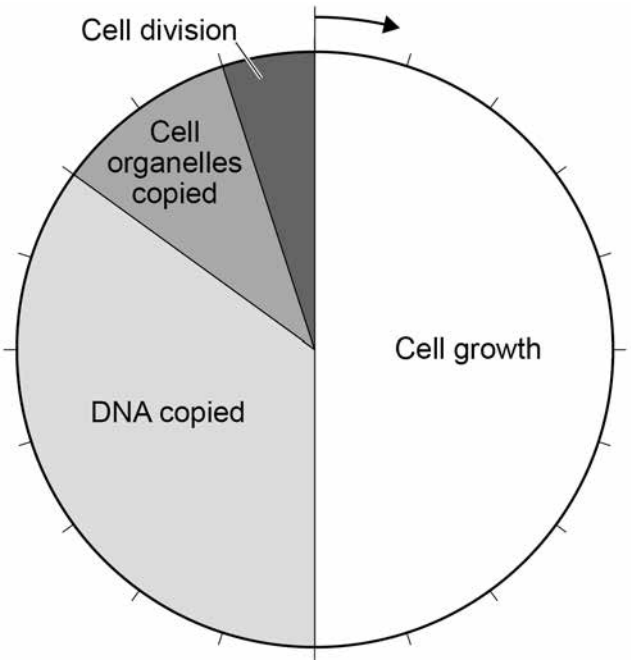
Question 2 continues on the next page

Do not write outside the box

Mitosis is part of the cell cycle.

Figure 2 shows the percentage of time taken by each stage of a cell cycle.

Figure 2



0 2 . 3 The cell cycle shown in **Figure 2** takes 21 hours in total.

Cell division takes 5% of the total time.

Calculate how many hours cell division takes.

[2 marks]

Time taken = _____ hours

0 2 . 4 What percentage of time is spent copying DNA in the cell cycle shown in **Figure 2**?

[2 marks]

Percentage = _____

Do not write outside the box

0 2 . 5 A sperm cell from a dog contains 39 chromosomes.

How many chromosomes are there in each dog muscle cell?

[1 mark]

Tick **one** box.

39 ☐

78 ☐

156 ☐

312 ☐

0 2 . 6 A sperm cell fuses with an egg cell.

What is this process called?

[1 mark]

Tick **one** box.

Fertilisation ☐

Meiosis ☐

Ovulation ☐

Respiration ☐

9

Turn over for the next question

Do not write outside the box

0 3 In 2017 more than 420 million people worldwide had diabetes.

Table 1 shows how the percentage of the population with diabetes has changed.

Table 1

Year	Percentage of population with diabetes		
	Low-income countries	**High-income countries**	**World**
1986	3.5	5.5	5.1
1992	4.4	5.9	5.8
1998	5.2	6.2	6.6
2004	6.0	6.5	7.2
2010	6.9	6.9	8.0

0 3 . 1 Use data from **Table 1** to complete the graph in **Figure 3**.

