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 2 Life and Environmental Sciences

Wednesday 20 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.

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ANSWER IN THE SPACES PROVIDED

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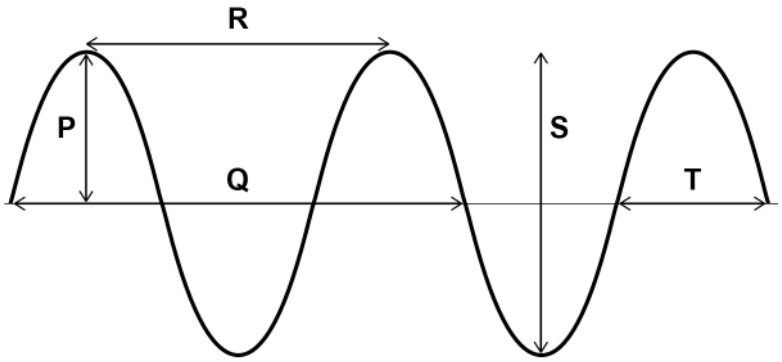
0 1 **Figure 1** shows a transverse wave.

Figure 1



0 1 . 1 Which arrow shows the amplitude of the wave?

[1 mark]

Tick (✓) **one** box.

P ☐ **Q** ☐ **R** ☐ **S** ☐ **T** ☐

0 1 . 2 Which arrow shows the wavelength of the wave?

[1 mark]

Tick (✓) **one** box.

P ☐ **Q** ☐ **R** ☐ **S** ☐ **T** ☐

Question 1 continues on the next page

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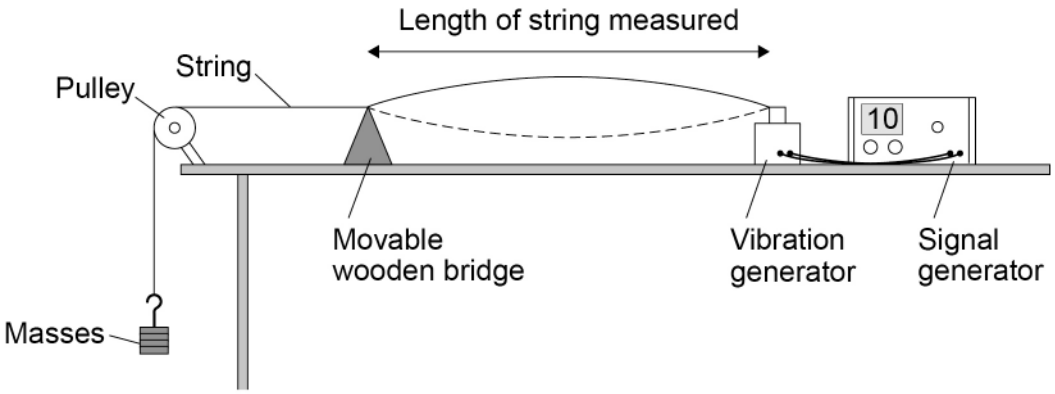
A teacher demonstrated waves on a string.

Figure 2 shows the apparatus used.

Figure 2



This is the method used.

1. Switch on the signal generator and vibration generator so the string vibrates up and down.

2. Move the wooden bridge until a clear wave pattern is formed between the wooden bridge and the vibration generator.

3. Use a metre rule to measure the length of the string between the wooden bridge and the vibration generator.

4. Record the frequency of the wave from the signal generator.

5. Record the number of loops in the wave pattern. The wave pattern shown in **Figure 2** has one loop.

6. Change the frequency on the signal generator until a new wave pattern is formed.

7. Repeat steps **4** to **6**.

0 1 . 3 Give **one** control variable in this demonstration.

[1 mark]

Do not write outside the box

0 1 . 4 The length of the string between the vibration generator and the wooden bridge was about 1.5 m

The teacher used a metre rule to measure the length of the string.

Suggest **two** reasons why making an accurate measurement was difficult.

[2 marks]

1 _____

_____

2 _____

_____

Question 1 continues on the next page

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Table 1 shows the results.

Table 1

Frequency in Hz	Wave pattern on 1.50 m string ⟷	Number of loops in wave pattern	Wavelength in m
10		1	3.00
20		2	1.50
30		3	1.00
40		4	0.75
50		5	**X**

0 1 . 5 Give **one** conclusion about frequency and wavelength from the data in **Table 1**.

[1 mark]

0 1 . 6 Each loop of the wave pattern is the length of half a wavelength.

Determine wavelength **X** in **Table 1**.

[2 marks]

Wavelength **X** = _____ m

Do not write outside the box

0 1 . 7 Calculate the period of the wave when the frequency was 30 Hz

Give your answer to 2 significant figures.

Use the Physics Equations Sheet.

[3 marks]

Period (2 significant figures) = _____ s

11

Turn over for the next question

Do not write outside the box

0 2 Plants absorb light to photosynthesise.

