Oxford Cambridge and RSA

Tuesday 13 May 2025 – Afternoon

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

J247/03 (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 Which mechanism is used to control **water balance** in the human body?

A Adjusting the glucose concentration of the urine

B Altering the volume of urine produced

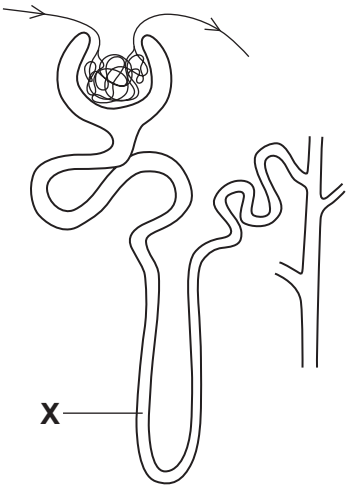
C Changing the rate of urea production

D Varying the rate of sweat production

Your answer ☐ **[1]**

2 The diagram shows a kidney tubule.

What is the structure labelled **X**?



A Bowman's capsule

B Collecting duct

C Glomerulus

D Loop of Henle

Your answer ☐ **[1]**

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3 The concentration of mineral ions in soil varies.

What describes how mineral ions move from soil into the root hair cells of a plant?

A By active transport and diffusion

B By active transport and osmosis

C By diffusion only

D By osmosis only

Your answer ☐ **[1]**

4 Which component of the nervous system **detects** stimuli?

A Effector

B Motor neurone

C Receptor

D Sensory neurone

Your answer ☐ **[1]**

5 Which of these biological molecules are **polymers**?

A Amino acid and protein

B DNA and glucose

C DNA and protein

D Glucose and protein

Your answer ☐ **[1]**

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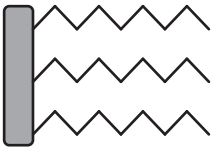
6 Which biological molecule does this diagram represent?



A Glucose

B Lipid

C Protein

D Starch

Your answer ☐ **[1]**

7 If the tail of an earthworm is cut and removed, the earthworm will live and grow new tail segments.

From which type of cells would the earthworm tissues grow?

A Meristem cells

B Nerve cells

C Red blood cells

D Stem cells

Your answer ☐ **[1]**

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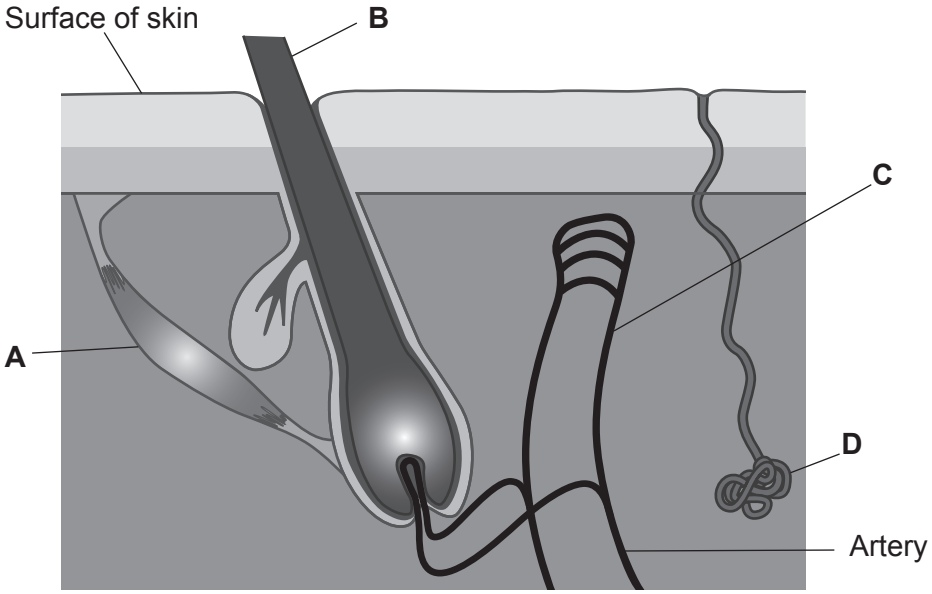
8 The diagram shows the structure of the skin.



