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F

Monday 15 November 2021 – Morning

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

J247/01 Paper 1 (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 | | | | | | 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 **32** pages.

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

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SECTION A

Answer **all** the questions.

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

Write your answer to each question in the box provided.

1 Base pairs are found in a molecule of DNA.

Which base pairs with cytosine?

A Adenine (A)

B Cytosine (C)

C Guanine (G)

D Thymine (T)

Your answer ☐ **[1]**

2 Which row in the table shows the order of neurones an impulse travels through in a reflex arc?

	Order of neurones in a reflex arc		
	First	**Second**	**Third**
A	sensory neurone	motor neurone	relay neurone
B	motor neurone	relay neurone	sensory neurone
C	motor neurone	sensory neurone	relay neurone
D	sensory neurone	relay neurone	motor neurone

Your answer ☐ **[1]**

3 After blood leaves the human heart it passes through different blood vessels.

Which is the correct order of these blood vessels?

A Heart → arteries → capillaries → veins

B Heart → arteries → veins → capillaries

C Heart → capillaries → arteries → veins

D Heart → veins → capillaries → arteries

Your answer ☐ **[1]**

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4 Plants contain stomata.

Where are stomata found in most plants?

A Mainly on the lower surface of the leaves.

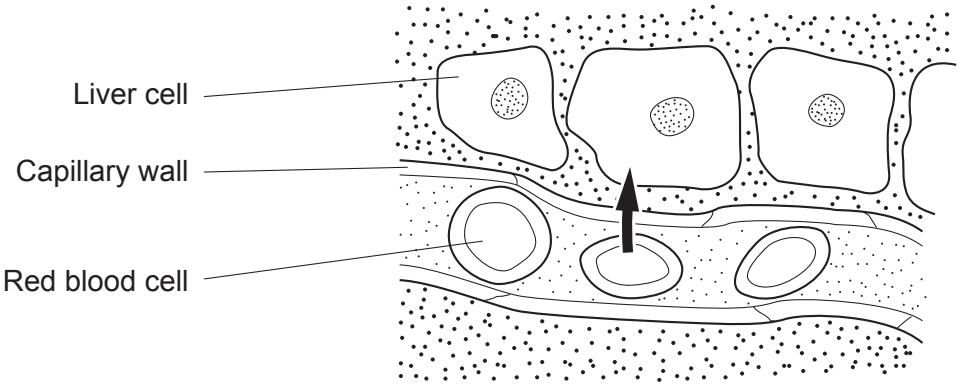
B Mainly on the upper surface of the leaves.

C Mainly on the surface of the stem.

D Mainly on the surface of root hairs.

Your answer ☐ **[1]**

5 The diagram shows a capillary inside liver tissue.



What does the arrow represent?

A Carbon dioxide diffusing into a liver cell.

B Carbon dioxide diffusing out of a liver cell.

C Oxygen diffusing into a liver cell.

D Oxygen diffusing out of a liver cell.

Your answer ☐ **[1]**

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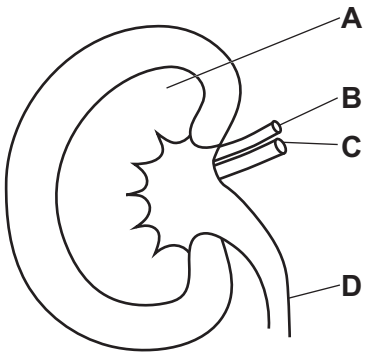
6 The diagram shows a section through a kidney.



Which part **A**, **B**, **C** or **D**, is the ureter?

Your answer ☐ **[1]**

7 Which part of the brain functions as an endocrine gland?

A Cerebellum

B Cerebrum

C Medulla

D Pituitary

Your answer ☐ **[1]**

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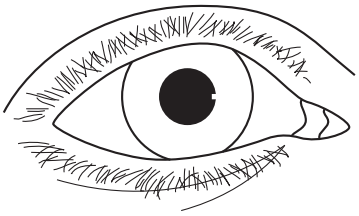
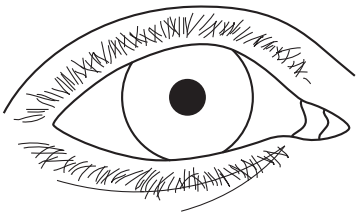
8 The eye changes in different light conditions.



