



Oxford Cambridge and RSA

Tuesday 13 May 2025 – Afternoon

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

J257/01 Breadth in biology (Foundation Tier)

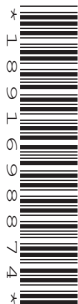
Time allowed: 1 hour 45 minutes

You must have:

- a ruler (cm/mm)

You can use:

- a scientific or graphical calculator
- an HB pencil



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

Centre number

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Candidate number

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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 **32** pages.

ADVICE

- Read each question carefully before you start your answer.

1 This question is about health.

(a) Which statements about health and disease are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
A healthy person has good mental and physical health.		
An unhealthy person always shows symptoms of disease.		
An unhealthy person is more likely to get other diseases.		
Only pathogens cause disease.		

[3]

(b) Draw lines to connect each **treatment** to the correct **named disease** it is used to treat.

Treatment

Named disease

	Cardiovascular disease
Antibiotics	HIV
Insulin	<i>Salmonella</i>
	Type 1 diabetes

[2]

(c) Which **two** of these diseases are communicable?

Tick (✓) **two** boxes.

Cardiovascular disease

☐

HIV

☐

Salmonella

☐

Type 1 diabetes

☐

[2]

(d)

(i) Complete the sentences to describe the cause and transmission of malaria.

Use words from the list.

bacteria

blood

mosquito

protist

urine

virus

Malaria is caused by a type of pathogen called a

It is transmitted when an infected person is bitten by a

The organism sucks from the infected person and passes the pathogen to another person when it bites them.

[3]

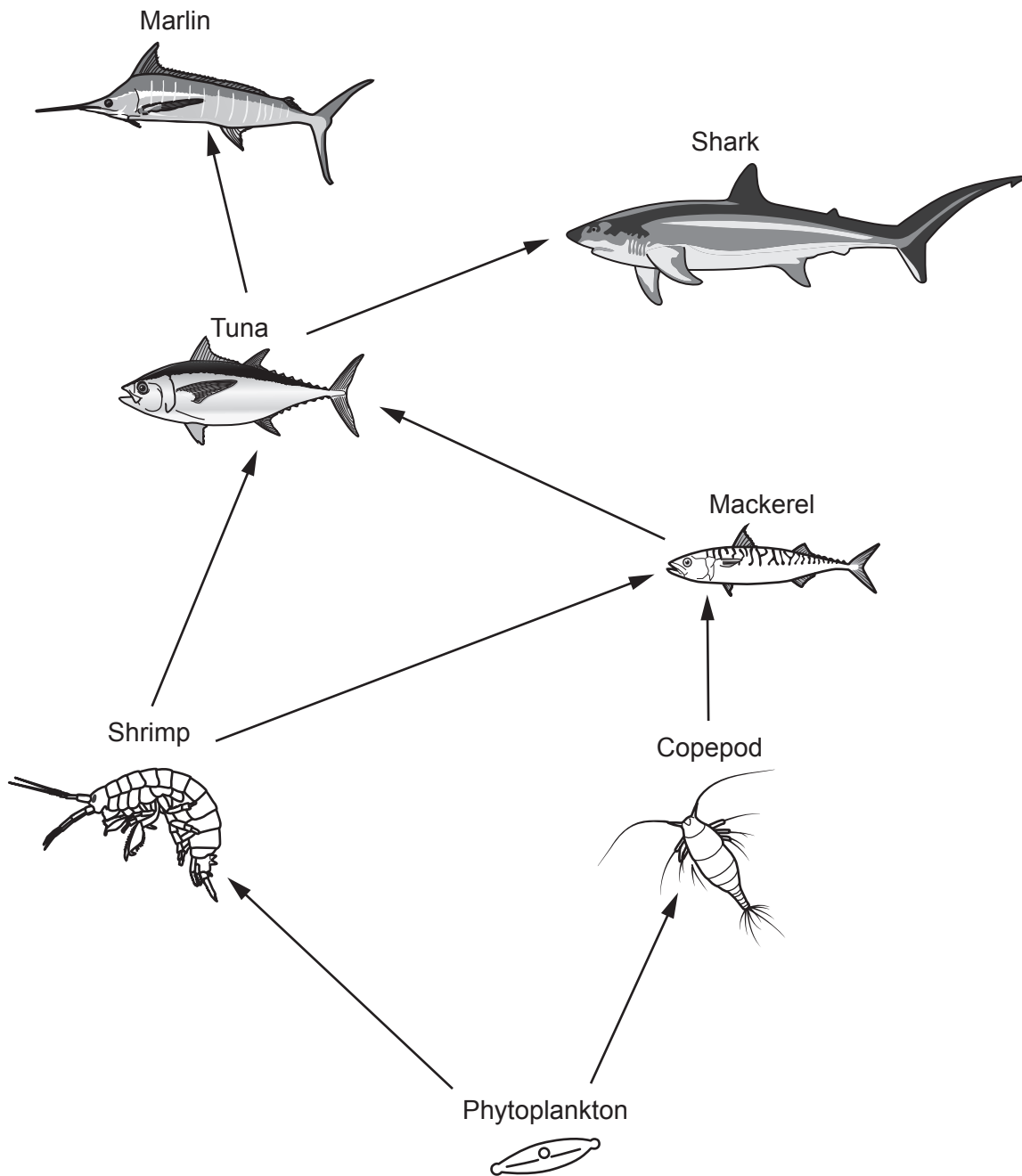
(ii) Suggest **one** way that the transmission of malaria can be prevented.

