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Monday 15 November 2021 – Morning

GCSE (9–1) Biology B (Twenty First Century Science)

J257/01 Breadth in biology (Foundation Tier)

Time allowed: 1 hour 45 minutes

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You must have:
- a ruler (cm/mm)

You can use:
- an HB pencil
- a scientific or graphical calculator

J257 01

Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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Answer **all** the questions.

1 Different substances are transported into and out of the human body to help keep its cells alive.

(a) (i) Complete the table to describe how each substance is related to the requirements of cells.

Tick (✓) at least **one** box in each row.

Substance	Used by cells for aerobic cellular respiration	Made by cells in aerobic cellular respiration	Helps to maintain the volume of the cell's cytoplasm
Carbon dioxide			
Oxygen			
Water			

[4]

(ii) The lungs are a gaseous exchange surface in the human body.

Complete the sentences to explain why this exchange surface is important.

Use the words.

You can use each word once, more than once, or not at all.

big **distance** **fast** **slow** **surface area** **volume**

The gaseous exchange surface in the lungs has a large .....

Without this exchange surface the exchange of gases would be too

.....

[2]

(b) It is important that the water content of the body remains constant.

(i) Which organ is responsible for maintaining the water balance of the human body?

Put a (ring) around the correct answer.

Heart **Kidney** **Skin** **Stomach**

[1]

(ii) State **two** ways in which the human body loses water.

1 .....

2 .....

[2]

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(c) If the amount of water in the blood increases, more water could enter cells.

(i) What is the name of the process that moves water into these cells?

Put a (ring) around the correct answer.

Active transport **Diffusion** **Excretion** **Osmosis**

[1]

(ii) If too much water enters a cell what could happen to the cell?

Tick (✓) **one** box.

It could burst ☐

It could shrink ☐

There would be no change ☐

[1]

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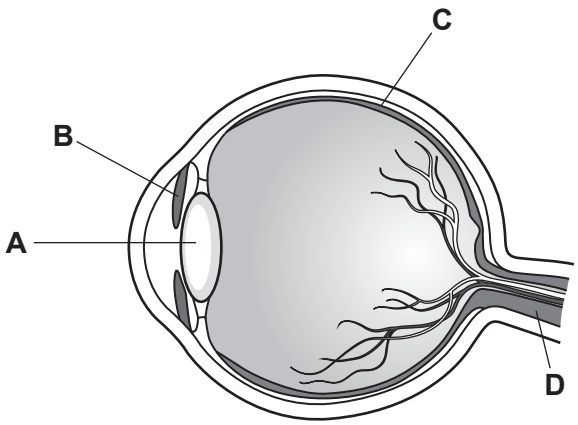
2 The diagram shows the human eye.



(a) (i) Which letter shows the lens?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

[1]

(ii) Which letter shows the part of the eye that controls the size of the pupil?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

[1]

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(b) Poor vision can be caused by a defect in the eye.

Draw lines to connect each common defect with what it is caused by.

Common defect	Caused by
Cataract	The eyes are too long.
Long-sightedness	The lens cannot become round enough.
Short-sightedness	A cloudy patch forms on the lens.

[2]

(c) Conjunctivitis is an infection of the eye. People with conjunctivitis often have red eyes with a sticky substance covering the eye.

The eyes are also itchy.

(i) Conjunctivitis can be caused by bacteria.

What could a doctor give a patient to help kill bacteria?

..... **[1]**

(ii) Conjunctivitis is a communicable disease.

Suggest how a person with conjunctivitis could prevent spreading the disease to another person.

.....

..... **[1]**

(d) Some bacteria can respire anaerobically.

Which statement about **anaerobic** respiration in bacteria is correct?

Tick (✓) **one** box.

- It does **not** use glucose ☐
- It does **not** use oxygen ☐
- It produces oxygen ☐
- It produces water ☐

[1]

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3 This question is about plants.

Select the correct word from the list to match each statement.

You can use each word once, more than once, or not at all.

auxin gravitropism meiosis meristem mitosis

photosynthesis phototropism stomata

(a) The name of a plant hormone. ..... **[1]**

(b) A growth response to gravity. ..... **[1]**

(c) A growth response to light. ..... **[1]**

(d) Unspecialised plant cells. ..... **[1]**

(e) Cell division that results in the formation of gametes. ..... **[1]**

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4 Humans have many non-specific defences to protect them from pathogens.

(a) **(i)** Name **one** physical defence.