Which structure vasodilates and vasoconstricts to control body temperature?

Your answer ☐ **[1]**

9 A student observes stomata using a light microscope with a total magnification of ×400.
In the image the student sees, the stomata are 14 mm long.

What is the **actual length** of the stomata?

A 3.5×10^{-2} mm

B 3.5×10^{-2} cm

C 3.86×10^{2} cm

D 5.6×10^{3} mm

Your answer ☐ **[1]**

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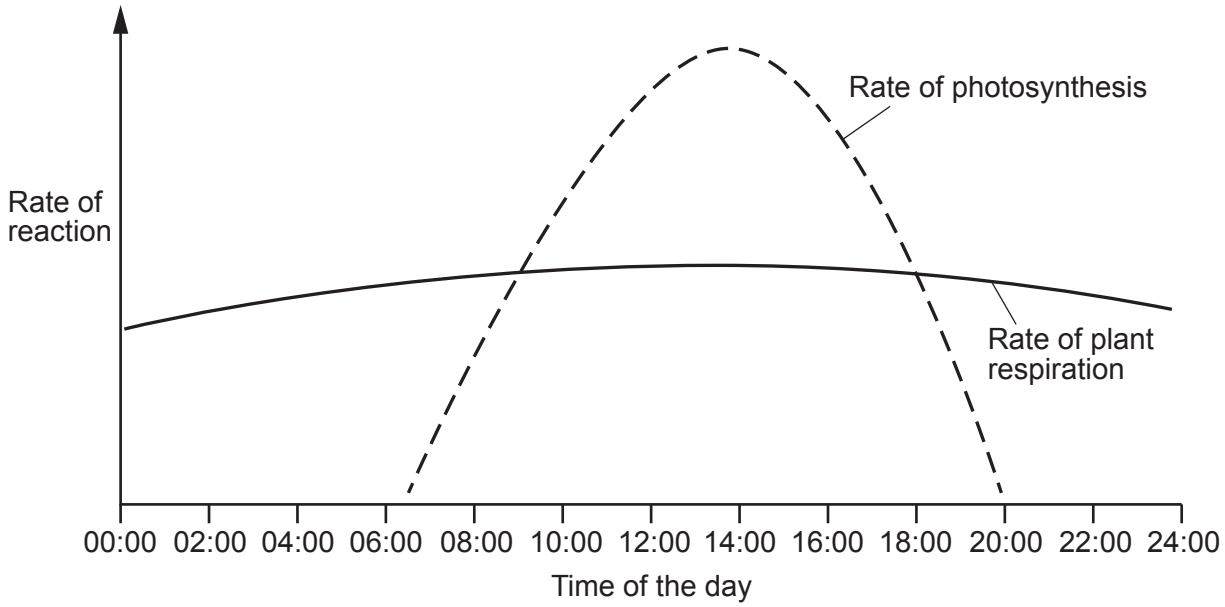
10 The graph shows the rate of photosynthesis and respiration in a plant over 24 hours.



Between which times will the plant produce more oxygen than it will use?

A 00:00 and 09:00

B 07:00 and 20:00

C 09:00 and 18:00

D 20:00 and 24:00

Your answer ☐ **[1]**

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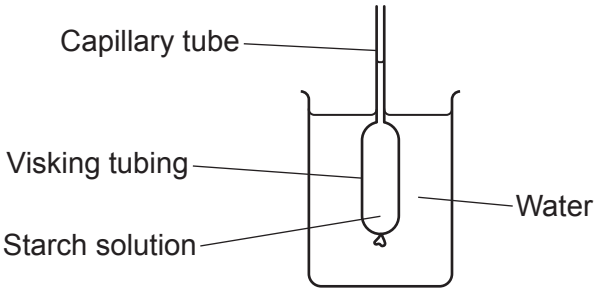
11 In which cell in the image will DNA replication be occurring?

Your answer ☐ **[1]**

12 Visking tubing is an artificial partially permeable membrane.

A student:

- puts starch solution into a visking tubing bag connected to capillary tubing
- puts the visking tubing bag in water (as shown in the diagram)
- measures the level of the solution in the capillary tubing at the start of the investigation and then one hour later.



What describes and explains what the students observes?