.....

..... [1]

2 Fig. 2.1 shows part of a food web for a marine ecosystem.

Fig. 2.1



- (a) Complete the sentences to describe the organisms in **Fig. 2.1**.

Use words from the list.

copepod	mackerel	primary consumers
producers	secondary consumers	tuna

Phytoplankton are

Shrimp are

An organism that feeds at two different trophic levels is the

[3]

- (b) Mercury is a heavy metal that can enter the water.

The mercury is absorbed by the smaller organisms which are at the start of the food web.

- (i) Complete the food chain to show how the mercury that enters the body of a copepod can enter a tuna fish.

Phytoplankton → Copepod → →

[2]

- (ii) Mackerel, marlin and tuna will accumulate different amounts of mercury in their bodies.

Write these **three** fish in order from the one that contains the **most** mercury to the one that contains the **least** mercury.

Use words from the list.

mackerel	marlin	tuna
-----------------	---------------	-------------

Most mercury

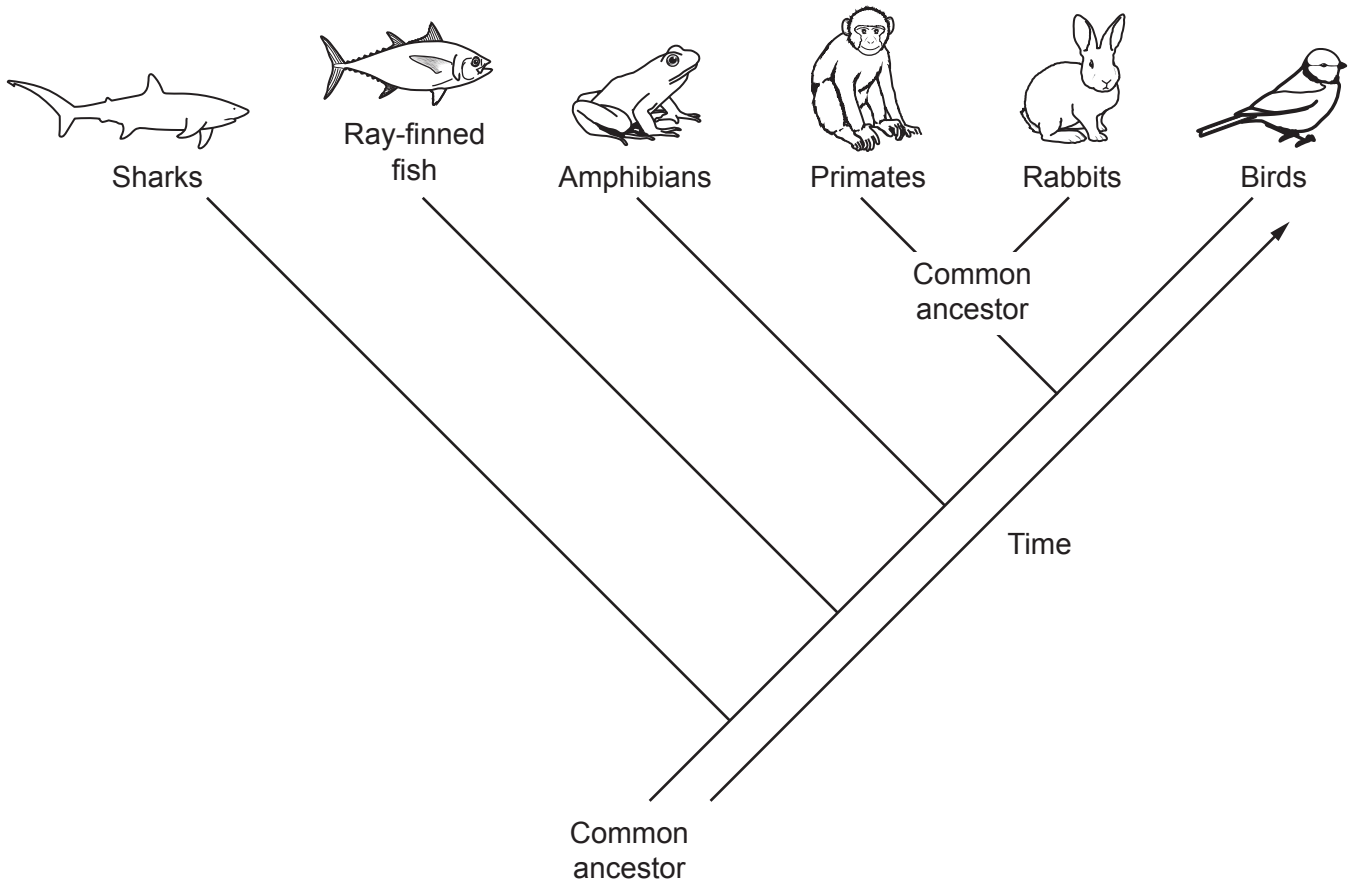
.....