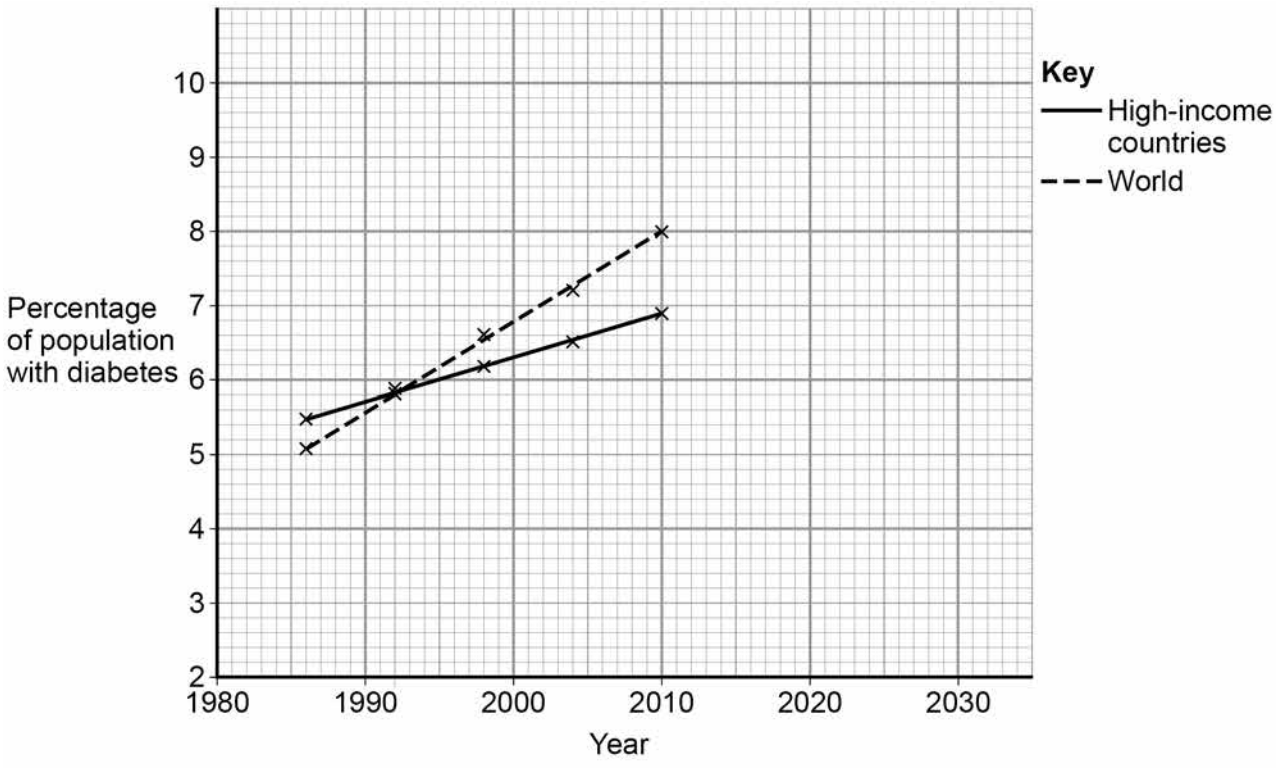
You should:

- plot the data for the low-income countries
- draw a line of best fit for the low-income countries.

The lines for high-income countries and the world have been drawn for you.

[3 marks]

Figure 3



Do not write outside the box

0 3 . 2 Predict the percentage of the world population with diabetes in **2022** if the current pattern were to continue.

You should extend the line of best fit for the world on the graph in **Figure 3**.

[2 marks]

Percentage = _____ %

0 3 . 3 The trend may **not** continue in the same pattern after 2010.

Suggest **one** reason why the trend may change.

[1 mark]

_____

_____

0 3 . 4 Give **two** conclusions from the data shown in **Figure 3**.

[2 marks]

1 _____

_____

2 _____

_____

Question 3 continues on the next page

Do not write outside the box

0 3 . 5 **Table 1** shows that the percentage of people with diabetes in the world has changed.

What are **two** possible reasons for this change?

[2 marks]

Tick **two** boxes.

People are becoming more obese ☐

People are doing more exercise ☐

People are eating less salt ☐

People are eating more sugar ☐

People are smoking less ☐

10

Do not write outside the box

0 4 Chickenpox is a disease. Many children get chickenpox.

Most children recover quickly with no serious long term effects.

Chickenpox cannot be treated with antibiotics.

0 4 . 1 What type of pathogen causes chickenpox?

[1 mark]

People can pay for their child to be vaccinated against chickenpox.

The vaccination stimulates the production of antibodies.

0 4 . 2 Which part of the blood produces antibodies?

[1 mark]

Tick **one** box.