..... **[1]**

(ii) Name **one** chemical defence.

..... **[1]**

(b) *Salmonella* are bacteria that can cause illness in humans.

(i) Explain how *Salmonella* can be spread.

.....

.....

.....

..... **[2]**

(ii) A *Salmonella* infection can cause the body's temperature to rise higher than normal.

Describe **two** changes that will take place in the skin to help bring the body's temperature back down to normal.

1. .....

.....

2. .....

.....

[2]

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(c) Scientists investigated samples of chicken on sale in the UK to see how many contained *Salmonella* bacteria.

The data are shown in **Table 4.1**.

	Country	Number of samples taken	Number of samples testing positive for *Salmonella*	Percentage of samples testing positive for *Salmonella* (%)
UK	England	2475	135	5.45
	Northern Ireland	797	44	5.52
	Scotland	794	70	8.82
	Wales	800	27	3.38

Table 4.1

(i) Calculate the mean percentage of samples that tested positive for *Salmonella* in the UK.

Give your answer to **2** significant figures.

Mean = ... % **[2]**

(ii) Which country had a higher percentage of samples that tested positive for *Salmonella* than the mean?

Use your answer to **(c)(i)**.

..... **[1]**

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(d) The scientists compared the data collected in the UK with data from other countries.

The results are shown in **Table 4.2**.

Country	Percentage of samples that tested positive (%)
Brazil	6
Denmark	10
France	17
Germany	17
Netherlands	12
Republic of Ireland	9
Thailand	4
UK	6

Table 4.2

Write down **two** conclusions that could be drawn from the data.

Use **Table 4.2**.

1 .....

.....

2 .....

.....

[2]

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5 A student is investigating a factor required for photosynthesis.

The student conducts an experiment using this method:

Step 1: Place a plant in the dark for a day.

Step 2: Remove the plant from the dark.

Step 3: Secure a piece of paper on one leaf as shown in **Fig. 5.1**.

Step 4: Leave the plant in the light for one day.

Step 5: Remove the leaf and test it for starch.

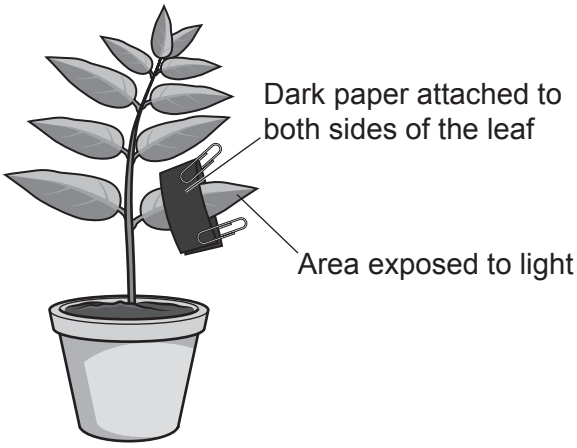

Fig. 5.1

(a) Which reagent would be used to test for starch?

Tick (✓) **one** box.

Benedict's ☐

Biuret ☐

Iodine ☐

[1]

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(b) A positive test for starch results in the reagent turning black/blue.

Shade the leaf in **Fig. 5.2** to show the area that would turn black/blue.

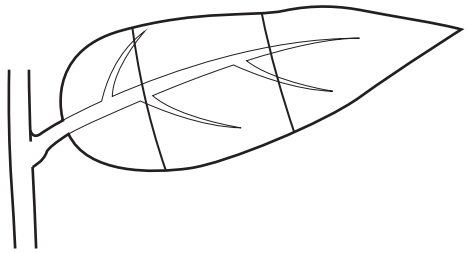

Fig. 5.2

[1]

(c) Complete the sentences to explain why the student placed the plant in the dark for a day, in **Step 1** of their method.

Put a (ring) around the correct answers.

The plant was placed in the dark so that it would not **grow / photosynthesise / respire**.

In the dark it will use up all of its existing stores of **carbon dioxide / starch / water**.

[2]

(d) The student was investigating only one factor that is required in photosynthesis.

Which **one** factor was being investigated?

..... **[1]**

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6 Multiple sclerosis is a disease which currently does not have a cure.
Scientists have conducted a trial with patients to see if stem cells could help cure this disease.

(a) (i) What is a stem cell?

.....

..... **[1]**

(ii) Stem cells can be taken from embryos.

Give **one** reason why people are against the use of these stem cells.

.....

