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H

Tuesday 17 May 2022 – Morning

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

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

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

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 Which row shows the correct type of reaction for photosynthesis and for respiration?

		Photosynthesis	**Respiration**
Type of Reaction	**A**	endothermic	endothermic
	B	exothermic	exothermic
	C	endothermic	exothermic
	D	exothermic	endothermic

Your answer ☐ **[1]**

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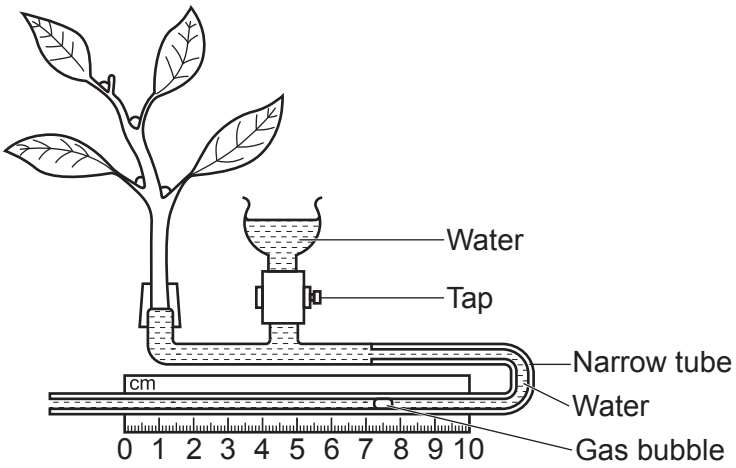
2 The diagram shows a potometer.



A student wants to test the hypothesis that the number of stomata on a plant affects water loss.

They first record the distance the gas bubble moves in 10 minutes.

What should the student do next before taking a second reading to test this hypothesis?

A Cover the plant with a black plastic bag.

B Remove some of the leaves.

C Repeat the test in a warmer room.

D Use an electric fan to move the air.

Your answer ☐ **[1]**

3 Transpiration will occur fastest in which conditions?

A A cold and windy environment

B A dark and cold environment

C A dark and warm environment

D A warm and windy environment

Your answer ☐ **[1]**

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4 Which adaptation of xylem helps prevent water leaving the xylem vessels?

A Lignin in the walls of the xylem

B Pits (holes) in the walls of the xylem

C The breakdown of cross walls between cells that make up the xylem

D The lack of cell contents in the cells that make up the xylem

Your answer ☐ **[1]**

5 Water moves into root hair cells due to differences in water potentials.

Which term describes this process?

A Active transport

B Diffusion

C Osmosis

D Translocation

Your answer ☐ **[1]**

6 Which hormone should be used to ripen fruit?

A Ethene

B FSH

C Gibberellins

D Thyroxine

Your answer ☐ **[1]**

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7 An elephant has 56 chromosomes in a stomach cell.

How many chromosomes will there be in an elephant's ear cell?

A 23

B 28

C 56

D 112

Your answer ☐ **[1]**

8 Liver cells are active cells producing many protein molecules.

Which organelles are present in liver cells?

A Chloroplasts and mitochondria

B Mitochondria and plasmids

C Nuclei and ribosomes

D Ribosomes and plasmids

Your answer ☐ **[1]**

9 A student cuts a cube of potato to use in an experiment. Each face of the cube is 2 cm by 2 cm.

What is the surface area : volume ratio of the cube?

A 3 : 1

B 4 : 8

C 8 : 24

D 16 : 8

Your answer ☐ **[1]**

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10 Farmers can control a cow's menstrual cycle using hormones.
Hormones controlling the menstrual cycle of a cow are the same as those in humans.

Which hormone would a farmer use to stimulate egg production?

A FSH

B LH

C Oestrogen

D Progesterone

Your answer ☐ **[1]**

11 The table shows some features of blood vessels.

	Valves along the length	**Thickness of walls**	**Diameter of lumen**
A	yes	thick	wide
B	no	thin	narrow
C	yes	thin	wide
D	no	thick	narrow

Which row in the table correctly describes the structure of arteries?