Least mercury

[2]

(c) Fig. 2.2 shows the evolutionary relationship of sharks to other organisms.

Fig. 2.2



(i) Which organism from Fig. 2.2 are sharks **most** closely related to?

..... [1]

(ii) Which organism from Fig. 2.2 are primates **most** closely related to?

Tick (✓) **one** box.

Amphibians

☐

Birds

☐

Rabbits

☐

[1]

- 3 To survive, organisms must detect and respond to changes in their internal and external environment.

The human body has two systems that coordinate responses:

- The nervous system.
- The hormonal system.

- (a) Which of these statements apply to the **nervous system** and which apply to the **hormonal system**?

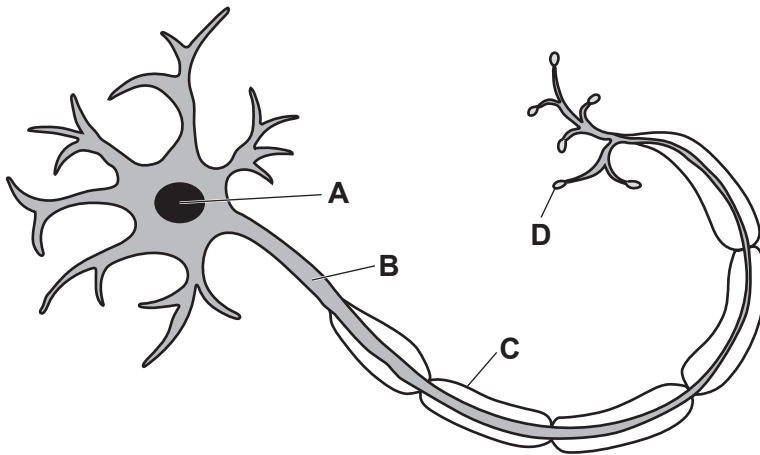
Tick (✓) **one** box in each row.

	Nervous system	Hormonal system
Response is faster.		
Response is longer lasting.		
Response is the result of an electrical impulse.		

[2]

- (b) Fig. 3.1 shows a diagram of a neuron.

Fig. 3.1



- (i) Which labelled structure, **A**, **B**, **C** or **D** is the axon?

..... [1]

- (ii) Which labelled structure **A**, **B**, **C** or **D** is the fatty sheath?

..... [1]

- (iii) What is the function of the fatty sheath?