View **A**



View **B**

What statement explains the changes between view **A** and view **B**?

A The iris makes the pupil smaller.

B The iris makes the pupil larger.

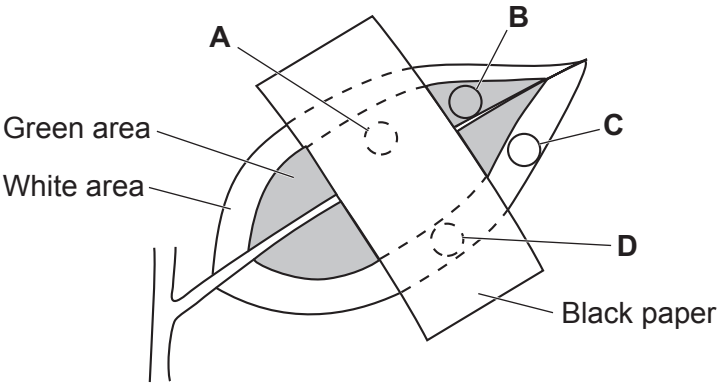
C The pupil makes the iris smaller.

D The pupil makes the iris larger.

Your answer ☐ **[1]**

9 A piece of black paper was placed over the leaf of a plant.

The plant was kept in the light for 2 days. Four discs were cut from the leaf.



Which disc **A**, **B**, **C** or **D**, would test positive for starch?

Your answer ☐ **[1]**

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10 Which molecule is joined to fatty acids to make a lipid?

A Amino acid

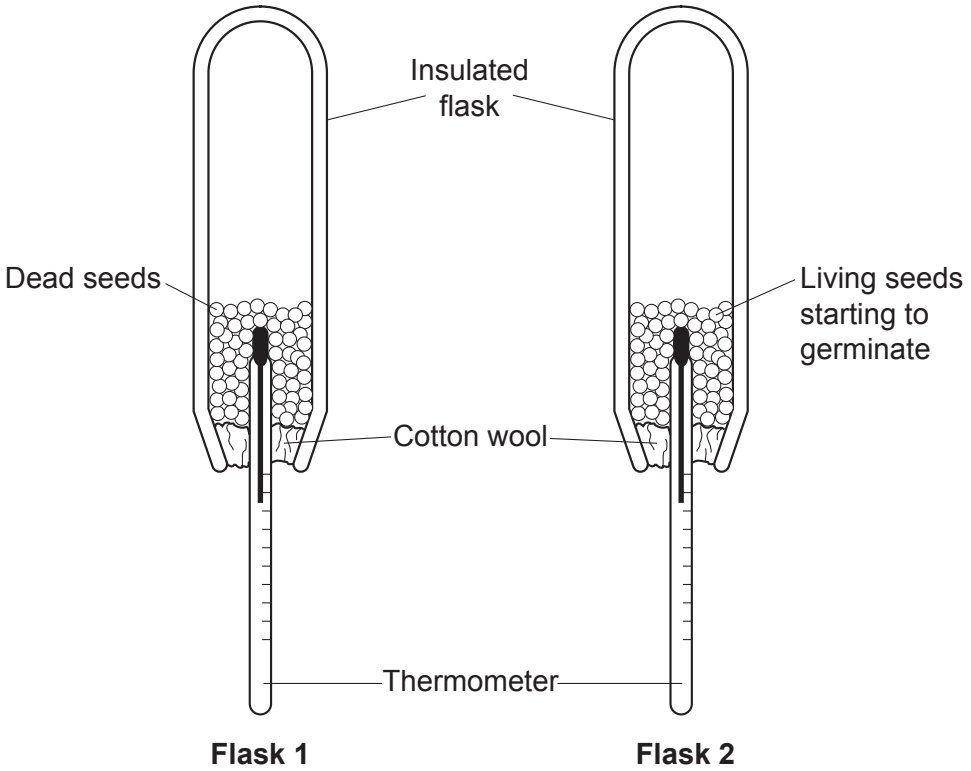
B Glucose

C Glycerol

D Starch

Your answer ☐ **[1]**

11 The diagram shows the apparatus used to demonstrate a biological process.



Which biological process could be demonstrated using this apparatus?

