Oxford Cambridge and RSA

Tuesday 16 May 2023 – Morning

GCSE (9–1) Biology A (Gateway Biology)

J247/03 Paper 3 (Higher 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

H

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 **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

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

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Section A

You should spend a **maximum** of **30 minutes** on this section.

Write your answer to each question in the box provided.

1 A person was in an accident and their **memory** is affected.

Which part of the brain is most likely to have been injured?

A Cerebrum

B Hypothalamus

C Medulla

D Pituitary

Your answer ☐ **[1]**

2 Single-celled algae found in the ocean absorb large amounts of carbon dioxide.

Which process inside the cells of the algae uses this carbon dioxide?

A Homeostasis

B Photosynthesis

C Respiration

D Temperature regulation

Your answer ☐ **[1]**

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3 In an osmosis experiment, a student measures out 45 cm^3 of a solution.
They use a beaker to measure out the volume.

Which piece of equipment would make this measurement most accurate?

A A 50 cm^3 measuring cylinder

B A 250 cm^3 measuring cylinder

C A conical flask

D A dropping pipette

Your answer ☐ **[1]**

4 Water passes through a plant and is lost in transpiration.

What is the correct route for water to move in this process?

A From the phloem to the stomata

B From the stomata to the phloem

C From the stomata to the xylem

D From the xylem to the stomata

Your answer ☐ **[1]**

5 How are mineral ions absorbed by plant roots?

A By active transport

B By diffusion

C By osmosis

D By translocation

Your answer ☐ **[1]**

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6 Which hormone can be used as a selective weedkiller?

A Auxin

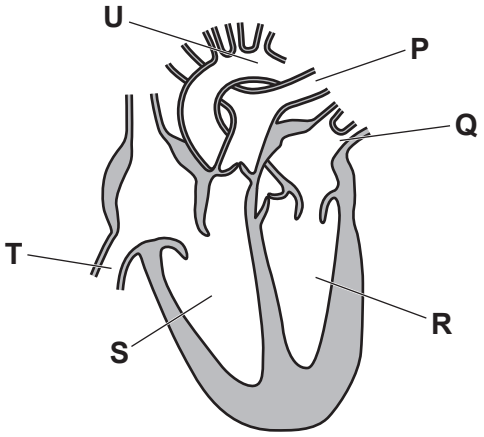
B Ethene

C Gibberellin

D Thyroxine

Your answer ☐ **[1]**

7 The diagram shows the main structures in the heart.



Blood flows from the lungs back to the heart and is then pumped to the body.

Which order of structures does blood go through?

A Q → R → P

B T → S → P

C Q → R → U

D T → S → U

Your answer ☐ **[1]**

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8 In an enzyme experiment, a student tries to measure pH by dipping universal indicator paper into a solution.

They then use a pH chart in their textbook.
They find it difficult to compare the indicator paper with the pH chart and cannot read the pH numbers on the chart.

Which statement could explain why?

A The student is colour blind.

B The student is colour blind and long-sighted.

C The student is colour blind and short-sighted.

D The student is short-sighted.

Your answer ☐ **[1]**

9 A cell divides by mitosis every 20 minutes.

How many cells will there be after 3 hours?

A 9

B 18

C 60

D 512

Your answer ☐ **[1]**

10 A drug is used to treat cancer. The drug stops the formation of microtubules that move chromosomes in cells.

Which statement explains how the drug stops more cancer cells being made?

A Chromosomes will be replicated but the chromosomes will not separate in mitosis.

B Dividing cells will not replicate their chromosomes.

C Four cells will be produced at the end of mitosis.

D New cells formed will only have half the number of chromosomes.

Your answer ☐ **[1]**

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11 What is the correct sequence in a reflex arc?