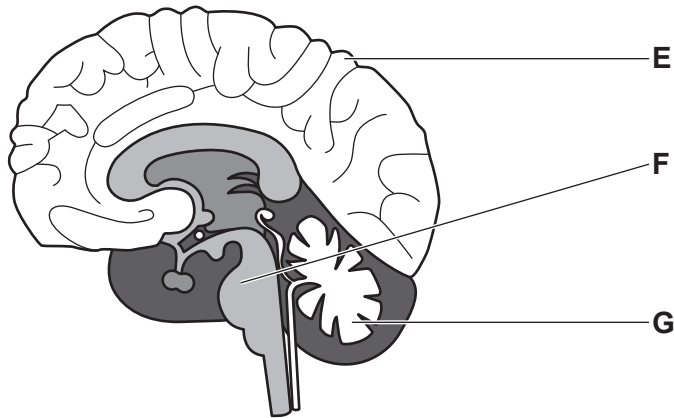
.....

..... [1]

- (c) The brain consists of billions of neurons.

Fig. 3.2 shows a diagram of the brain.

Fig. 3.2



Which labelled structure **E**, **F** or **G** is the cerebellum?

..... [1]

- (d) During surgery, patients may be given medication or a nerve block.
- (i) A patient is given some medication. Their breathing and heart rate slow down.

Which part of the brain must the medication be affecting?

Tick (✓) **one** box.

Brain stem	☐
Cerebellum	☐
Cerebral cortex	☐

[1]

- (ii) A nerve block is injected into the space around the spinal cord of another patient. The patient is then unable to move their legs.

Which type of neuron must the nerve block be blocking?

Tick (✓) **one** box.

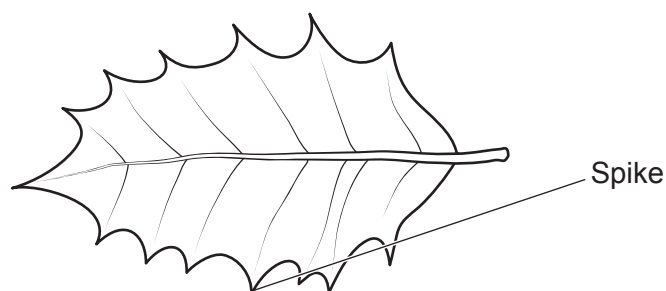
Motor	☐
Relay	☐
Sensory	☐

[1]

- 4 Holly is a species of plant found in woodlands in the UK.

Holly leaves are eaten by sheep and deer.

The diagram shows a holly leaf.



- (a) A student collects five holly leaves from the same part of a holly plant. They count the number of spikes on each leaf.

Table 4.1 shows the data they collect.

Table 4.1

Holly leaf	Number of spikes
A	5
B	7
C	7
D	6
E	7

- (i) Calculate the mean number of spikes for the holly leaves shown in **Table 4.1**.

Give your answer to the nearest **whole number**.

Mean = [3]

- (ii) State the mode for the number of spikes on the holly leaves shown in **Table 4.1**.

Mode = [1]

- (b) The student observes that the number of spikes on a holly leaf changes depending on the position of the leaf on the plant.

The student investigates this further by following this method:

- Collect five leaves from seven different positions on the plant.
- Measure how high each position is from the ground.
- Calculate the mean number of spikes on the five leaves collected from each position.

Table 4.2 shows the data they collect.

Table 4.2

Height from ground (m)	Mean number of spikes per leaf
0.25	8
0.50	7
0.75	7
1.00	5
1.25	3
1.50	2
1.75	0

- (i) Describe the pattern shown by the results in **Table 4.2**.

.....
 [1]

- (ii) Suggest an explanation for the pattern shown by the data in **Table 4.2**.

.....
 [1]

- (iii) Describe how the student could investigate whether the results are repeatable.

.....
 [1]

- (c) Holly bushes do **not** lose their leaves in winter. The leaves stay green all year round.

Explain how this is an advantage to the plant.

.....

 [2]

(d) Which vessel in the holly plant transports water and mineral ions to the leaf?

Tick (✓) **one** box.

Artery

☐

Capillary

☐

Phloem

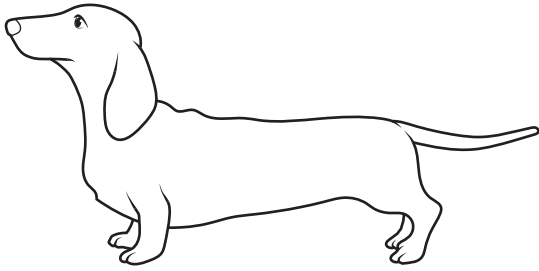
☐

Xylem

☐

[1]

- 5 The diagram shows a breed of small dog that has been selectively bred.