A Digestion

B Mitosis

C Photosynthesis

D Respiration

Your answer ☐ **[1]**

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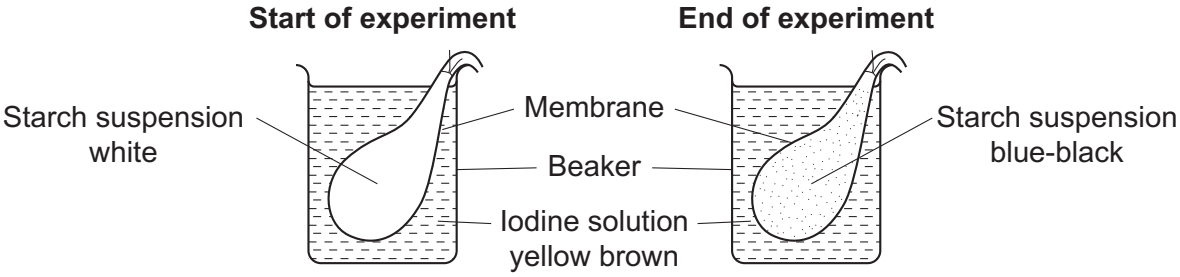
12 Look at the diagrams modelling transport of molecules into and out of cells.



What do the results show about the size of the molecules?

A Iodine molecules are larger than the pores in the membrane.

B Iodine molecules are similar in size to starch molecules.

C Iodine molecules are smaller than the pores in the membrane.

D Starch molecules are smaller than the pores in the membrane.

Your answer ☐ **[1]**

13 Which row in the table is the correct description for the process of **translocation**?

	Structure involved	**Liquid transported**	**Direction of movement**
A	phloem	sugar	downwards
B	phloem	sugar and water	upwards and downwards
C	xylem	sugar	upwards
D	xylem	sugar and water	upwards and downwards

Your answer ☐ **[1]**

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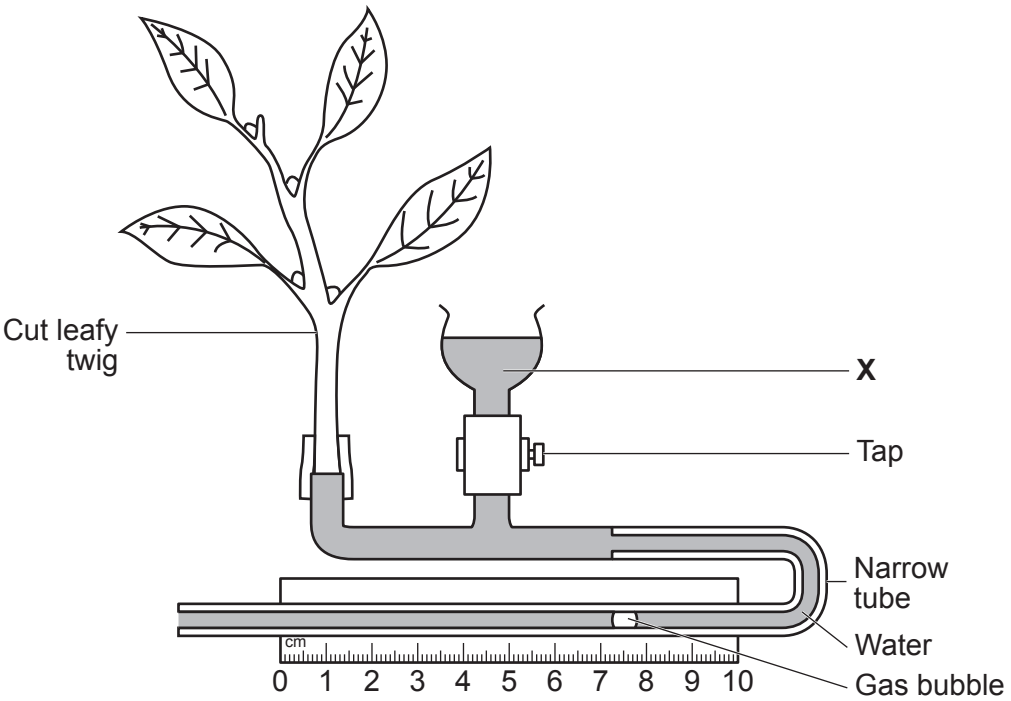
14 The diagram shows a potometer.