A Effector → receptor → sensory neurone → relay neurone → motor neurone

B Motor neurone → sensory neurone → relay neurone → effector → receptor

C Receptor → sensory neurone → relay neurone → motor neurone → effector

D Receptor → relay neurone → sensory neurone → effector → motor neurone

Your answer ☐ **[1]**

12 In a keto diet, people eat foods that consist mainly of proteins and lipids.

What will they lack in their diet?

A Amino acids, fatty acids and glucose

B Glucose

C Glucose and fatty acids

D Glycerol and amino acids

Your answer ☐ **[1]**

13 Which molecules are all polymers?

A DNA, amino acids and starch

B Fatty acids, glycerol and amino acids

C RNA, glucose and fatty acids

D Starch, protein and DNA

Your answer ☐ **[1]**

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14 Which blood vessels have a valve at the junction between the blood vessel and the heart?

A Aorta and pulmonary artery

B Aorta and vena cava

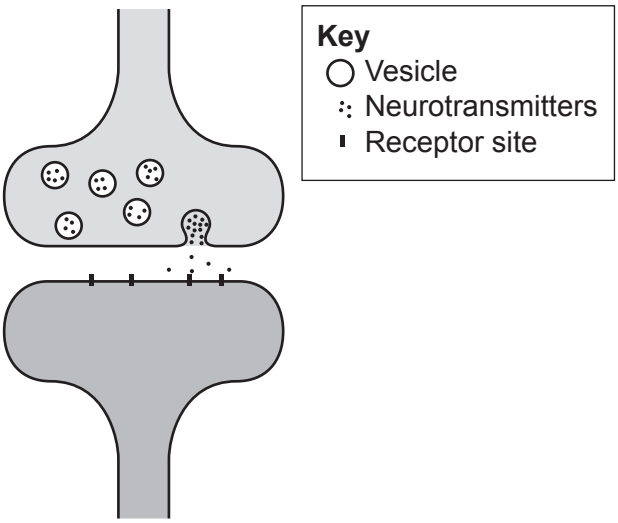
C Aorta, pulmonary artery and pulmonary vein

D Aorta, pulmonary artery, pulmonary vein and vena cava

Your answer ☐ **[1]**

15 Synapses are junctions between neurones.
For an impulse to be generated in another neurone, a neurotransmitter chemical diffuses across the gap and binds to receptor sites.

This process is shown in the diagram.



Which direction can an impulse pass across a synapse?

A Only from the neurone that contains the vesicles to the neurone that contains the receptor sites

B Only from the neurone that has the receptor sites to the neurone that contains the vesicles

C Either way across a synapse because the neurotransmitter can diffuse either way

D Either way across a synapse because the neurotransmitter is produced by both neurones

Your answer ☐ **[1]**

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Section B

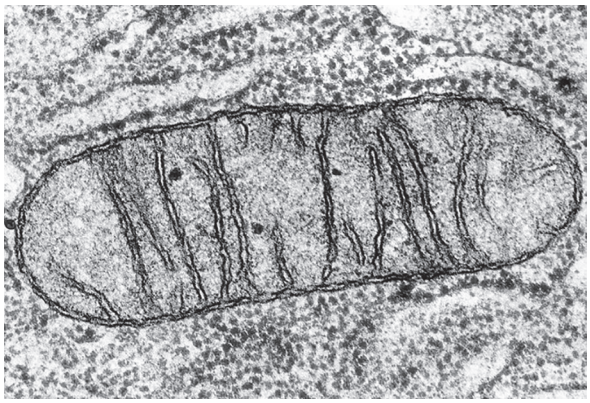
16 **(a)** The contents of sub-cellular structures found in eukaryotic cells enable the structure to perform its function.

Draw lines to connect each **sub-cellular structure** to its **contents**.
Then draw lines to join each of the **contents** to its correct **function** within the cell.

Sub-cellular structure	Contents	Function
cell membrane	chlorophyll	allows communication with other cells
chloroplast	enzymes	catalyses reactions in aerobic respiration
mitochondria	receptors	needed for photosynthesis

[4]

(b) The image is of a mitochondrion.