0 2 . 1 Complete the word equation for photosynthesis.

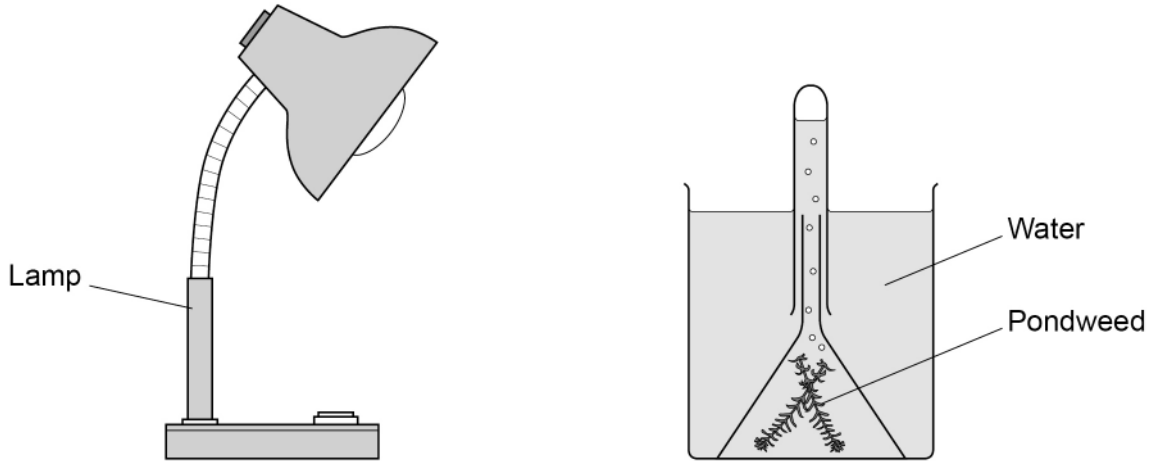
[1 mark]

_____ + water ⟶ _____ + glucose

Light intensity affects the rate of photosynthesis.

Figure 3 shows some of the equipment used to measure the rate of photosynthesis.

Figure 3



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0 2 . 2 Describe a method to investigate the effect of light intensity on the **rate** of photosynthesis.

Use the equipment in **Figure 3** and other laboratory equipment.

[6 marks]

Question 2 continues on the next page

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Algal cells photosynthesise.

Scientists investigated the effect of light intensity on algal cells.

The algal cells were placed in different light intensities.

Table 2 shows the number of **extra** algal cells after two days.

Table 2

Light intensity in lux	Number of EXTRA algal cells after two days
0	no extra cells
250	1.00×10^6
500	1.65×10^6
750	2.15×10^6
1000	2.40×10^6
1250	2.50×10^6
1500	2.50×10^6

0 2 . 3 The initial number of algal cells was 200 000

Calculate the total number of algal cells after two days when the light intensity was 500 lux

[2 marks]

Total number of algal cells = _____

Do not write outside the box

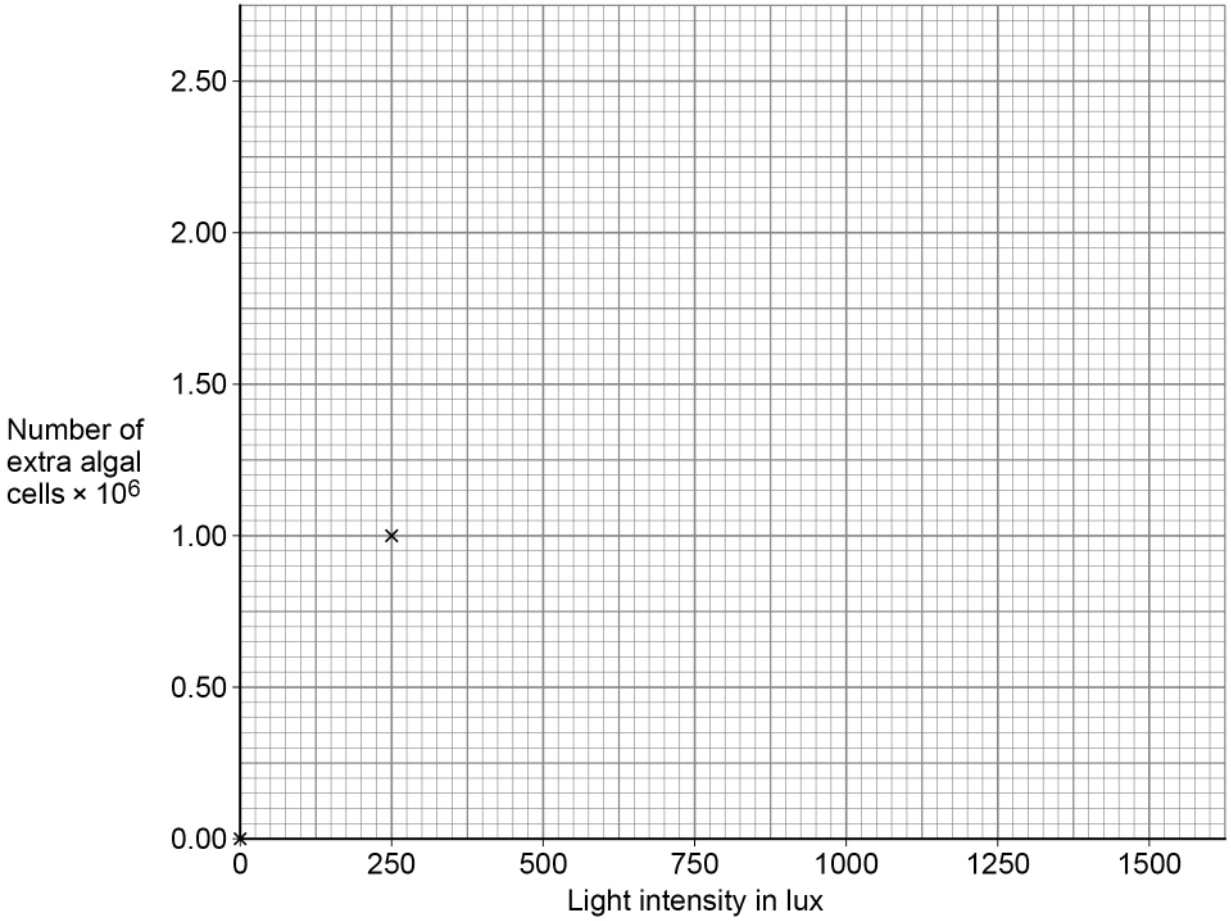
0 2 . 4 Plot the data from **Table 2** on **Figure 4**.