- Plasma ☐
- Platelets ☐
- Red blood cells ☐
- White blood cells ☐

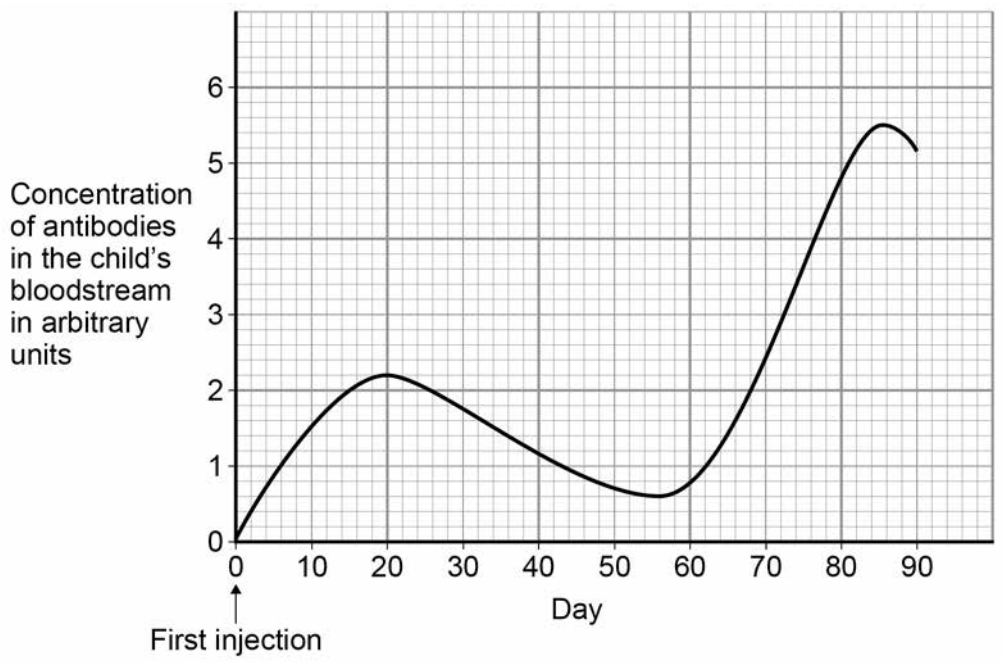
Question 4 continues on the next page

Do not write outside the box

The vaccination involves two injections.

Figure 4 shows how the concentration of antibodies in a child's bloodstream changes.

Figure 4



0 4 . 3 Suggest on what day the second injection was given.

[1 mark]

Day = _____

0 4 . 4 On which day is the child's ability to defend against chickenpox at its peak?

[1 mark]

Day = _____

Do not write outside the box

Children can only have the chickenpox vaccination if their parents pay for the vaccine.

Some people think the vaccination should be free to all children.

0 4 . 5 If more people were vaccinated the number of children getting chickenpox would decrease.

What are **two** possible reasons for the decrease?

[2 marks]

Tick **two** boxes.

- Drugs to treat chickenpox are no longer effective ☐
- Children are less likely to come into contact with someone with the disease ☐
- More people will have the correct antibodies ☐
- People may catch the disease from the vaccination ☐
- People may have a weakened immune system ☐

0 4 . 6 The government needs to decide whether to make the chickenpox vaccination free to all children.

Suggest **two** factors the government should consider when making this decision.

[2 marks]

1 _____

_____

2 _____

_____

8

Turn over for the next question

Do not write outside the box

0 5 All living organisms are classified into groups.

Table 2 shows the classification of one species of wheat.

Table 2

Kingdom	Plant
Phylum	Angiosperms
Class	Monocotyledons
Order	Commelinids
Family	Poaceae
Genus	Triticum
Species	spelta

0 5 . 1 What is the binomial name for the wheat in **Table 2**?

[1 mark]

Tick **one** box.

Angiosperm monocotyledons ☐

Poaceae triticum ☐

Species spelta ☐

Triticum spelta ☐

Do not write outside the box

Modern classification systems compare the similarity between the DNA of organisms.