..... **[1]**

(b) Trials using stem cells are not risk free.

Give **one** benefit and **one** risk of taking part in the trial.

Benefit .....

.....

Risk .....

.....

[2]

(c) This research was published in a peer-reviewed journal.

(i) Describe what happens during peer review.

.....

.....

.....

..... **[2]**

(ii) Publishing research in peer-reviewed journals is one way of communicating the scientists' findings.

Identify who else would be interested in finding out about this research, other than scientists.

..... **[1]**

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7 **Fig. 7.1** shows an animal called a Tasmanian devil.

Fig. 7.1

(a) Tasmanian devils are only found on an island off the coast of Australia. They look very similar to other small animals in Australia but have been classified as a **different** species.

What evidence from their cells could have been used to classify them as a different species?

..... **[1]**

(b) **Fig. 7.2** shows the estimated population of Tasmanian devils from 1995 to 2008.

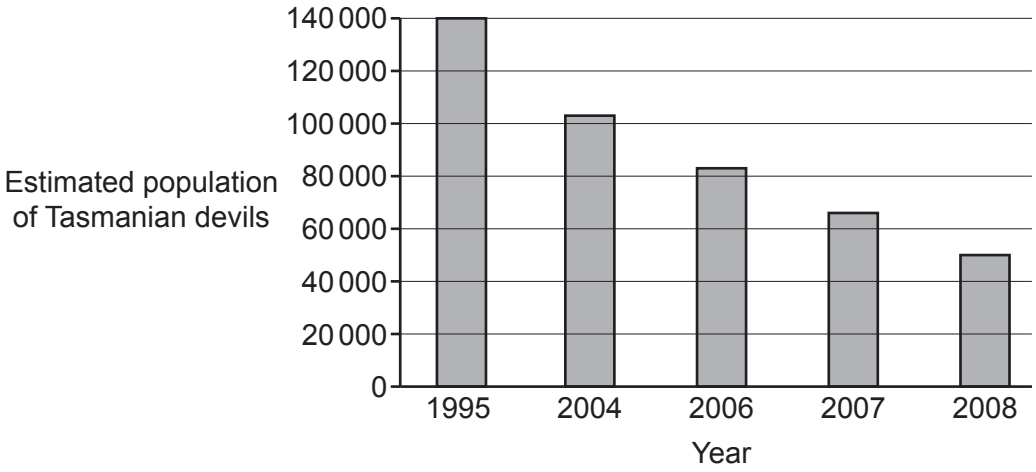

Fig. 7.2

(i) How many Tasmanian devils were there in 1995?

Number of Tasmanian devils = ... **[1]**

(ii) In 2008 there were fewer Tasmanian devils.

Calculate the difference in the population from 1995 to 2008.

Difference = ... **[2]**

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(c) (i) The decrease in population is because of a disease called Devil Facial Tumour disease.

Explain why scientists are concerned about the population of Tasmanian devils.

Use data from **Fig. 7.2** to support your answer.

.....

.....

.....

..... **[2]**

(ii) Devil Facial Tumour is a form of cancer. It is spread from one Tasmanian devil to another when they bite each other.

How is the Devil Facial Tumour cancer different from cancers found in humans?

.....

.....

.....

..... **[2]**

(iii) Scientists have recently discovered that some Tasmanian devils have developed resistance to Devil Facial Tumour disease.

This resistance can be passed on to offspring and is becoming more common in each generation of the population.

Which process is causing the resistance to become more common?

Tick (✓) **one** box.

Immunity ☐

Infection ☐

Natural selection ☐

[1]

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8 As the human population is increasing, we need to provide more food.

(a) Explain how farmers selectively breed cows that produce more meat.

.....

.....

.....

.....

.....

..... **[3]**

(b) Humans use technology to help increase food production.

Draw lines to connect each technology with the statement which explains how this improves food production.

Technology	Improved food production
Fertilisers	Fewer crops are eaten by insects.
Genetic engineering	It gives plants the ability to survive disease and drought.
Pesticides	Plants obtain more essential nutrients so grow more.

[2]

(c) Give **one** way in which pesticides can reduce biodiversity.

.....

..... **[1]**

(d) Biofuel is now used in some vehicles as a fuel. It is made from plants.

Burning biofuel releases carbon dioxide. However, biofuel is described as carbon neutral.

Suggest why biofuel is described as carbon neutral.

Use ideas about photosynthesis in your answer.

.....

.....

.....