A The level of the liquid in the capillary tube falls as starch moves out of the visking tubing by diffusion.

B The level of the liquid in the capillary tube falls as water moves out of the visking tubing by diffusion.

C The level of the liquid in the capillary tube rises as water moves into the visking tubing by osmosis.

D There is no change in the position of the liquid in the capillary tube.

Your answer ☐ **[1]**

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13 Which blood vessel transports blood **out** of the left ventricle?

A Aorta

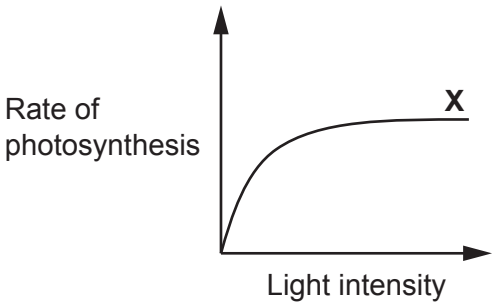
B Pulmonary artery

C Pulmonary vein

D Vena cava

Your answer ☐ **[1]**

14 Which factor or factors could limit the rate of photosynthesis at **X** on the graph?



A Carbon dioxide and light intensity

B Carbon dioxide and temperature

C Light intensity and temperature

D Light intensity only

Your answer ☐ **[1]**

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15 In multiple sclerosis, the speed of nervous transmission is reduced.

Damage to which part of the motor neurone will reduce the speed of nervous transmission?

A Cell body

B Dendrite

C Myelin sheath

D Synapse

Your answer ☐ **[1]**

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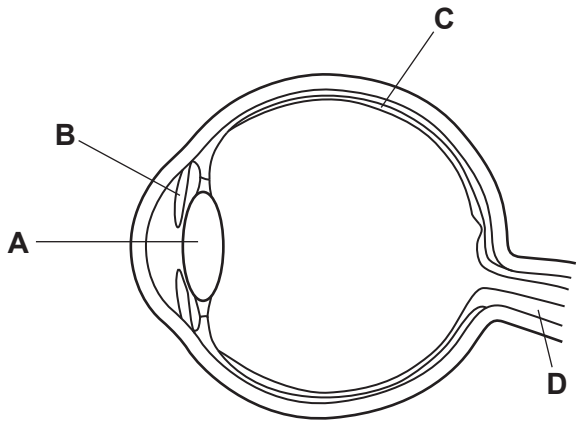
Section B

16 The diagram shows the human eye.



(a) State which letter in the diagram performs each of the following functions:

Controls the size of the pupil .....

Focuses the light on the retina .....

Transmits electrical impulses to the brain .....

Detects light .....

[3]

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(b) Short-sightedness is a condition that causes the light entering the eye to be focused before it reaches the retina.

Opticians measure the focusing power of the eye in dioptres (D).
It is written as a minus number and indicates how short-sighted you are.

	Focusing power in dioptres (D)
Low short-sightedness	less negative than –3.0
Mild short-sightedness	–3.0 to –4.0
Moderate short-sightedness	–4.1 to –6.0
High short-sightedness	more negative than –6.0

(i) A student has an eye test.
The optician tells the student that the focusing power of their eyes is –3.5 dioptres.

Explain to the student what this result means and how it is likely to be treated.

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

(ii) Once short-sightedness has developed, it usually gets worse.

Another student has a focusing power of –1.0 D which is changing by –0.5 D per year.
Using a drug called atropine will reduce the change to –0.2 D per year.

Calculate how many **more** years it will take for them to develop **mild short-sightedness** if they use the drug compared to not using the drug.

Number of years more = ... **[2]**

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17 A student is investigating mitosis in garlic roots.

The student grows some garlic for 10 days as shown in **Fig. 17.1** and removes a root.

The student takes a sample of tissue from four parts of the root, **A**, **B**, **C** and **D**, as shown in **Fig. 17.2**.