The first two points have been plotted.

Draw a line of best fit.

[3 marks]

Figure 4



0 2 . 5 Give **two** conclusions from the results.

Use information from **Table 2**.

[2 marks]

1 _____

_____

2 _____

_____

Question 2 continues on the next page

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0 2 . 6 Explain how an increase in temperature from 20 °C to 25 °C would affect the number of algal cells.

[2 marks]

16

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ANSWER IN THE SPACES PROVIDED

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0 3 Water is cycled through the environment.

0 3 . 1 Rain provides fresh water.

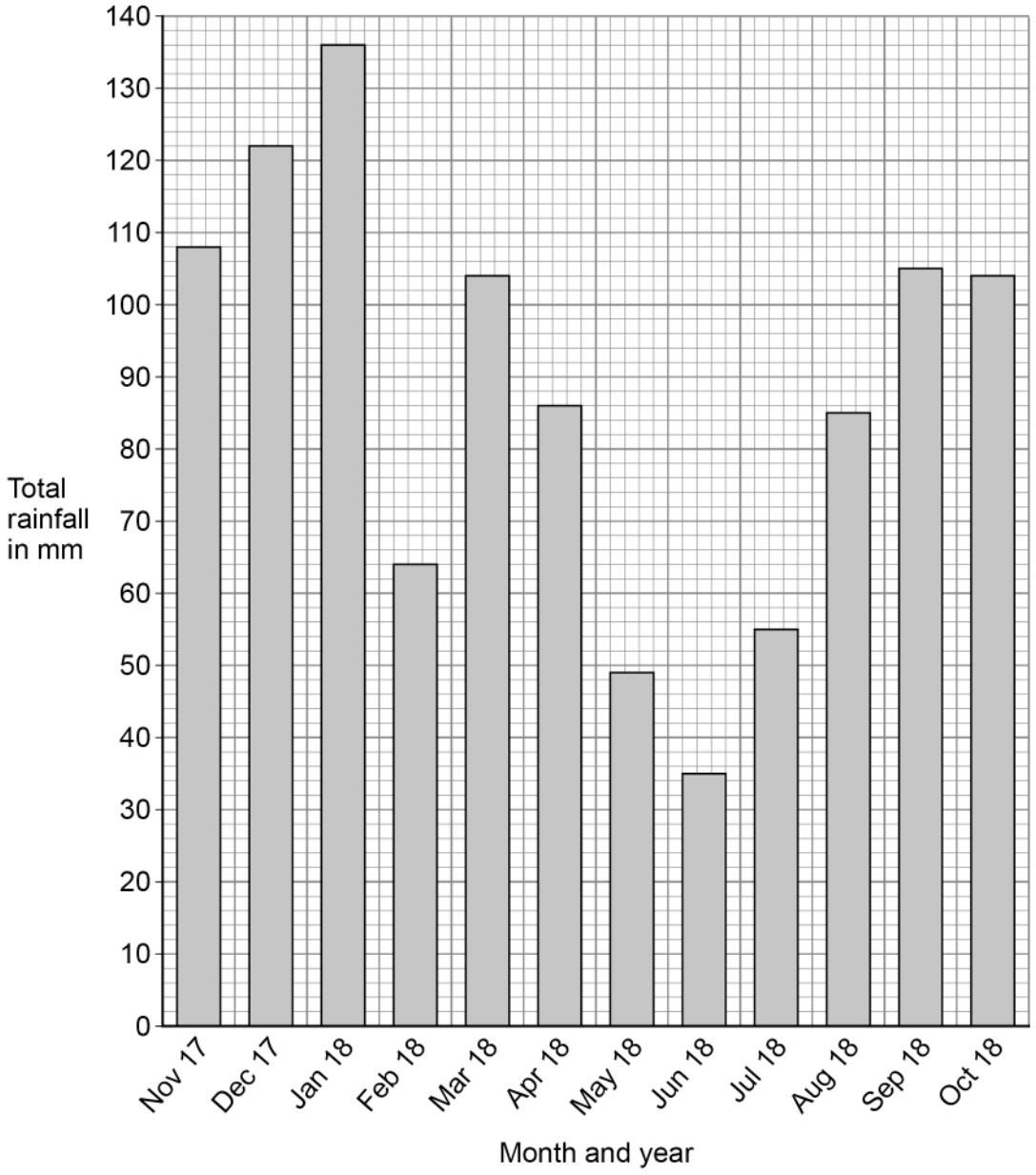
Fresh water in the ground contains small amounts of dissolved substances.