- (a) These dogs with short legs have been bred from taller hunting dogs.

- (i) The statements describe the steps in the process.

They are **not** in the correct order.

- A Select the offspring with short legs and breed again.
- B Breeders select a male and a female hunting dog with short legs.
- C Continue to do this for many generations.
- D Breed the two selected individuals together.

Write the letters in the boxes to show the correct order of the steps.

--	--	--	--

[3]

- (ii) There are 39 chromosomes in the **gametes** of a dog.

How many chromosomes are in the **body cells** of a dog?

Tick (✓) **one** box.

156	☐
78	☐
46	☐
39	☐

[1]

- (iii) When two dogs are mated a zygote will form. The zygote will divide to form an embryo.

What type of cell division will produce the cells of the embryo?

..... [1]

- (iv) The cells of the embryo will become specialised and form tissues with particular functions.

What causes the cells to become specialised?

.....
 [1]

- (b) Some breeds of dogs are more susceptible to cataracts which affect their vision.

- (i) Which part of the eye do cataracts affect?

Tick (✓) **one** box.

Cornea	☐
Iris	☐
Lens	☐
Retina	☐

[1]

- (ii) Dogs can have surgery for cataracts.

Give **one** benefit and **one** risk of this treatment.

Benefit

.....

Risk

.....

[2]

6 It is important that the human body maintains blood plasma at the correct concentration.

(a) Blood plasma can become too concentrated.

(i) Complete the sentence to explain what happens to body cells if the blood plasma becomes too concentrated.

Use words from the list.

active transport	burst	into
osmosis	out of	shrink

If the blood plasma becomes too concentrated, water will move body cells by and the cells will

[2]

(ii) Suggest what can cause blood plasma to become too concentrated.

.....
 [1]

(b) The kidneys filter excess water from the blood.

(i) State the name of **one other** substance filtered from the blood by the kidneys.

..... [1]

(ii) Kidneys filter around 180 litres of blood plasma a day.

The volume of blood plasma in an average person is approximately 3 litres.

Calculate how many times per day an average person's blood plasma is filtered by the kidneys.

Number of times per day blood plasma is filtered = [2]

- (c) Some people have kidney disease. This stops their kidneys from working efficiently.

One solution for these people is to have a kidney transplant. A kidney is taken from a donor and put into the body of the person with kidney disease.

Suggest why it is common for kidneys to be donated by **living relatives** of the person receiving the kidney.

.....
 [1]

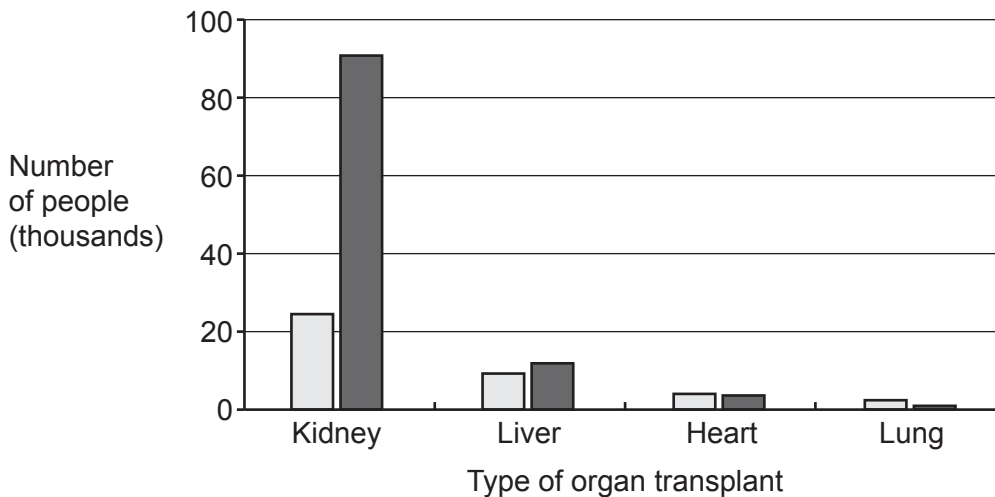
- (d) The graph shows information about organ transplants.

It shows:

- the number of people who received one of four types of transplant in a year
- the number of people remaining on the waiting lists for these transplants.