The more similar the DNA code, the more closely the organisms are related.

Table 3 shows DNA codes in five different organisms.

Table 3

	DNA Codes									Number of differences in DNA code compared with the human sequence
Human	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	
Pig	J	F	C	D	E	F	G	H	I	
Wheat	C	I	K	D	M	F	G	H	I	
Yeast	C	I	K	D	L	M	G	H	I	5
Chicken	J	F	C	D	M	F	G	H	I	3

0 5 . 2 Complete the final column of **Table 3** for Pig and for Wheat.

[1 mark]

0 5 . 3 Which organism in **Table 3** appears to be most closely related to humans?

[1 mark]

0 5 . 4 Give **one** reason why conclusions about the similarities between organisms should not be made using **only** the DNA codes in **Table 3**.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

Chickens can be bred either for meat or for laying eggs.

Figure 5 gives some information about different types of chicken.

Figure 5

	Chicken bred for meat	Chicken bred for laying eggs
		
Average weight in kg	1.8	0.7
Average number of eggs laid per week	2	6

0 5 . 5 Describe how selective breeding has been used to produce chickens bred for meat.

[3 marks]

0 5 . 6 Give **one** advantage of selective breeding to the farmer.

[1 mark]

Do not write outside the box

0 5 . 7 Selective breeding can lead to disadvantages for the chickens.

What is a possible disadvantage of selective breeding for the chickens bred for meat in **Figure 5**?

[1 mark]

Tick **one** box.

The chickens will be genetically identical ☐

There will be less food to feed people ☐

The chickens may weigh too much to be able to stand ☐

The chickens will be kept in better conditions ☐

9

Turn over for the next question

Do not write outside the box

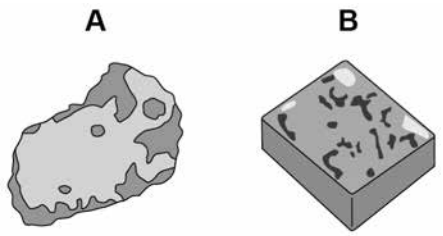
0 6 Two large semi-precious stones are discovered.

A student is asked to find out what material each of the two stones is made of.

The student does this by determining the density of the material of each stone.

Figure 6 shows the two stones.

Figure 6



0 6 . 1 The student wants to measure the volume of stone **A**. Stone **A** cannot be measured using a metre rule as the stone is an irregular shape.

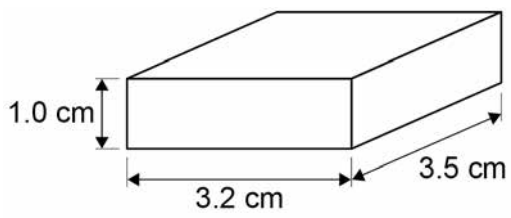
Describe how the student could determine the volume of stone **A** by putting it into water.

[3 marks]

The student makes measurements of stone **B** using a metre rule.

The measurements of stone **B** are shown **in Figure 7**.

Figure 7



Do not write outside the box

0 6 . 2 Which piece of equipment could the student use to get a more accurate measurement of the length of stone **B**?

[1 mark]

Tick **one** box.

Electronic balance ☐

Microscope ☐

Newtonmeter ☐

Vernier callipers ☐

0 6 . 3 Use the following equation to calculate the volume of stone **B** in cm^3

volume = length x width x height

[1 mark]

Volume = _____ cm^3

0 6 . 4 The mass of stone **B** is 56 grams.

Use your answer from Question **06.3** to calculate the density of stone **B** in g/cm^3

Use the following equation.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[2 marks]

Density = _____ g/cm^3

Question 6 continues on the next page

Do not write outside the box

0 6 . 5 The student calculates the density of the material stone **A** is made of as 5.2 g/cm^3

The student looks up the density of some materials in a text book.

Figure 8 shows this information.