(i) Draw the mitochondrion in the box. Your drawing should be a scientific drawing.

[2]

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(ii) What type of microscope was used to create the image of the mitochondrion?

Explain your answer.

Type of microscope .....

Reason .....

.....

[2]

(c) Name **one** structure found in both an animal cell and a prokaryotic cell.

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

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17 **(a)** Arteries, capillaries and veins are blood vessels found in the human circulatory system.

Put ticks (✓) in each row to identify which blood vessels have each feature.

Feature	Arteries	Capillaries	Veins
Have valves along their length			
Have a very thick muscle wall			
Have a wide lumen			

[3]

(b) Chronic venous insufficiency (CVI) is a condition caused by faulty valves found in some blood vessels in the legs.

Describe how CVI will affect the person's blood circulation.
Suggest **one** symptom of this condition.

Effect on blood circulation .....

.....

Symptom .....
[2]

(c) The volume of blood pumped from the left ventricle into the aorta during one contraction is 70 ml.

Calculate the volume of blood that will be pumped into the aorta in one hour if a person has a resting heart rate of 76 beats per minute.

Volume = ... ml / hour **[2]**

(d) Red blood cells contain haemoglobin to transport oxygen.

Give **one** other feature of red blood cells.
How does this other feature allow the cell to perform its function?

.....

.....

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

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18 **(a)** The colour of a person's urine changes depending on the concentration of their blood.

Complete the sentences below to describe why a person will have urine that is dark in colour.

Use the words in the list.

ADH	**FSH**	**glucagon**	**hypothalamus**
medulla	**pituitary gland**		

If a person has not consumed enough water, the concentration of the blood increases.

This is detected by receptors in the ..... .

These receptors send a message to the ..... .

This causes more ..... to be released into the bloodstream.

[3]

(b) Give **one** factor, other than lack of water intake, that could cause a person to have concentrated urine.

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

(c) Nephritis is a condition where part of the kidney tubule becomes inflamed. The result of this is that proteins can enter the tubule and pass out in the urine.

Describe a test that could be used to determine if a patient has nephritis.

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.....

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

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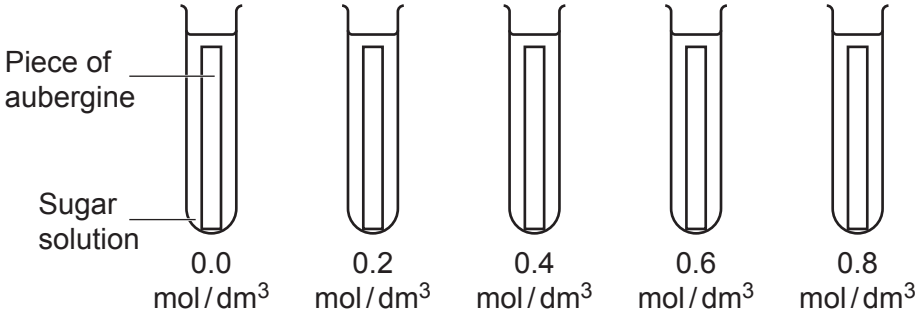
19 An aubergine is a fruit with a thick, shiny skin.
A student does an experiment to find the solute concentration in the cells of an aubergine.

They follow this method:

- Remove the skin and cut five pieces of aubergine of equal size.
- Weigh each piece before placing into one of 5 different sugar solutions.
- Leave for 4 hours.
- Remove the pieces of aubergine and reweigh.



The table shows their results.

	Concentration of sugar solution				
	0.0 mol / dm^3	**0.2 mol / dm^3**	**0.4 mol / dm^3**	**0.6 mol / dm^3**	**0.8 mol / dm^3**
Mass before the experiment (g)	5.0	5.2	5.5	5.1	5.3
Mass after the experiment (g)	7.0	6.5	5.8	4.5	3.5
Percentage change in mass (%)	+40.0	+ 25.0	+5.50	–11.8	

(a) Why did the student remove the skin from the aubergine before placing it in the sugar solution?