Fig. 17.1

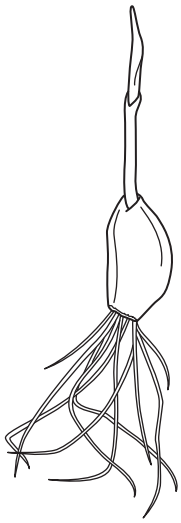
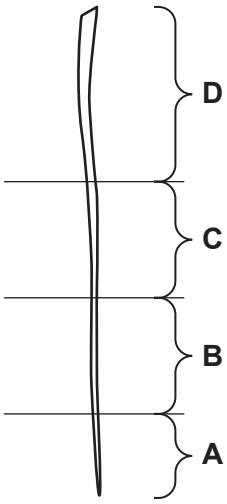


Fig. 17.2



(a) The student prepares a slide to look for mitosis in the different parts of the root.
The student adds a stain when preparing the slide.

Explain why the student adds a stain to look for mitosis.

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

(b) The student uses a light microscope to look at the garlic root cells on the prepared slide.

Describe how the student would set up the microscope so that the details of the garlic root cells are clearly visible.

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

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(c) The student takes two measurements when observing the cells under the microscope:

- the total number of cells in the field of view
- the number of cells in the field of view that are undergoing mitosis.

The results are in the table.

Part of the root	Total number of cells in field of view	Number of cells undergoing mitosis in field of view	Percentage of cells undergoing mitosis in field of view (%)
A	120	.....	75
B	125	55	44
C	88	0	0
D	78	0	0

Calculate the number of cells undergoing mitosis in the field of view in part **A**.

Number of cells = ... **[2]**

(d) The student concludes that only cells found in certain parts of the root can divide by mitosis.

How does the data in the table support their conclusion?

.....

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

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(e) The student wants to improve their experiment to:

- make a more accurate conclusion about where cells in the root can divide by mitosis
- check that their results are reproducible.

Draw **two** lines to connect each **improvement** with **how it can be achieved**.

Improvement	**How it can be achieved**
	Compare the results with other students' results.
Make a more accurate conclusion.	
	Use a lower magnification so that more cells can be counted.
Check that the results are reproducible.	
	Sample from more points in regions **A** and **B**.

[2]

(f) Cells located in region **D** differentiate to form a tissue responsible for translocation.

State the name of this tissue.

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

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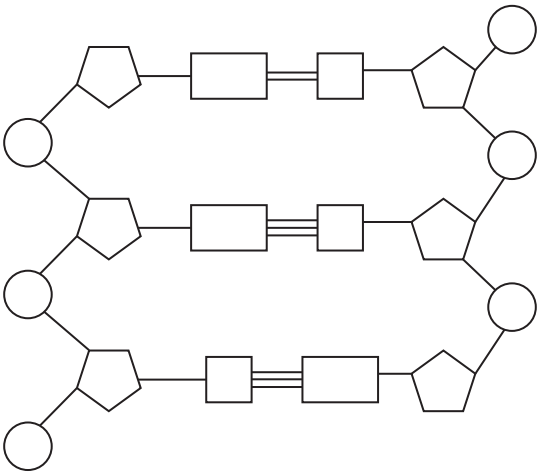
18 The diagram shows part of a DNA molecule.



(a) Draw a circle around **one** nucleotide on the diagram. **[1]**

(b) Complete the sentences to describe how DNA codes for the production of a protein.

Use words from the list.

amino acids	**chromosome**	**fatty acids**	**gene**	**mitochondrion**
ribosome	**transcribed**	**translated**	**transpired**	

A small section of the DNA molecule containing the ..... unzips.

The DNA is ..... and mRNA is formed.

The mRNA molecule moves to a ..... in the cytoplasm.

tRNA molecules carry ..... which join to form a protein.

The nucleotide sequence has been ..... .

[5]

(c) DNA molecules are found in both eukaryotic and prokaryotic cells.

Describe the differences in the location and shape of the molecule in these two types of cell.

Location .....

.....

Shape .....

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[2]

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19

(a) Describe the process of photosynthesis.