..... **[2]**

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9 Catalase is an enzyme. It breaks down hydrogen peroxide into water and oxygen.

The action of this enzyme can be investigated using the equipment shown in **Fig. 9.1**.

The catalase and hydrogen peroxide are placed in the conical flask. The oxygen produced by the reaction is collected in the measuring cylinder.

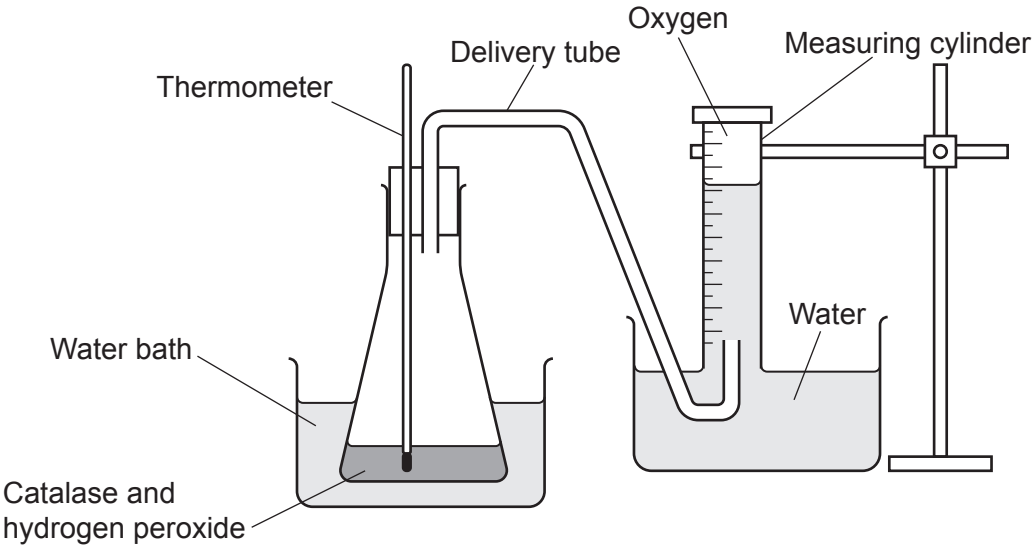

Fig. 9.1

Amir wants to investigate how enzyme concentration affects this reaction.

(a) (i) Amir uses a beaker to measure out the hydrogen peroxide solution.

Suggest **one** piece of equipment that Amir could use instead of a beaker **and** why this would improve his experiment.

Piece of equipment .....

Reason for choice .....

[2]

(ii) Describe how Amir could use the equipment in **Fig. 9.1** to investigate the effect of enzyme concentration on the rate of this reaction.

.....

.....

.....

..... **[2]**

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(b) Temperature is one variable that needs to be controlled in this experiment.

State **two** other variables that would need to be controlled.

Variable 1 .....

Variable 2 .....

[2]

(c) **Fig. 9.2** shows the effect of temperature on the rate of reaction for the enzyme catalase.