.....

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

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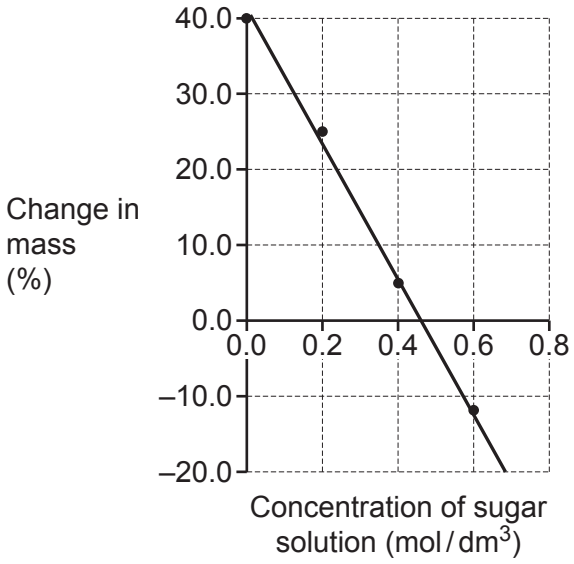
(b) Calculate the percentage change in mass for the piece of aubergine placed in 0.8 mol / dm^3.

Give your answer to **3** significant figures.

Percentage change in mass = ... % **[3]**

(c) The student plots a graph to work out the solute concentration of the cells in the aubergine.



The student concludes that the solute concentration of the aubergine cells is 0.46 mol/dm^3.

Explain why the student is **correct**.

.....

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

(d) Describe how you could improve the method to determine the concentration of the cells in the aubergine with greater accuracy.

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

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(e) Another student evaluates the method used in the experiment. This student finds that two errors were made.

For each error, decide if it is a random error or a systematic error.

Tick (✓) **one** box for each error.

Error	**Random error**	**Systematic error**
Excess fluid was left on some aubergine pieces which will affect the mass.		
The scale used to weigh the aubergine pieces was not calibrated correctly.		

[1]

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20 A student makes pineapple jelly using two different methods. Both methods use a protein called gelatin which causes the jelly to set.

Tinned pineapple is fresh pineapple which has been treated with heat.

Method 1	**Method 2**
Fresh pineapple is added to the gelatin. It is left for 2 hours. The jelly does not set.	Tinned pineapple is added to the gelatin. It is left for 2 hours. The jelly sets.

Pineapple contains an enzyme called bromelain. Bromelain digests proteins.

(a) Explain why the jelly made with fresh pineapple does **not** set but the jelly made with tinned pineapple does set.

Use your knowledge of enzymes.

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..... **[4]**

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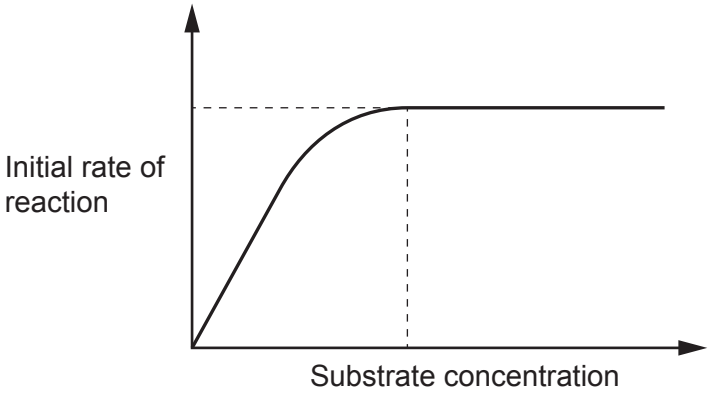
(b) The graph shows the rate of an enzyme catalysed reaction as the concentration of substrate is changed.