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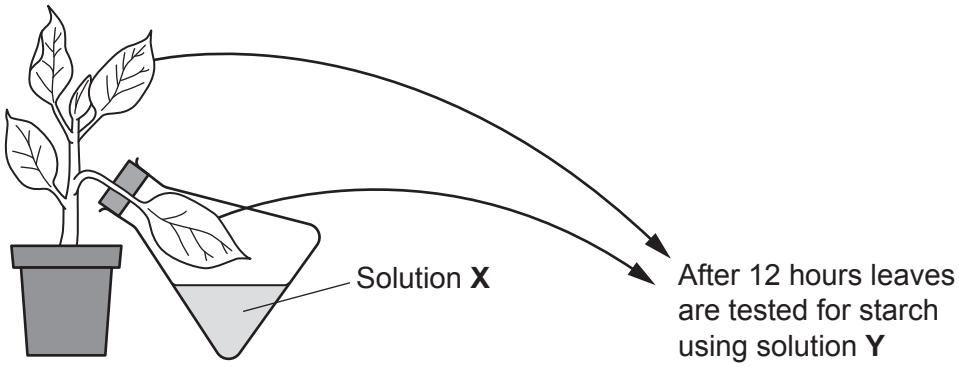
..... **[3]**

(b) The diagram shows an experiment to show that carbon dioxide is needed in photosynthesis.



Give possible names for solution **X** and solution **Y**.

Solution **X** .....

Solution **Y** .....

[2]

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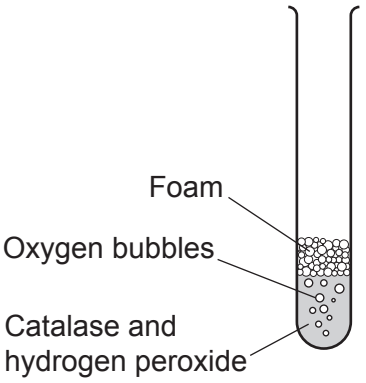
20 Catalase is an enzyme that breaks down hydrogen peroxide into oxygen and water.

When catalase is added to hydrogen peroxide in a test tube, the oxygen bubbles are visible as foam, as shown in **Fig. 20.1**.

The amount of foam present indicates how active the catalase enzyme is.

Fig. 20.1



(a)* Design an investigation to determine the effect of temperature on catalase activity.

Include in your answer:

- the measurements to be taken
- how to make sure the data obtained is valid.

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

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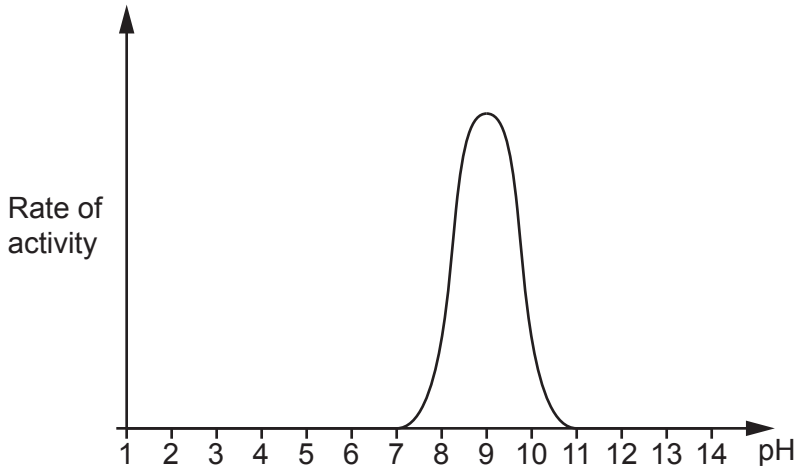
(b) Catalase is found in the human body.

Fig. 20.2 shows the effect of pH on the rate of activity of human catalase.

Fig. 20.2



What can you conclude about the effect of pH on the rate of activity of human catalase?

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

(c) Explain why catalase can only break down hydrogen peroxide.

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

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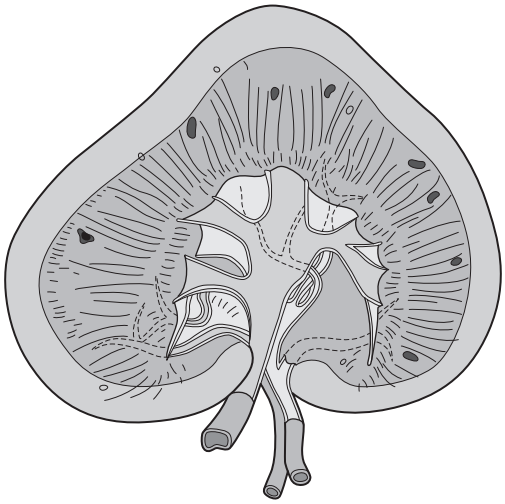
21 A horse has two kidneys. The internal structure of each kidney is similar to a human kidney.