Key:

- ☐ Organ transplants received
☐ Patients remaining on the waiting list



Which conclusions from the graph are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
The number of kidney transplants received each year is greater than the number of liver, heart and lung transplants received altogether.		
The proportion of transplants received compared to the number of people remaining on the waiting list is smallest for kidney transplants.		
The waiting list is highest for kidney transplants.		
The waiting list is lowest for heart transplants.		

[2]

- 7 An organism is found preserved in some wetlands.

The organism stopped living over 2000 years ago but was **not** decomposed by microorganisms.

- (a) The wetlands the organism is found in are acidic and the oxygen content is low.
- (i) Complete the sentences to explain why the organism was **not** decomposed.

Use words from the list.

active site	breathe	photosynthesise
product	respire	substrate

The acidic conditions of the wetlands caused the of the enzymes produced by the microorganisms to change shape so the did not fit.

This slowed down the enzyme catalysed reactions.

Without oxygen the microorganisms were unable to

[3]

- (ii) Enzymes are proteins.

Which small molecules are used to make proteins?

Tick (✓) **one** box.

Amino acids	☐
Fatty acids	☐
Glucose	☐
Glycerol	☐

[1]

(b) There are many types of wetlands which are all habitats with unique biodiversity.

(i) Explain what is meant by the term biodiversity.

.....

.....

.....

..... [2]

(ii) State **two** reasons why conserving biodiversity is important.

1

.....

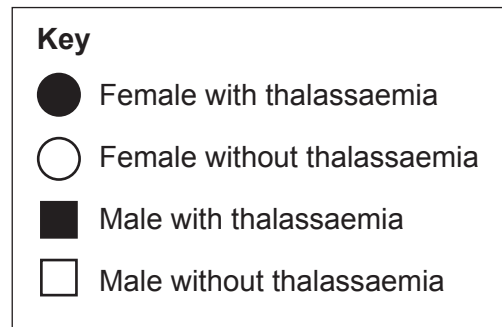
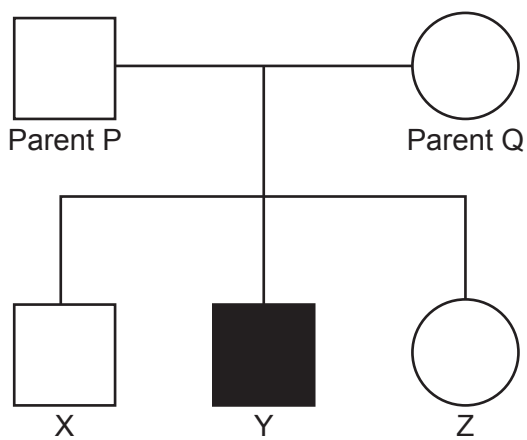
2

.....

[2]

- 8 Thalassaemia is an inherited genetic disorder caused by a recessive allele.

The diagram shows a family tree.
It includes two parents and their three children.



- (a) How many of the three children have thalassaemia?

Number of children with thalassaemia = [1]

(b) Both parents have one recessive allele and one dominant allele.

(i) Which of the following describes the parents' genotype?

Tick (✓) **one** box.

Heterozygous

☐

Homozygous dominant

☐

Homozygous recessive

☐

[1]

(ii) The parents decide to have another child.

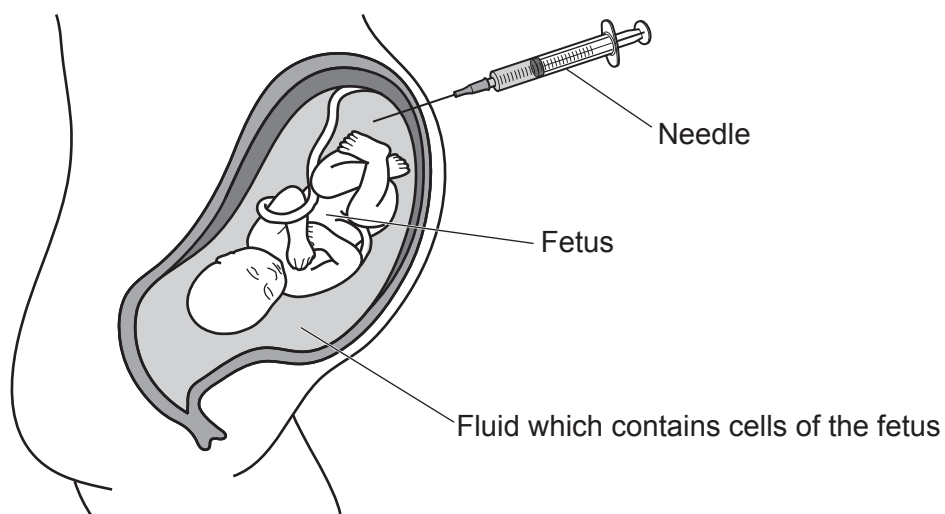
Complete the Punnett square to find the probability that the child will have thalassaemia.