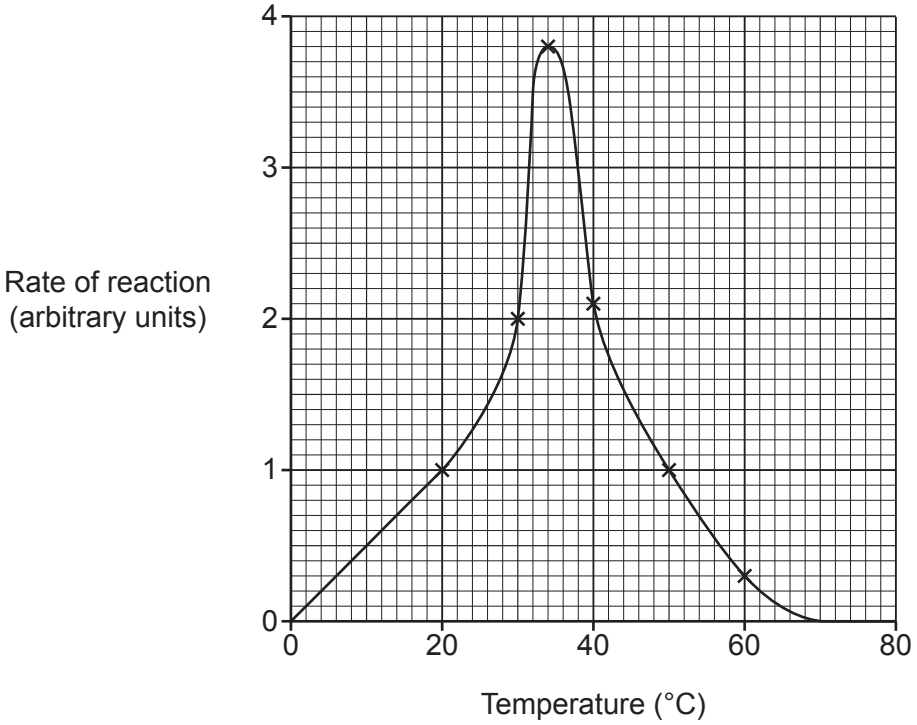

Fig. 9.2

(i) What is the optimum temperature for catalase? ..... °C **[1]**

(ii) How could this investigation be improved to find a more accurate optimum temperature?

.....

..... **[1]**

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(d) Enzyme molecules start to become denatured at temperatures above the optimum temperature.

What was the lowest temperature at which all of the catalase molecules became denatured?

Use **Fig. 9.2**.

Tick (✓) **one** box.

0 °C ☐

40 °C ☐

68 °C ☐

80 °C ☐

[1]

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10 (a) Plants and animals use small organic molecules to make larger organic molecules.

Draw lines to connect the small organic molecules with the large organic molecules that they are used to make.

Small organic molecules	**Large organic molecules**
Amino acids	Fats
Fatty acids	Long-chain carbohydrates
Glycerol	Proteins
Sugar	

[2]

(b) Plants obtain important substances from their environment.

Which list of elements must plants obtain from the environment?

Tick (✓) **one** box.

- Carbon, hydrogen, and oxygen ☐
- Carbon, hydrogen, nitrogen, and oxygen ☐
- Nitrogen and carbon ☐
- Only carbon ☐

[1]

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11 Tay-Sachs disease is an inherited disease caused by a recessive allele.

The symptoms of the disease start when a child is 3–6 months old. The disease is usually fatal.

Charlie and Eve decide they want to have a child. They do not have the disease, but they are concerned that they may be carriers of this disease and will pass it on to their child.

(a) Describe how Charlie and Eve could find out if they are carriers.

.....

.....

..... **[2]**

(b) Charlie and Eve find out they both have the genotype **Tt**.

What word is used to describe this genotype?

..... **[1]**

(c) Charlie and Eve still want to have a child.

Complete the Punnett square to find out the probability of their child having Tay-Sachs disease.

Probability of child having Tay-Sachs disease = ... **[3]**

(d) Charlie and Eve decide that they do not want to risk their child inheriting Tay-Sachs disease.

Suggest **two** ways in which they can have a child that does not have the disease.

1. .....

.....

2. .....

.....

[2]

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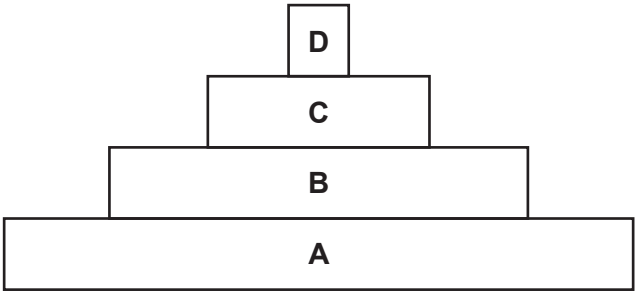
12 The diagram shows a pyramid of biomass for the following food chain.

Food chain

Tree ⟶ Insect ⟶ Sparrow ⟶ Kestrel

Pyramid of biomass



	Dry weight (g/m^2)
D	**1.5**
C	**11**
B	**37**
A	**809**

(a) Which organism in the food chain would you place in **bar A** of the pyramid of biomass?

..... **[1]**

(b) Describe the general change in biomass that occurs between the trophic levels shown in the pyramid **and** give **two** reasons for this change.

.....

.....

.....

.....

.....

..... **[3]**

(c) The percentage efficiency of the biomass transfer between trophic levels can be calculated using the efficiency equation:

$$\textbf{Percentage efficiency} = \frac{\textbf{average biomass in higher trophic level } (g/m^2)}{\textbf{average biomass in lower trophic level } (g/m^2)} \times 100\,\%$$

Calculate the percentage efficiency of the biomass transfer between trophic levels 2 and 3.

Give your answer to **1** significant figure.

Efficiency = ... % **[3]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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