Suggest **one** source of these dissolved substances.

[1 mark]

Figure 5 shows the total monthly rainfall from November 2017 to October 2018 in the UK.

Figure 5



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0 3 . 2 Give **two** conclusions you can make from the data shown in **Figure 5**.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 3 Determine the percentage increase in rainfall in the month of January 2018 compared to the month of November 2017.

[3 marks]

_____

_____

_____

_____

_____

Percentage increase = _____ %

0 3 . 4 Suggest **one** reason why scientists cannot accurately predict the total rainfall in the UK for November 2020.

[1 mark]

_____

_____

_____

Question 3 continues on the next page

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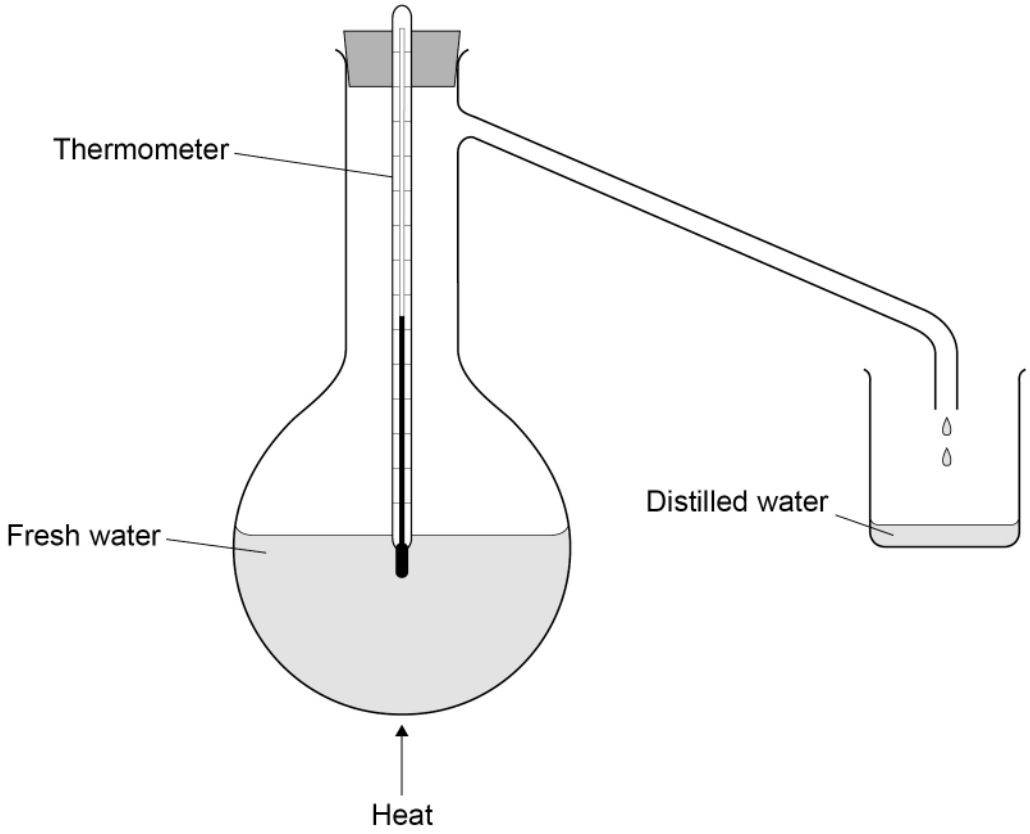
A student produced distilled water from fresh water.

Figure 6 shows the apparatus used.

Figure 6



0 3 . 5 The student stated that the thermometer measured the boiling point of water.