Your answer ☐ **[1]**

12 In a sample of DNA, 37% of the bases are thymine (T).

What will be the percentage of the other bases in this sample?

A Adenine (A) 13%, Cytosine (C) 13%, Guanine (G) 37%

B Adenine (A) 37%, Cytosine (C) 13%, Guanine (G) 13%

C Adenine (A) 0%, Cytosine (C) 37%, Guanine (G) 26%

D Adenine (A) 21%, Cytosine (C) 21%, Guanine (G) 21%

Your answer ☐ **[1]**

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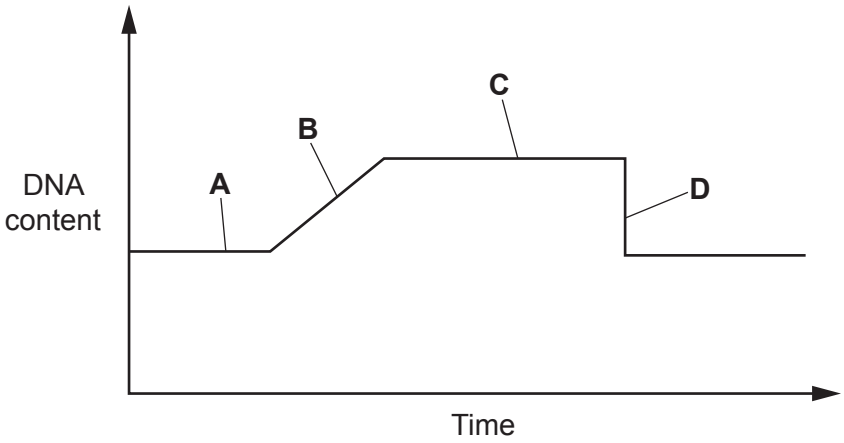
13 The graph shows how the DNA content of a cell changes during the cell cycle.



Which part of the graph **A**, **B**, **C** or **D** represents DNA replication?

Your answer ☐ **[1]**

14 The cell cycle consists of the following stages:

1. Cell growth
2. Movement of chromosomes
3. DNA replication

Which is the correct order of the stages in one cell cycle?

A 1, 2, 3, 2

B 1, 3, 1, 2

C 2, 1, 3, 1

D 2, 3, 1, 3

Your answer ☐ **[1]**

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15 In experiments about photosynthesis, it is often necessary to compare light intensities.

Which equation gives the light intensity at a distance (d) from a light source?

A Light intensity = $1/d$

B Light intensity = $1/d^2$

C Light intensity = $d - 1$

D Light intensity = $\frac{d \times 2}{1}$

Your answer ☐ **[1]**

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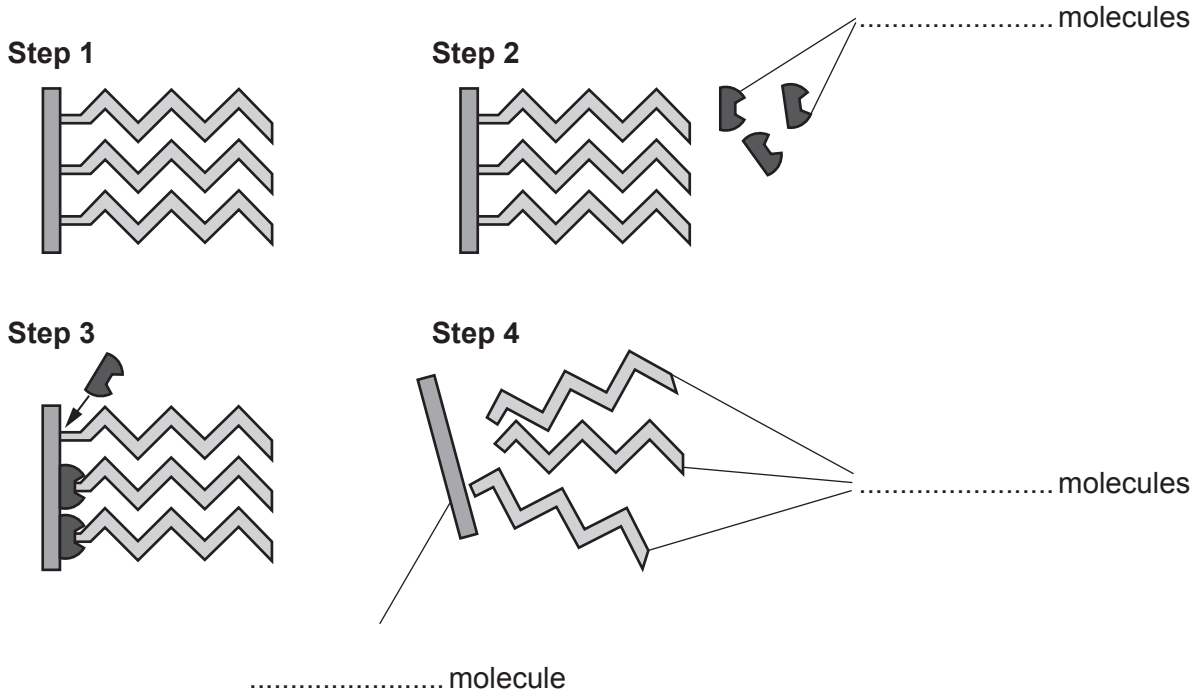
SECTION B