Draw an **X** on the graph to show where approximately 50% of the enzymes' active sites are occupied with substrate.

Explain your decision.

.....

.....

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

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21 IVF is a fertility treatment which involves egg cells being fertilised by sperm in a laboratory before transferring embryos into a female's uterus.

In this procedure a female's natural menstrual cycle is controlled using hormones.

Four hormones are used:

- GnRHα – a hormone that prevents the development of eggs
- hCG – a hormone that triggers the final stage of egg development
- FSH
- progesterone.

(a) Complete the table to identify the hormone that should be used at each stage of this procedure.
One has been filled in for you.

Stage in IVF procedure	Hormone to be used
A hormone is used to stop a female's natural cycle.	
The female is then stimulated to produce a large number of immature eggs.	
The eggs produced by the female are matured 12 hours before they are collected.	hCG
The female's uterus lining is maintained for 14 days after egg collection.	

[2]

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(b) In IVF, the number of egg cells collected from each female differs.

This table shows the number of eggs collected from 10 females.

Female	Number of eggs collected
1	3
2	8
3	9
4	12
5	24
6	8
7	10
8	10
9	8
10	11

(i) Write down **two** conclusions about the number of eggs produced by females in this process.

1 .....

.....

2 .....

.....

[2]

(ii) Only 60–80% of the eggs collected from a female will be mature and therefore able to be used for IVF.

Of the mature eggs collected, only 70–80% will be fertilised.

Calculate the **maximum** number of eggs that can be fertilised if a female produces 10 eggs in one cycle.

Give your answer to the nearest whole number.

Maximum number of eggs = ... **[2]**

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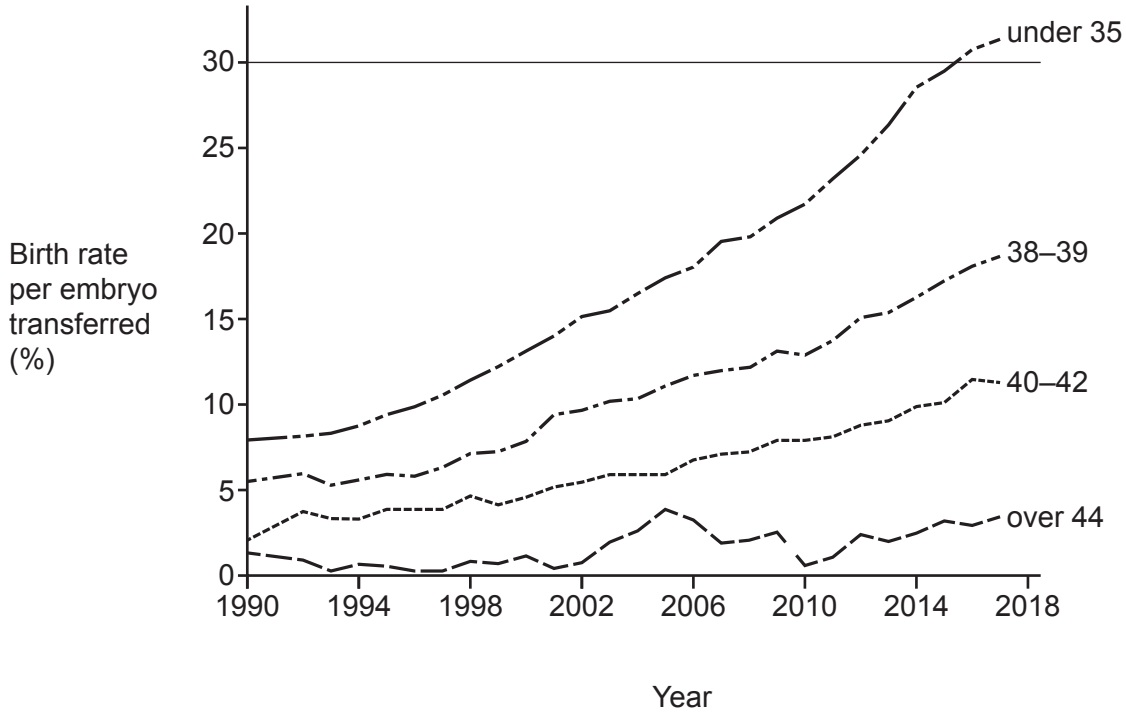
(c) The graph shows the birth rate per embryo transferred for some different age groups of females between 1990 and 2017.