The reading on the thermometer was 102 ºC

Describe how the apparatus can be changed to obtain the correct value for the boiling point of water.

Give **one** reason why the change is needed to obtain the correct value.

[2 marks]

Change _____

_____

Reason _____

_____

Do not write outside the box

0 3 . 6 The student collected less distilled water than expected from a sample of fresh water.

Suggest **one** change to the apparatus to increase the volume of distilled water collected from the fresh water sample.

Give **one** reason why this suggestion would increase the volume of distilled water collected.

[2 marks]

Change _____

_____

Reason _____

_____

Sea water in some parts of the world is used to produce potable water.

Distillation can be used to desalinate sea water.

0 3 . 7 Explain **one** disadvantage of using distillation to obtain potable water.

[2 marks]

_____

_____

_____

_____

0 3 . 8 Name **one** other method used for desalination.

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

[1 mark]

_____

_____

14

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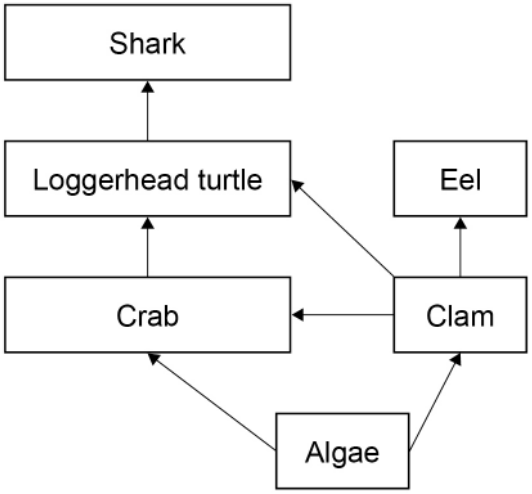
0 4 **Figure 7** shows part of a food web.

Figure 7



0 4 . 1 There are four levels of feeding relationship shown in the food web in **Figure 7**.

Algae are at level 1 in the food web.

Why is it difficult to identify the level of the loggerhead turtle in the food web?

[1 mark]

Do not write outside the box

0 4 . 2 Explain the effects a decrease in the population of clams could have on the other organisms in **Figure 7**.

[6 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 3 Female loggerhead turtles lay their eggs in nests on sandy beaches.

Table 3 shows how the temperature of the nest affects the sex of the loggerhead turtles.

Table 3

Temperature of nest in °C	Sex of loggerhead turtles hatching from eggs
> 29	more females than males
29	equal numbers of males and of females
< 29	more males than females

Explain how the continued use of fossil fuels could affect the population of loggerhead turtles.

Use information from **Table 3**.

[4 marks]

11

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ANSWER IN THE SPACES PROVIDED

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0 5 Two 18-year-old male students measured their reaction times.

The students used two methods, Method **1** and Method **2**.

Method 1

1. Sit in front of a tablet computer.
2. When the tablet makes a sound, touch the tablet screen as quickly as possible.
3. Record the reaction time shown on the tablet.
4. Repeat steps **1** to **3** another two times.

Method 2

1. Hold a metre rule so the bottom of the rule is level with the top of the other student's thumb.
2. Let go of the metre rule.
3. The other student catches the metre rule.
4. Record the position of the student's thumb on the metre rule.
5. Convert the position on the metre rule to a reaction time using a conversion table.
6. Repeat steps **1** to **5** another two times.

Table 4 shows the results.

Table 4

Student	Reaction time in seconds							
	Method 1				Method 2			
	Test 1	Test 2	Test 3	Mean	Test 1	Test 2	Test 3	Mean
A	0.72	0.69	0.71	0.71	0.8	0.6	0.8	0.7
B	0.53	0.49	0.52	0.51	0.6	0.7	0.5	0.6

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0 5 . 1 Student **A** and student **B** had different reaction times.

Suggest **two** reasons why student **A**'s reaction time was longer than student **B**'s reaction time.

[2 marks]

1 _____

_____

2 _____

_____

0 5 . 2 Give **two** reasons why Method **1** would give more accurate results than Method **2**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 5 continues on the next page

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0 5 . 3 In Method **1** the students react to a sound.

In Method **2** the students react when they see the metre rule drop.

A sound wave is a longitudinal wave.

Visible light is a transverse wave.

Describe the difference between a longitudinal wave and a transverse wave.

[2 marks]

0 5 . 4 The nervous system coordinates reflex actions.

A person accidentally touches a hot object.

The person moves their hand away quickly.

Describe how information about the hot object is detected, **and** how the information reaches the muscles in the arm.

[4 marks]

10

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0 6 This question is about breathing and gas exchange.

Figure 8 shows a person using a peak flow meter.

Figure 8

Peak flow is how quickly air can be breathed out of the lungs.

Table 5 shows the peak flow of a person on two different days.