Answer **all** the questions.

16 Lipase is an enzyme produced in the human digestive system. It breaks down lipids.

(a) **Fig. 16.1** shows the steps in lipid digestion.

Fig. 16.1

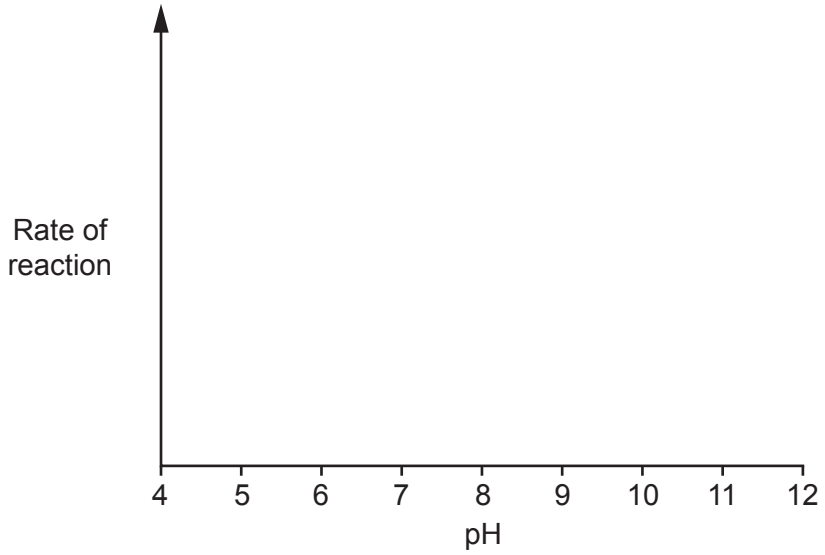


(i) Complete the labels in **Fig. 16.1**. **[3]**

(ii) Lipase is found in the small intestine where the pH is alkaline.

Draw a curve on **Fig. 16.2** to show the effect the pH will have on the rate of reaction for the digestion of lipids by lipase.

Fig. 16.2



[2]

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(b) Phenolphthalein is an indicator that turns pink in an alkaline solution of pH 10.

When lipase breaks down lipids, the indicator goes colourless.

A group of students investigate how temperature affects the enzymes that break down lipids found in milk.

Describe an experiment that the students could use to investigate the effect of temperature on the breakdown of the lipids found in milk.

In your description include:

- how the independent variable could be changed
- the observations that should be made
- **two** variables that need to be controlled.

To change the independent variable, I will .....

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The observations I make will be to .....

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I will need to control .....

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[5]

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17 The female menstrual cycle is regulated by hormones.
As women get older, they go through a stage called menopause when their periods stop.