Figure 8

Material	**Density in g/cm^3**
Amber	1.1 – 1.2
Cubic Zirconia	5.5 – 5.9
Garnet	3.8 – 3.9
Haematite	5.1 – 5.3

What material is stone **A** made of?

[1 mark]

Tick **one** box.

Amber ☐

Cubic Zirconia ☐

Garnet ☐

Haematite ☐

8

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

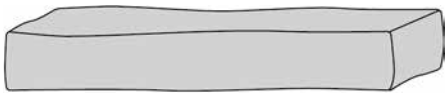
Do not write outside the box

0 7 Osmosis is the movement of water through partially permeable cell membranes.

A group of students investigated the effect of temperature on the rate of osmosis in potato cells. The students used five potato chips all cut to the same size.

Figure 9 shows one chip.

Figure 9



This is the method used.

1. Half fill a boiling tube with distilled water.
2. Heat the water to 25 °C
3. Place one potato chip in the boiling tube.
4. Keep the boiling tube and potato chip at 25 °C for 30 minutes.
5. Repeat steps 1–4 at four other temperatures.

0 7 . 1 All of the potato chips gained water by osmosis.

Explain how the students would find out the **rate** of water uptake by osmosis in each potato chip.

[3 marks]

0 7 . 2 One of the students used a knife to cut the potato chips.

Suggest how the student could improve the method of cutting the potato chips to make sure they are all the same size.

[1 mark]

Do not write outside the box

0 7 . 3 Another student cut their potato chips as shown in **Figure 10**.

Figure 10

Suggest how the rate of water uptake by osmosis in this investigation was different from the investigation with the chips shown in **Figure 9**.

Give a reason for your answer.

[2 marks]

0 7 . 4 The students carried out the experiment at 25 °C, 30 °C, 35 °C, 40 °C and 45 °C

Predict what you would expect the results to show as the temperature increases.

Give a reason for your answer.

[2 marks]

Prediction

Reason

8

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 8 Water is important to all living organisms.

In some parts of Africa getting potable water may be difficult.

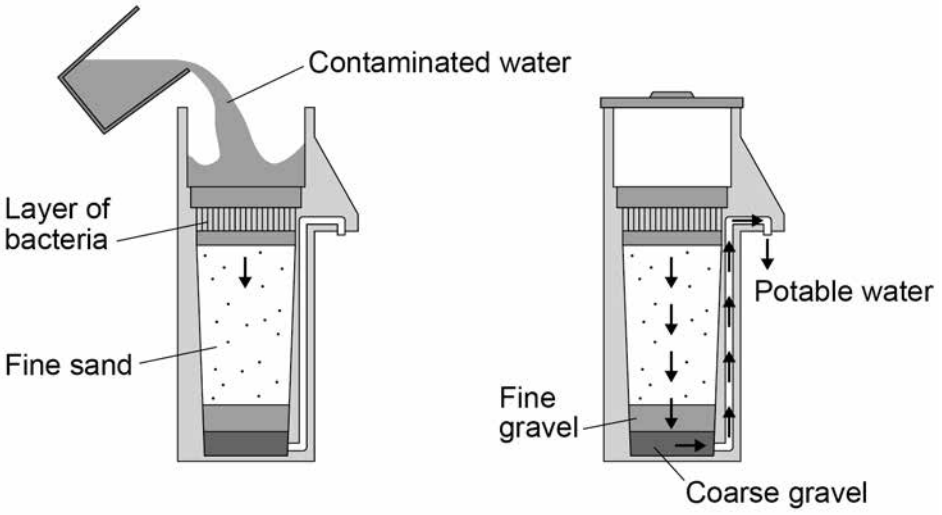
0 8 . 1 What is potable water?

[1 mark]

Biosand units are one method of purifying water used in some parts of Africa**.**

Figure 11 shows a Biosand unit.

Figure 11



0 8 . 2 Describe the role of the fine sand.

[1 mark]

Question 8 continues on the next page

Do not write outside the box

Another method of purifying water is Solar Disinfection (SODIS).