Table 5

Day	Peak flow in dm^3 per minute			Mean peak flow in dm^3 per minute
	Test 1	Test 2	Test 3	
1	513	511	521	515
2	467	**X**	478	473

Do not write outside the box

0 6 . 1 The person has different peak flow results on Day **1** and Day **2**.

Suggest **one** reason why peak flow was lower on the second day.

[1 mark]

0 6 . 2 Calculate value **X** for Day **2**.

[3 marks]

X = _____ dm^3 per minute

Question 6 continues on the next page

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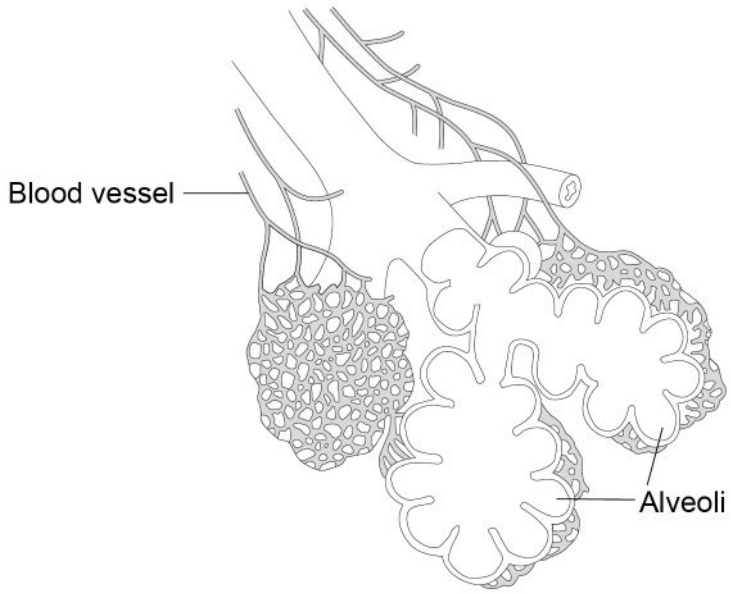
0 6 . 3 **Figure 9** shows part of the lungs.

There are many alveoli in the lungs.

Alveoli provide a large surface area for gas exchange.

Figure 9



Explain how **two** other adaptations of the alveoli allow efficient gas exchange.

Do **not** refer to surface area in your answer.

[4 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

8

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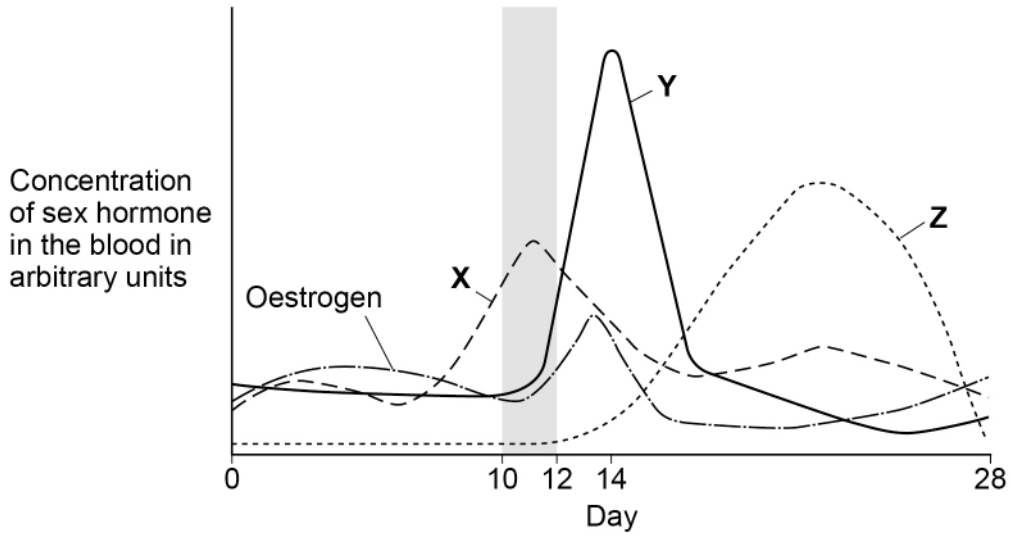
0 7 Endocrine glands produce hormones.

0 7 . 1 Which hormone stimulates basal metabolic rate?

[1 mark]

Figure 10 shows how concentrations of sex hormones in the blood vary during a 28-day menstrual cycle.

Figure 10



0 7 . 2 Which hormone does **X** represent?

[1 mark]

Tick (✓) **one** box.

FSH ☐

LH ☐

Progesterone ☐

Testosterone ☐

Do not write outside the box

0 7 . 3 Which hormone does **Z** represent?

[1 mark]

Tick (✓) **one** box.

FSH ☐

LH ☐

Progesterone ☐

Testosterone ☐

0 7 . 4 Describe **two** effects of oestrogen between day 10 and day 12 of the menstrual cycle.