Fig. 21.1 is a diagram of the internal structure of a horse kidney.

Fig. 21.1



(a) Label the cortex region of the kidney on **Fig. 21.1**. **[1]**

(b) A horse produces approximately 650 ml of urine per hour.

Calculate the volume of urine a horse produces in one day.

Give your answer in litres.

Volume of urine = ... l **[2]**

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(c) Diabetes insipidus is a disease in horses that causes a reduction in the amount of ADH produced.

Complete **Fig. 21.2** to explain the effect of this disease on the urine produced by the horse.

Fig. 21.2

Less ADH is released from the ..... gland in the brain.

↓

Less water is reabsorbed from the ..... into the blood.

↓

Urine produced by the horse has a ..... volume

and ..... concentration.

[4]

(d) A horse owner suspects their horse has diabetes insipidus.

Suggest **one** symptom, other than changes to urine, that the horse owner may observe.

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

(e) Pregnant female horses have oestrogen in their urine.

Pharmaceutical companies collect the urine and use the oestrogen it contains to make a drug called Premarin.
Premarin is taken by some human females.

(i) Give **one** function of oestrogen in the female menstrual cycle.

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

(ii) Large numbers of pregnant female horses are bred to collect enough oestrogen.
The horses are kept in stables and have a bag attached to them to collect the urine.

Suggest why some people do not agree with using horses to produce Premarin.

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

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22 When a person has diabetes, more blood sugar attaches to the haemoglobin in their red blood cells.

A blood test can determine what percentage of haemoglobin has sugar attached to it.

This haemoglobin is called HbA1c.

The normal range for HbA1c is between 4% and 5.6%.

People with symptoms of diabetes have a value that is 6.5% or higher.

(a) Explain why an individual with diabetes has a higher percentage of haemoglobin with sugar attached than an individual who does not have diabetes.

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

(b) Describe how an individual with type 2 diabetes could change their lifestyle to manage their diabetes.

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

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(c) Doctors use the HbA1c blood test to inform them about how well their patients are managing their diabetes.

The doctor will give the patients an HbA1c blood test every three months.

The table shows the results of one patient's blood tests.

Test	**HbA1c (%)**
1 (at diagnosis)	13.2
2	11.5
3	8.7
4	7.4
5	6.9
6	7.2

What can the doctor conclude about how well this patient is managing their type 2 diabetes?

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

(d) In 2015 there were an estimated 31 500 children in the UK with diabetes.

In 2019 this figure was estimated to be 36 000.

Calculate the percentage increase in the number of children diagnosed with type 2 diabetes, between 2015 and 2019.

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

Percentage increase = ... % **[3]**

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23

(a) Draw lines to link each **part of the brain** with its correct **function**.

Part of the brain	Function
cerebellum	coordinates conscious movement
cerebrum	controls heart rate and breathing rate
medulla	responsible for learning, language and memory

[2]

(b) Dopamine is a neurotransmitter chemical that is released at synapses in the brain.

Describe the function of a neurotransmitter chemical at a synapse.

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

(c) Parkinson's disease results in a reduction in dopamine in neurones deep in the brain.

To try to identify the cause of the disease, scientists use two methods:

- animals have part of their brain deliberately damaged and are then observed
- the brains of people with the disease are studied.

Explain any difficulties scientists may encounter when using these two methods for studying Parkinson's disease.

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

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(d) Scientists now think that a protein produced in the brain which helps brain cells survive is lost in Parkinson's patients.

A clinical trial of a possible treatment for Parkinson's disease was carried out by the scientists.

- Using robotic assisted surgery, tubes containing the protein were placed into the brain of Parkinson's patients.
- 41 patients took part in the study.
- After nine months, the scientists took a brain scan of each patient.
- The patients that had been given the protein showed an increase in the number of cells in the area of the brain where cells are lost in people with Parkinson's disease.

The scientists have said that more research is needed before this treatment will be offered to all Parkinson's patients.

Explain why.

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

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

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