Table 4 gives some information about both methods.

Table 4

Method	Description	Percentage reduction in pathogens that cause diarrhoea
Biosand unit	Before use, it needs to be left for 2 weeks for the bacteria in the unit to grow. Can treat 40 litres of water per hour. Made of concrete. Needs replacing every 10 years.	47
SODIS	Plastic bottles are filled with water and left in sunlight. Ultraviolet (UV) kills bacteria. Bottles need to be left in sunlight for at least 8 hours. Bottles have to be replaced every 6 months.	31

0 8 . 3 A 1 litre bottle for SODIS costs 29p. Each litre bottle needs replacing after 6 months.

A family uses 6 litres of potable water per day.

Calculate the cost per year of using SODIS for the family.

[2 marks]

Cost per year = £ _____

Do not write outside the box

0 8 . 4 Other than cost, give **two** disadvantages of using the Biosand unit instead of SODIS.

[2 marks]

1 _____

_____

2 _____

_____

0 8 . 5 Give **two** advantages of using the Biosand unit instead of SODIS.

[2 marks]

1 _____

_____

2 _____

_____

0 8 . 6 SODIS uses UV light to sterilise water.

Give **one** other method of sterilising water.

[1 mark]

_____

_____

9

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

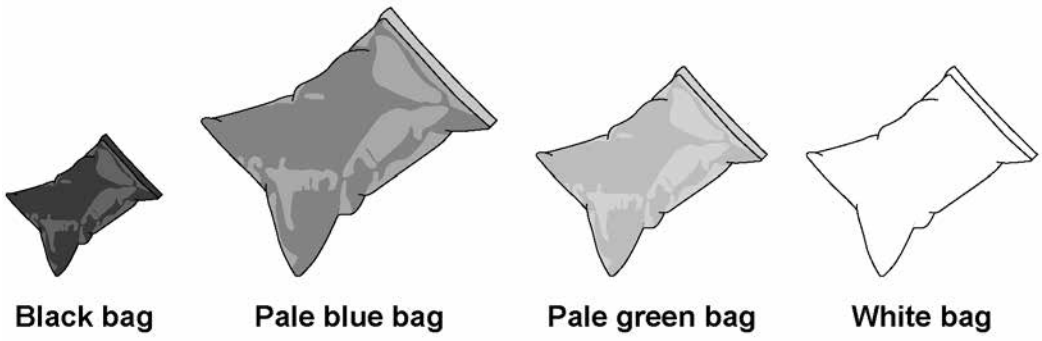
Do not write outside the box

0 9 A solar water bag can be used to heat water for an outdoor swimming pool.

A student wanted to find out if the colour of the solar water bag affects the temperature increase of the water inside the bag.

Figure 12 shows some of the equipment used.

Figure 12



This is the method used.

1. Fill each bag with water.
2. Place the four bags on the ground outside.
3. After three hours, measure the temperature of the water inside each bag.
4. Repeat steps 1–3 on the next two days.

0 9 . 1 Suggest **three** changes the student should make to this method to get valid results.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

Question 9 continues on the next page

Do not write outside the box

The student repeated the investigation using an improved method.

The results obtained were valid.

Table 5 shows the results.

Table 5

Colour of bag	Temperature increase in °C			
	Day 1	**Day 2**	**Day 3**	**Mean**
Black	44.0	31.4	43.4	39.6
Pale blue	38.5	23.6	38.1	33.4
Pale green	37.9	23.7	37.7	33.1
White	25.3	23.4	24.2	**X**

0 9 . 2 The student used a thermometer to measure the temperature of the water inside each bag.

What was the resolution of the thermometer?

[1 mark]

Resolution = _____ °C

0 9 . 3 Suggest **one** reason why the temperatures increased less on Day 2 than on Day 1 and Day 3.

[1 mark]

_____

_____

Do not write outside the box

0 9 . 4 Calculate the mean temperature increase for the white bag.