Give **two** conclusions that can be made from the graph.

Conclusion 1 .....

.....

Conclusion 2 .....

.....

[2]

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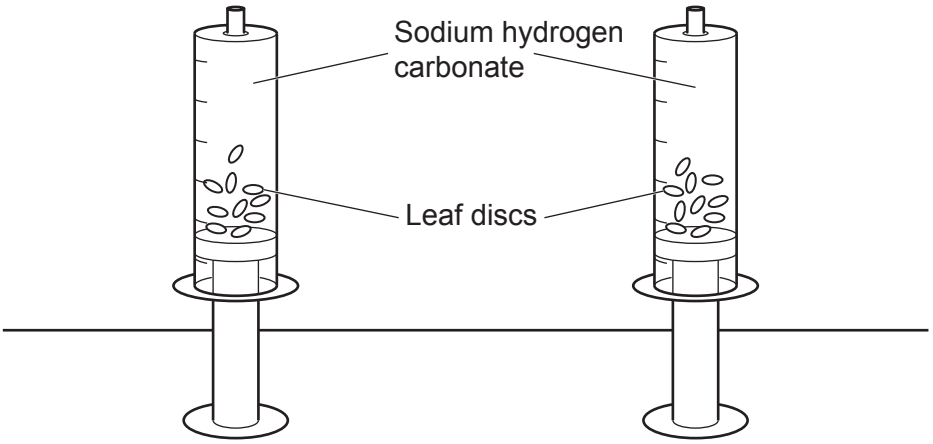
22 A student investigates the rate of photosynthesis in two different species of plant.

The student's method:

- Cut 10 leaf discs from a leaf of one of the plants.
- Place the discs into a syringe containing sodium hydrogen carbonate solution.
- Repeat this using a leaf from the other plant.
- Record the time it takes for the leaf discs to rise to the top of each syringe.



(a) Give **three** variables that the student must control to ensure that data collected for the two species of plant is valid.

1 .....

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2 .....

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3 .....

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[3]

(b) Explain why the leaf discs rise to the top of the syringes.

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

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(c) Describe how the student could change their investigation to find the effect of light intensity on the rate of photosynthesis for **one** type of leaf.

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

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23 **(a)** Hormones are released when an athlete is preparing for and running a marathon.

Complete the sentences below to describe the hormones involved before and during the race.

Use the words from the list.

adrenaline	**digestive**	**endocrine**	**glucagon**	**glucose**
glycogen	**insulin**	**nervous**	**thyroxine**	

Before the race, the athlete's body needs to prepare for action. The body responds by

secreting the hormone ..... .

This hormone causes blood to be diverted from the ..... system to the muscles.

During the race, blood sugar levels will decrease, so another hormone called

..... will be released.

This results in stores of ..... being used to maintain the blood sugar levels

allowing the athlete to complete the marathon.

[4]

(b) Hormones are part of the endocrine system.

Describe **two** differences between the endocrine system and the nervous system.

1 .....

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2 .....