Use **T** to represent the dominant allele and **t** to represent the recessive allele.

		Male	
Female			

Probability that the child will have thalassaemia = [3]

- (c) The diagram shows a procedure that can be used during pregnancy to find out if a fetus has thalassaemia.



A small sample of fluid from around the fetus is removed.

Explain how testing the sample of fluid allows doctors to diagnose thalassaemia in an unborn fetus.

.....

.....

.....

.....

.....

.....

..... [3]

21
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Turn over for the next question

9 There are approximately 350 000 African savannah elephants.

(a) 130 000 of these elephants live in Botswana, a country in southern Africa.

Which of these is the closest approximation to the fraction of African savannah elephants that live in Botswana?

Tick (✓) **one** box.

$\frac{1}{2}$ ☐

$\frac{1}{3}$ ☐

$\frac{1}{4}$ ☐

$\frac{1}{5}$ ☐

[1]

(b) The African savannah elephant is an endangered species.

Conservation efforts have been successful in increasing the number of elephants.

Suggest **one** method that may have been used to help conserve this species.

.....

..... [1]

- (c) In May 2020, many elephants were found dead in a region of Botswana.

Scientists discovered that their death was caused by a bacterium that only causes disease once in the blood of an elephant.

The bacterium usually lives in the nose of some elephants where it does **not** cause disease.

Scientists think a rise in environmental temperature caused the bacteria to enter the blood of these elephants.

- (i) Suggest why the scientists may be concerned about this bacterium.

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

- (ii) Which of these will ingest and digest the bacterium?

Tick (✓) **one** box.

Antibodies	☐
Platelets	☐
Red blood cells	☐
White blood cells	☐

[1]

- (iii) Which of these will tag the bacterium for attack?

Tick (✓) **one** box.

Antibodies	☐
Platelets	☐
Red blood cells	☐
White blood cells	☐

[1]

- (d) To identify the type of bacterium responsible for the death of the elephants, the scientists cultured the bacteria.

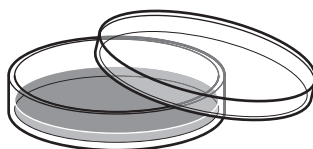
They poured some of the bacteria onto agar jelly in a Petri dish and spread it with a glass spreader.

Then they incubated the Petri dish.

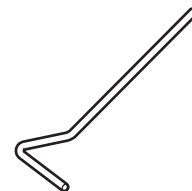
The diagram shows the equipment they used.



Glass bottle containing the sample of bacteria



Petri dish containing agar jelly



Glass spreader

Suggest **two** ways the scientists could improve their method to make sure the technique was aseptic.

1

.....

2

.....

[2]

- (e) Some bacteria have evolved to become resistant to antibiotics.

The statements describe the steps in this process.

They are **not** in the correct order.

- A** Bacterium survives.
- B** Bacterium has a selective advantage.
- C** Bacterium passes resistance gene to offspring.
- D** Bacterium reproduces.
- E** Mutation occurs in the DNA of a bacterium creating a gene for antibiotic resistance.

Write the letters in the boxes to show the correct order of the steps.

One of the steps has been done for you.

		A		
--	--	----------	--	--

[2]

- (f) Bacteria evolve by natural selection.

Darwin was one of the scientists who originally developed the theory of natural selection.

Who was the **other** scientist?

..... [1]

- 10** Yeast produce ethanol during fermentation.
A scientist investigated how temperature affects ethanol production.

The scientist measured the concentration of ethanol in a yeast solution at six different temperatures.