What is the purpose of the water in **X**?

A To provide water for the leafy twig.

B To reset the gas bubble to the start of the scale.

C To remove the gas bubble from the narrow tube.

D To measure the volume of water lost in transpiration.

Your answer ☐ **[1]**

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15 Q_{10} is a measure of the rate of change of a reaction when temperature is increased by 10°C.

Q_{10} is calculated using this formula:

Q_{10} = rate at higher temperature ÷ rate at lower temperature

An enzyme reaction has a rate of 36 units / min at 30 °C and 16 units / min at 20 °C.

What is the Q_{10} for this enzyme?

A 0.44

B 2.25

C 20

D 576

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

16 (a) Eukaryotic and prokaryotic cells have sub-cellular structures.

Complete the table to show which type of cell contains each sub-cellular structure.
Each row should have **one** tick (✓).

The first row has been done for you.

Sub-cellular structure	Only in eukaryotic cells	Only in prokaryotic cells	In both eukaryotic and prokaryotic cells
Cell membrane			✓
Nucleus			
Mitochondria			
Plasmid			

[3]

(b) (i) A student looks at plant cells using a light microscope, as shown in **Fig. 16.1**.

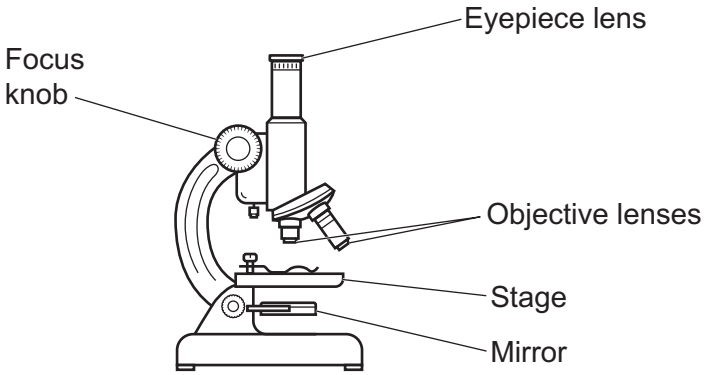

Fig. 16.1

Write **1** to **5** in the boxes to show the correct order of steps in using a light microscope to view the cells.

One has been done for you.

Adjust the focus knob to see the image.	
Place the plant cells onto a microscope slide.	
Place microscope slide on stage.	
Place a coverslip over the plant cells.	
Select low power objective lens.	**3**

[2]

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(ii) The microscope shown in **Fig. 16.1** has a ×10 eyepiece and a ×40 objective lens.

Calculate the magnification of the image of the plant cells that the student sees using the microscope.

Magnification = × ..... **[1]**

(iii) A chloroplast in one of the plant cells is 5 μm in diameter.

Use your answer from **(b)(ii)** to calculate the diameter of the chloroplast image seen under the microscope.

Diameter = ... μm **[1]**

(iv) Explain why the plant cells can make food in the form of sugars.

.....

.....

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

(v) The cell wall in the plant cell is made from a carbohydrate called cellulose. Cellulose is a polymer.

Explain why sugars are needed to make the cell wall.

.....

.....

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

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17 The circulatory system and gas exchange system are linked.

Two male students investigate how the type of exercise affects breathing rate.

They each record their breathing rates at rest.

Student A then exercises for 5 minutes by jogging on the spot.
Student B exercises for 5 minutes by doing star jumps.

Both students measure their breathing rate each minute during the 5 minutes of exercise.

(a) What is the **dependent** variable in this investigation?

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

(b) Write down **two** variables the students tried to control in their experiment.

1 .....

2 .....
[2]

(c) Why is it important to first record the students' breathing rate at rest?

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

(d) The results of their investigation are shown in the table.

Time (min)	**Breathing rate (breaths / min)**	
	Student A	**Student B**
0 (rest)	10	11
1	13	16
2	16	25
3	24	29
4	27	33
5	29	37

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The increase in breathing rate for **student A** is 19 breaths per minute.

Calculate the percentage difference in breathing rate increase between **student A** and **student B**.