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[2]

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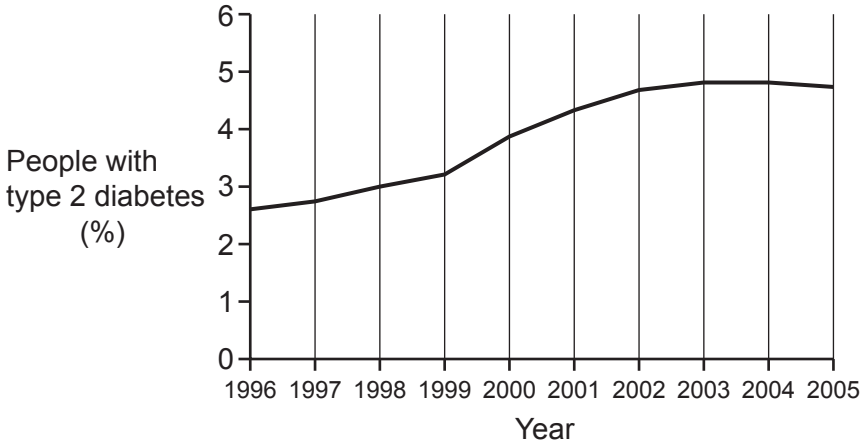
(c) The graph shows the percentage of people with type 2 diabetes between 1996 and 2005.



Suggest reasons for the changes in the percentage of people with type 2 diabetes shown in the graph.

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

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24 (a) * Beta thalassaemia is a genetic disorder caused by a mutation in DNA.

In this mutation, some bases are inserted into the gene that codes for the production of the haemoglobin protein.

Explain how this mutation causes a different haemoglobin protein to be produced.

Use your knowledge of DNA and protein synthesis.

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..... **[6]**

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(b) The haemoglobin in the red blood cells of a person with beta thalassaemia does **not** function correctly.

Suggest **one** symptom that a person with beta thalassaemia may have.

.....

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

(c) Beta thalassaemia can be treated with stem cells.
Stem cells are taken from a donor and placed in the vein of the patient.

Explain why using stem cells from a donor can be used as a treatment for this disease.

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

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25 **(a)** Two students are discussing respiration.

One student says, 'I know all animals respire but I don't think plants need to.'

Explain why the student's statement is **not** correct.

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

(b) Scientists researching how mitochondria produce ATP came up with a theory.

Their theory said:

- Hydrogen ions are transported into the space between the two membranes surrounding the mitochondria, shown in **Fig. 25.1**.
- The ions become concentrated in this space.
- The ions diffuse back into the mitochondria making ATP.

To test this theory the scientists removed the outer membrane of the mitochondria, as shown in **Fig. 25.2**.

Fig. 25.1

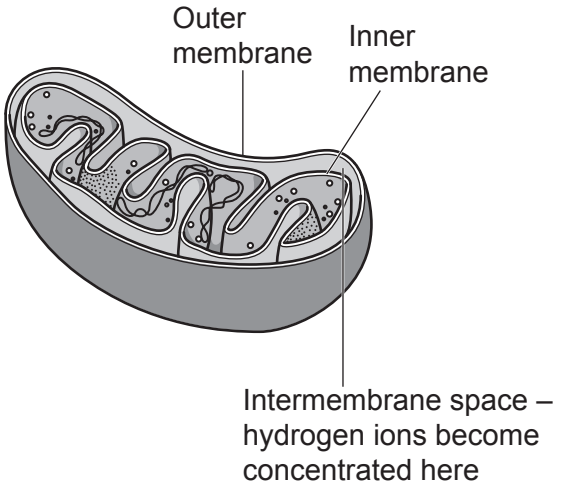
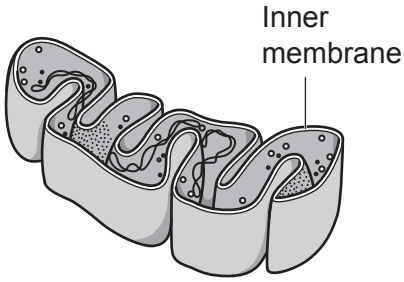


Fig. 25.2



The result of their experiment showed that less ATP is formed.

Explain how this result shows that their theory is correct.

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.....

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

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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