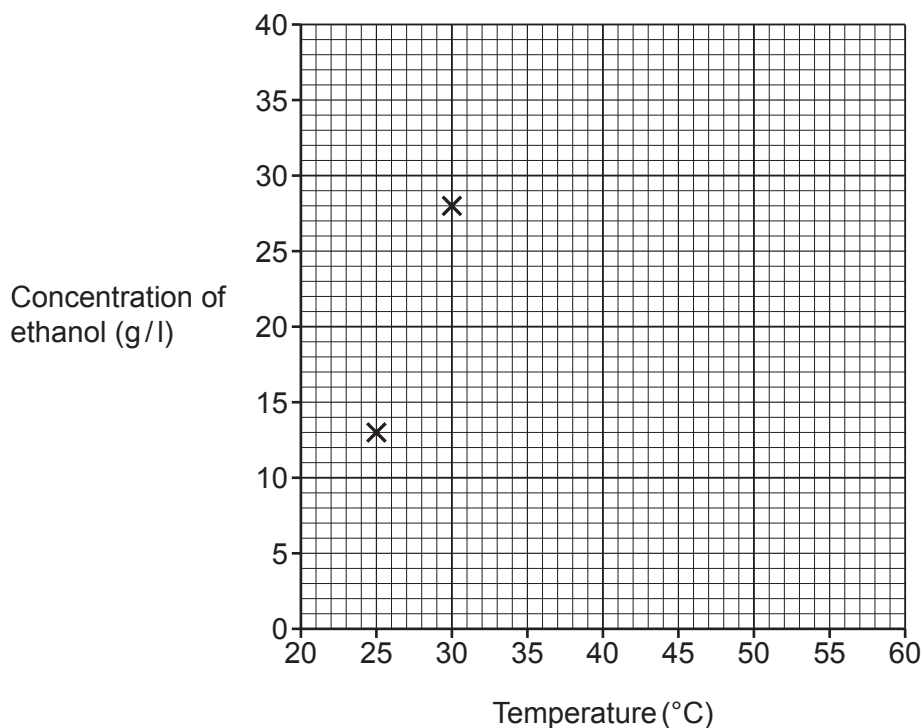
The table shows their results.

Temperature (°C)	Concentration of ethanol (g/l)
25	13
30	28
35	30
40	35
45	33
50	30

(a)

- (i)** Plot the results from the table on the graph.

Two points have been plotted for you.



[1]

- (ii)** Draw a curve of best fit on the graph.

[1]

(b) State **two** conclusions that can be made from these data.

1

.....

2

.....

[2]

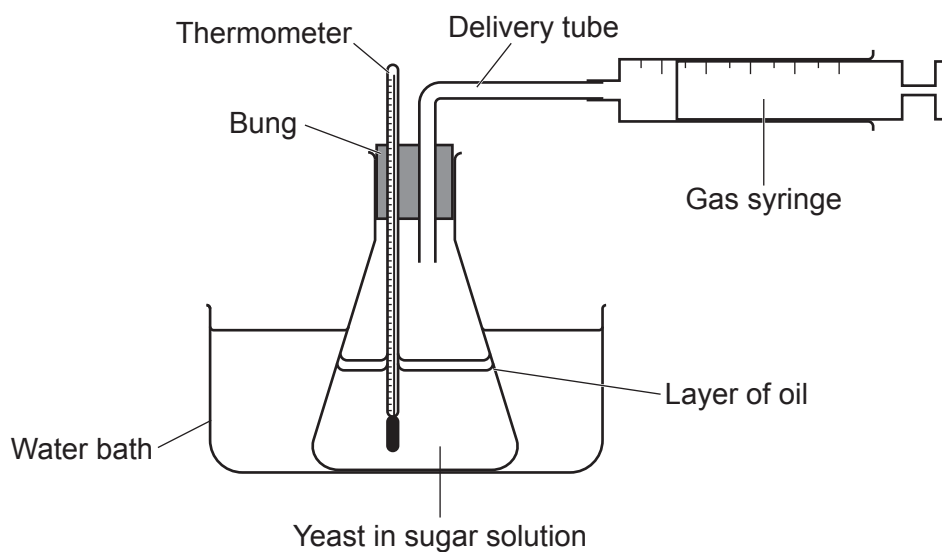
(c) Fermentation is another name for anaerobic respiration in yeast.

Complete the equation for **anaerobic** respiration in yeast.

sugar $\longrightarrow$ ethanol +

[1]

- (d) The diagram shows the equipment used to investigate the effect of different sugars (sucrose, glucose and galactose) on the rate of respiration in yeast.



For this investigation, describe:

- the dependent variable
- the independent variable
- a control variable that should be kept constant.

Dependent variable

.....

Independent variable

.....

Control variable

.....

[3]

END OF QUESTION PAPER

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