Use the formula:

$$\text{Percentage difference} = \frac{\text{increase in } \textbf{student B} - \text{increase in } \textbf{student A}}{\text{increase in } \textbf{student A}} \times 100$$

Give your answer to **1** decimal place.

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

(e) Use the results from the investigation to write down **two** conclusions about how exercise affects breathing rate.

1 .....

.....

2 .....

.....
[2]

(f) **(i)** Give **two** problems with the method used by the students.

1 .....

.....

2 .....

.....
[2]

(ii) Suggest **one** way the method could be improved.

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

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18 (a) (i) **Fig. 18.1** shows the cell cycle. The letters represent different stages.

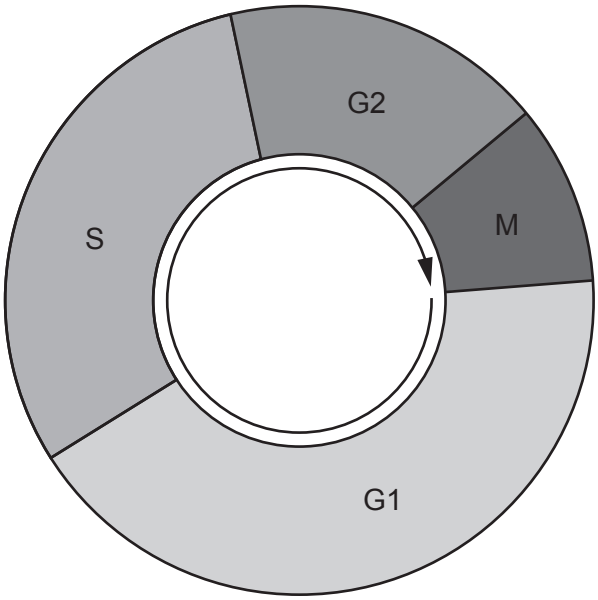

Fig. 18.1

Complete the table to identify the stages from the description of what happens during the cell cycle.
One stage has been done for you.

Stage	Description of what happens
	DNA replication
G2	growth and preparation for mitosis
	movement of chromosomes
	cell growth

[2]

(ii) DNA replication produces a new DNA molecule.

What name describes the shape of a DNA molecule?

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

(b) (i) Cell differentiation occurs during growth in multicellular organisms.

Explain why cell differentiation is important.

.....

.....

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

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(ii) Stem cells are found in embryonic and adult tissue in animals.

Where are stem cells found in plants?

Put a (ring) around the correct answer.

meristem **phloem** **stomata** **xylem**

[1]

(c) A gardener digs up a bush and then plants it in a different position in their garden. They try to dig up the bush with as much soil as possible so that the root hairs are not damaged.

Explain why the gardener tries to prevent the root hairs being damaged.

.....

.....

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

(d) Growth in plants is controlled by plant hormones.

Write down **two** other processes in plants that are controlled by plant hormones.

1 .....

2 .....

[2]

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19 **(a)** Insulin is a hormone that is important in controlling blood sugar levels.

Which organ in the body produces insulin?

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

(b) Diabetes is a disorder that results in being unable to control blood sugar levels.

Table 19.1 shows some notes written by a doctor about a patient who has **type 1** diabetes.

Patient
35 years old
symptoms developed quite quickly
patient often feels tired
cells that make insulin have been destroyed

Table 19.1

(i) Which note in **Table 19.1** indicates that the patient has type 1 diabetes and **not** type 2?

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

(ii) Describe how the patient should be treated.

.....

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

(c) **(i)** Explain how changes in blood sugar levels caused by diabetes affect the water potential of the blood.

.....

.....

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

(ii) Explain how surrounding cells will be affected by these changes in water potential in the blood.

.....

.....

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

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(d) Glucose may be found in the urine of people who have diabetes. This happens if their blood sugar levels are too high.

The diagram shows a kidney tubule (nephron).