[2 marks]

1 _____

_____

2 _____

_____

Question 7 continues on the next page

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In vitro fertilisation (IVF) is a fertility treatment.

0 7 . 5 Hormones are used in IVF treatment.

Explain how different hormones are used to help a woman become pregnant.

[3 marks]

0 7 . 6 **Table 6** shows information about IVF success rates.

Table 6

Age of woman in years	Percentage (%) of IVF treatments resulting in pregnancy
<35	29
35–37	23
38–39	15
40–42	9
43–44	3
>44	2

A 35-year-old woman with fertility problems wants a child.

Suggest why she should start IVF treatment as soon as possible.

You **must** include data from **Table 6** in your answer.

[1 mark]

9

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Turn over for the next question

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0 8 A scientist investigated the effect of exercise on reducing the risk of some medical conditions.

- The investigation involved two groups of people.
- One group walked quickly and the other group ran.
- The people in the walking group exercised for more time than the people in the running group.
- Each group transferred the same amount of energy.

Table 7 shows data from the investigation.

Table 7

Medical condition	Percentage (%) reduction in risk of developing the medical condition	
	Walking quickly	Running
Coronary heart disease	9.3	4.5
Diabetes	12.3	12.1
High blood pressure	7.2	4.2
High concentration of cholesterol in the blood	7.0	4.3

0 8 . 1 Name **two** factors that should be controlled.

Do **not** refer to amount of energy transferred, age or sex in your answer.

[2 marks]

1 _____

_____

2 _____

_____

Do not write outside the box

0 8 . 2 Blood pressure measures how hard the blood is forced against the walls of the arteries.

Regular exercise makes the heart muscle stronger.

A stronger heart can pump more blood with less effort so the forces on the walls of the arteries decrease.

Suggest why walking reduces the risk of high blood pressure more than running reduces the risk of high blood pressure.

[1 mark]

0 8 . 3 Explain how a high concentration of cholesterol in the blood can cause coronary heart disease.

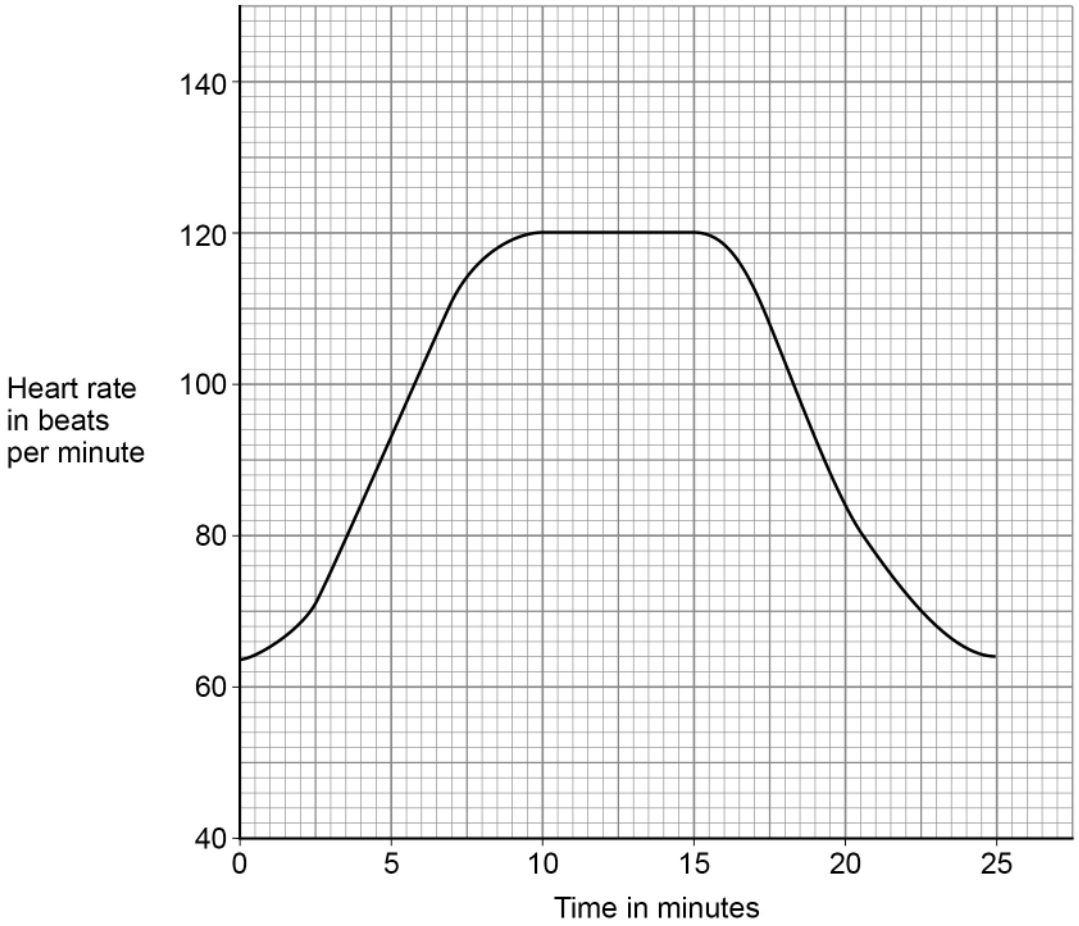
[2 marks]

Question 8 continues on the next page

A student walked quickly for 15 minutes.