[1 mark]

Mean temperature increase = _____ °C

0 9 . 5 Which colour of bag would be best to use to heat water?

Give a reason for your answer.

[2 marks]

Colour _____

Reason _____

8

Turn over for the next question

Do not write outside the box

1 0 Dravet syndrome is caused by a genetic mutation.

Dravet syndrome causes epileptic seizures. An epileptic seizure is caused by unusual brain activity.

1 0 . 1 Mutations often happen when cells divide.

Give **one** other cause of genetic mutations.

[1 mark]

1 0 . 2 Scientists have transferred the mutated gene for Dravet syndrome into zebrafish using genetic engineering.

This means the scientists could test a new drug to treat Dravet syndrome on the zebrafish.

Which **two** of the following are used during the process of genetic engineering?

[2 marks]

Tick **two** boxes.

- Enzymes ☐
- Placebos ☐
- Vaccines ☐
- Vectors ☐
- White blood cells ☐

Do not write outside the box

1 0 . 3 Scientists used the genetically engineered zebrafish to test the new drug.

Describe the processes that then need to happen to test the new drug before it can be used to treat all children with Dravet syndrome.

[6 marks]

9

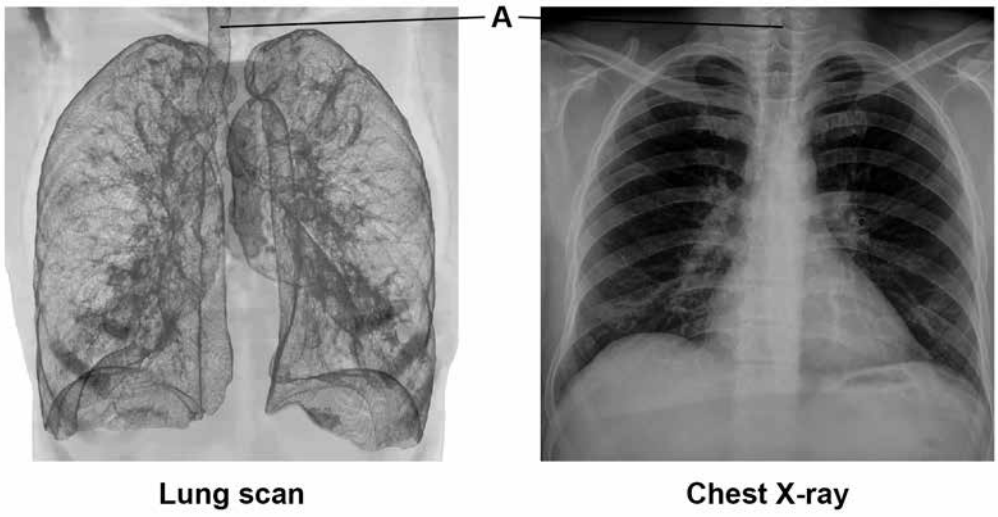
Turn over for the next question

Do not write outside the box

1 1 A man with breathing difficulties goes to hospital.

Figure 13 shows his lung scan and chest X-ray.

Figure 13



1 1 . 1 What is part **A**?

[1 mark]

Tick **one** box.

Bronchus ☐

Capillary ☐

Trachea ☐

Vein ☐

1 1 . 2 Give **one** advantage of using the **lung scan**, rather than the chest X-ray, to diagnose problems with the man's breathing system.

[1 mark]

Do not write outside the box

1 1 . 3 Give **one** advantage of using the **chest X-ray**, rather than the lung scan, to diagnose problems with the man's breathing system.

[1 mark]

1 1 . 4 Aerobic respiration and anaerobic respiration are the two types of cell respiration.

Give **three** differences between aerobic and anaerobic respiration.

[3 marks]

1

2

3

Question 11 continues on the next page

Do not write outside the box

1 1 . 5 A health website contains the following advice:

Stop smoking and you will be healthier and live longer.

Explain why stopping smoking will improve a person's health.

[6 marks]

12

END OF QUESTIONS