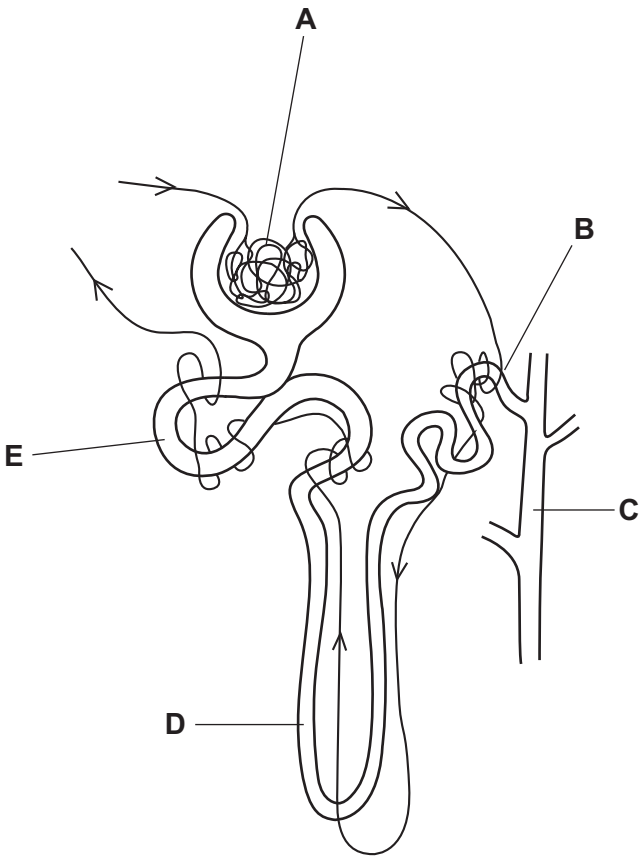

Table 19.2 shows some of the possible ways that diabetes can change kidney function.

For each change in function, write **A**, **B**, **C**, **D** or **E** to identify where in the kidney tubule each change occurs.

Change to kidney function	Part of tubule where change occurs
Glomerulus filters too much glucose from the blood.	
Proximal convoluted tubule only reabsorbs some of the glucose back into the blood.	
Collecting duct transports urine containing glucose.	

Table 19.2

[3]

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20 **(a)** **(i)** **Fig. 20.1** shows a cell from the nervous system. This cell helps control the body by transmitting impulses away from receptors.

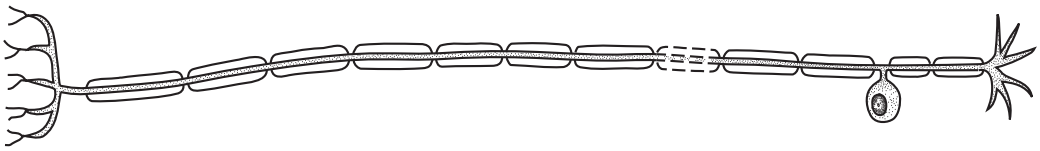

Fig. 20.1

What is the name of this cell?

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

(ii) The endocrine system is also involved in sending messages.

Describe how the endocrine system sends messages.

.....

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

(b) The eye is part of the nervous system.

Different parts of the eye can perform different functions to help with sight.

Draw lines to connect the correct **eye part** to the correct **function**.
One line has been drawn for you.

Eye part	**Function**
Cornea	Can carry electrical impulses from retina to brain.
Iris	Changes shape to control amount of light entering eye.
Lens	Changes shape to fine focus light onto retina.
Optic nerve	Curved to refract light into eye.

[2]

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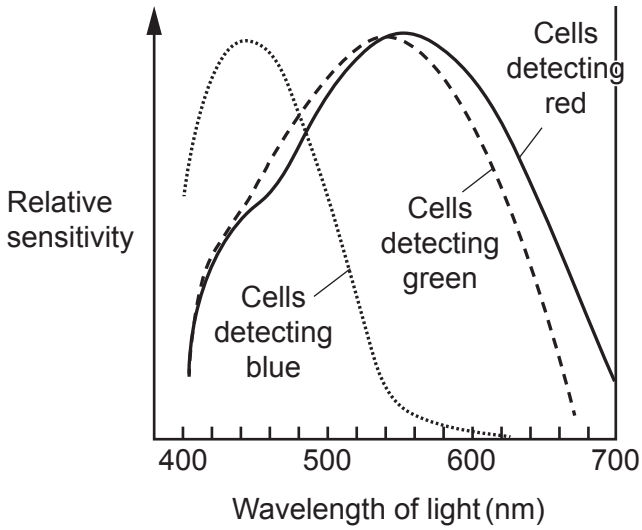
(c) (i)* All colours of visible light can be produced by combinations of blue, green and red light.