Figure 11 shows the effect walking quickly had on the student's heart rate.

Figure 11



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0 8 . 4 Determine the rate of increase in heart rate of the student at 8.5 minutes.

Use **Figure 11**.

[4 marks]

Rate of increase = _____ beats/min^2

0 8 . 5 Explain why heart rate needs to increase during exercise.

[3 marks]

12

Turn over for the next question

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0 9 Bananas from wild banana plants are **not** eaten by humans.

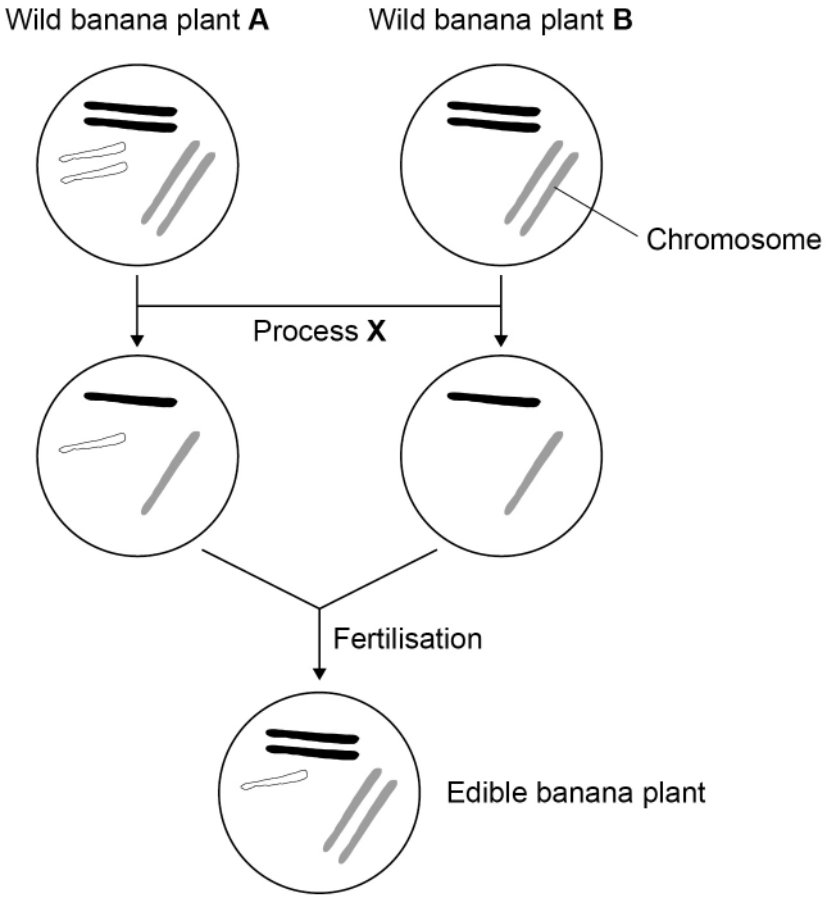
Edible banana plants are grown commercially.

Humans can eat bananas from edible banana plants because they do not contain seeds.

The edible banana plant evolved from the wild banana plant.

Figure 12 shows how scientists think the edible banana plant may have evolved.

Figure 12



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0 9 . 1 What is process **X** in **Figure 12**?

[1 mark]

Tick (✓) **one** box.

- Differentiation ☐
- Meiosis ☐
- Mutation ☐
- Natural selection ☐

0 9 . 2 Explain why the edible banana plant cannot produce gametes.

[2 marks]

Question 9 continues on the next page

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0 9 . 3 Cloning is used to reproduce edible banana plants.

The cloned cells divide by mitosis.

Describe the process of mitosis.

[4 marks]

Do not write outside the box

0 9 . 4 Banana plants can become infected by the TR4 fungus.

The fungus enters the plant through the roots and grows within the xylem vessels.

The xylem vessels become blocked and the leaves turn yellow.

Describe why blockage of the xylem vessels causes the leaves to turn yellow.

[1 mark]

0 9 . 5 TR4 fungus is a threat to the global banana industry.

Some wild banana plants have a gene for resistance to the TR4 fungus.

What could scientists do to protect edible banana plants from the TR4 fungus?

[1 mark]

Tick (✓) **one** box.

Allow banana plants to breed by sexual reproduction. ☐

Allow plants with TR4 resistance to breed with edible banana plants. ☐

Selectively breed edible banana plants that have resistance to TR4. ☐

Transfer the gene for TR4 resistance into edible plants. ☐

9

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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