Different cells in the eye detect blue, green or red light.

Some people are colour blind because they have damaged cells that detect colours (wavelengths) of light differently.

Fig. 20.2 shows cells detecting colour in normal vision and in someone who is colour blind.

Normal vision



Colour blind

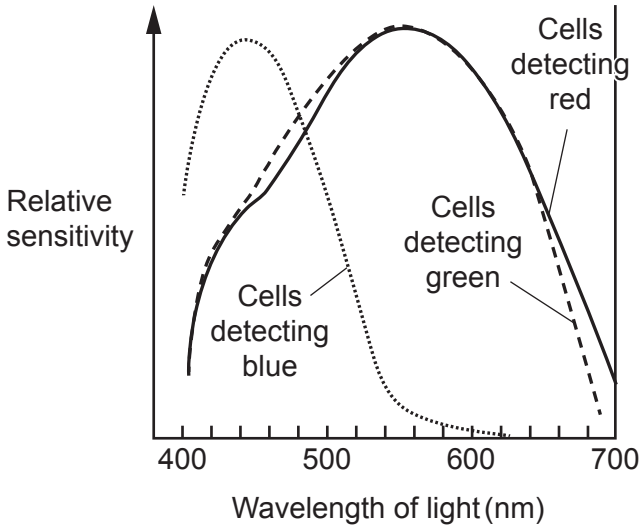


Fig. 20.2

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If the cells in the eye have the same sensitivity to different colours then the brain cannot tell these colours apart.

Special glasses can be worn to remove colours in the 560 to 640 nm range of visible light.

Identify the part of the eye that contains the different types of cells and use **Fig. 20.2** to explain:

- which colours the colour blind person has trouble identifying
- how the glasses might help treat this colour blindness.

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

(ii) Opsin is a protein needed to detect different wavelengths of visible light. Opsin is a protein made inside cells in the light sensitive part of the eye.

Which substance is used by the cells to make the protein opsin?

Put a (ring) around the correct answer.

amino acids **fatty acids** **glucose** **nucleotides**

[1]

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(d) The brain processes information from the eyes. This occurs in the same part of the brain responsible for controlling conscious thought.

Which part of the brain is responsible for processing vision?

Put a (ring) around the correct answer.

cerebrum **cerebellum** **hypothalamus** **medulla**

[1]

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21 Polymenorrhea is a condition which affects the menstrual cycle.

Symptoms of the condition include the time between ovulation and the next period being shorter than usual.

(a) **(i)** What is the name of the hormone that could treat the symptoms of this condition?

Tick (✓) **one** box.

FSH ☐

Oestrogen ☐

Progesterone ☐

Testosterone ☐

[1]

(ii) Describe how the hormone chosen in part **(a)(i)** would help.

.....

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

(b) Stem cells can be obtained from embryos. Stem cells can also be extracted from menstrual blood. These two types of cells are different.

(i) Embryo stem cells can be used to treat a wider range of disorders than menstrual blood stem cells.

Explain why.

.....

.....

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

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(ii) The time it takes for a population to double in size is called the **doubling time**.
For menstrual blood stem cells, doubling time is 19.4 hours.

Starting with 1 stem cell, assuming a constant growth rate, it is possible to work out how long a population takes to grow.

Calculate the time it takes for the population to reach 16 cells.

Time to reach 16 cells = ... hours **[2]**

(iii) The doubling time for umbilical cord stem cells is 48 hours.

How many times faster is the growth of menstrual blood stem cells?

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

(iv) Discuss why scientists think menstrual blood stem cell extraction is a positive development.

.....

.....

.....

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

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22 Marimo moss balls are made up of green algae. They are found in lakes and are known to rise and fall during different times of the day. **Fig. 22.1** shows some moss balls in a beaker of water.

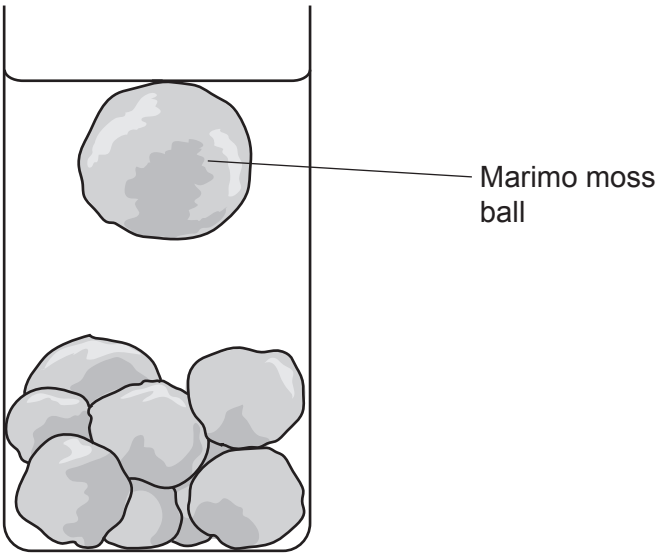

Fig. 22.1

Scientists predict that the moss balls rise because they are covered in tiny bubbles of oxygen.

(a) The scientists test their prediction by using a chemical that stops a biological process in the algae. When the chemical is added they found the moss balls did **not** rise.

(i) Which biological process is affected by the chemical?
Tick (✓) **one** box.

Diffusion	☐
Osmosis	☐
Photosynthesis	☐
Respiration	☐

[1]

(ii) Explain why the moss balls did **not** rise.

.....

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

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(b) The scientists then investigate how exposure to light affects a moss ball which had been in the dark.

- In **Experiment 1**, a moss ball is exposed to 12 hours of light then 12 hours of darkness.
- In **Experiment 2**, the moss ball is exposed to continuous light for 24 hours.

They measure the height of the moss ball in a column of water.

Fig. 22.2 shows their results.

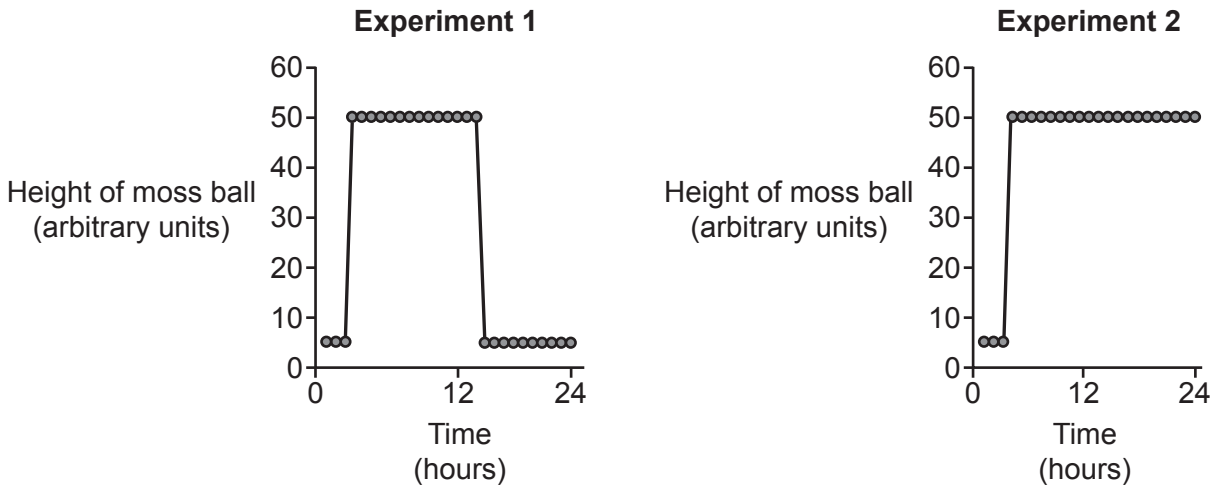

Fig. 22.2

(i) What conclusion can be made from **Experiment 1** about the effect of light on the position of the moss ball?

.....

.....

.....

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

(ii) Suggest an explanation for the differences between the two graphs.

.....

.....

.....

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

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(c) Light is one environmental factor that affects plants.

Explain how increasing the temperature from 15 °C to 40 °C can affect plants.

.....

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.....

.....

..... **[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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