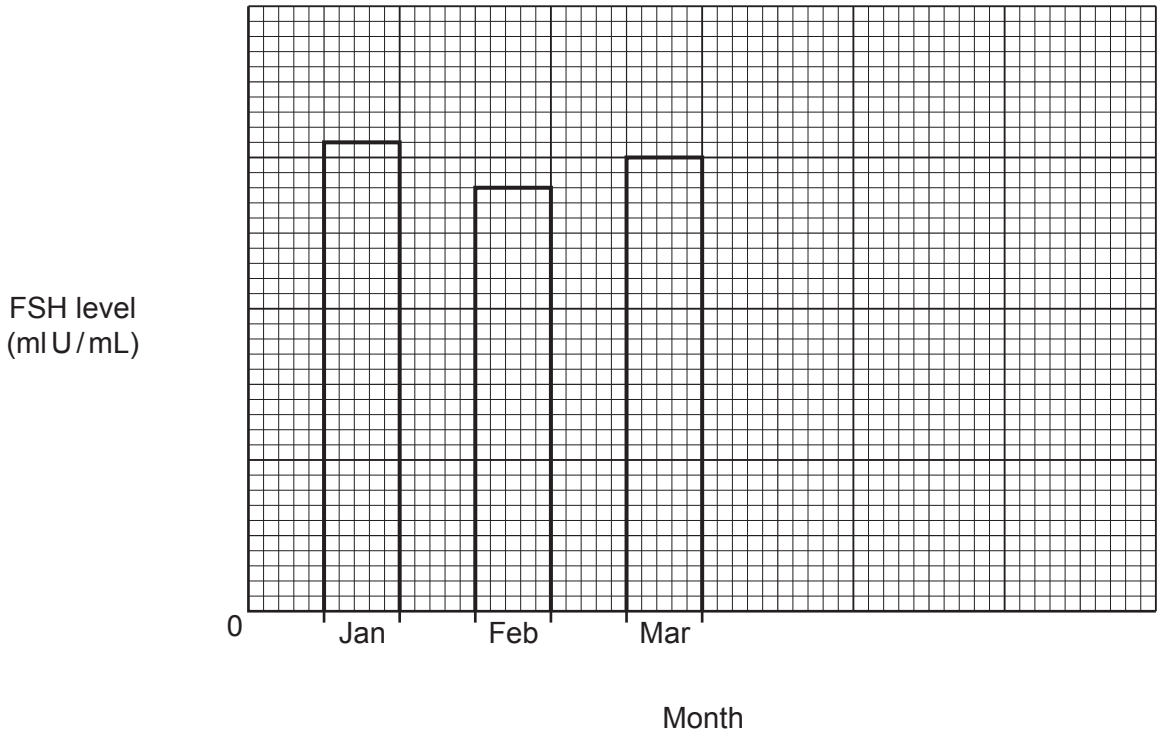
- Doctors can determine if a woman is going through menopause by measuring the level of FSH in their blood.
- If the FSH level goes above 30 mIU / mL, this indicates that menopause may have started.

A patient has her FSH levels measured each month for six months as shown in the table.

Month	FSH level (mIU / mL)
January	31
February	28
March	30
April	32
May	30
June	33

(a) (i) Complete the bar chart for the remaining values from the table.

Finish the scales for both axes.



[2]

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(ii) What evidence is there to suggest this patient **may** have started menopause?

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

(iii) The doctor decides they need more evidence to confirm if the patient has started menopause.

Suggest what further evidence the doctor should collect.

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

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(b) The doctor discusses a treatment called hormone replacement therapy (HRT) with the patient.

The doctor gives the patient a leaflet about HRT.

Information about HRT

HRT usually contains the hormones oestrogen and progesterone.

Benefits of HRT

When some women reach the menopause, it can affect their health.

They can get hot flushes, mood swings and it can weaken their bones.

These symptoms can be reduced by taking HRT.

Risks of HRT

HRT increases the risk of blood clots and, if you are overweight, this risk is increased further.

HRT increases the risk of heart disease in people over the age of 60.

Taking HRT for more than a year can increase the risk of breast cancer.

A 56-year-old patient is deciding if she should take HRT. She is overweight.

Discuss what factors the patient should consider when trying to decide whether to take HRT.

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

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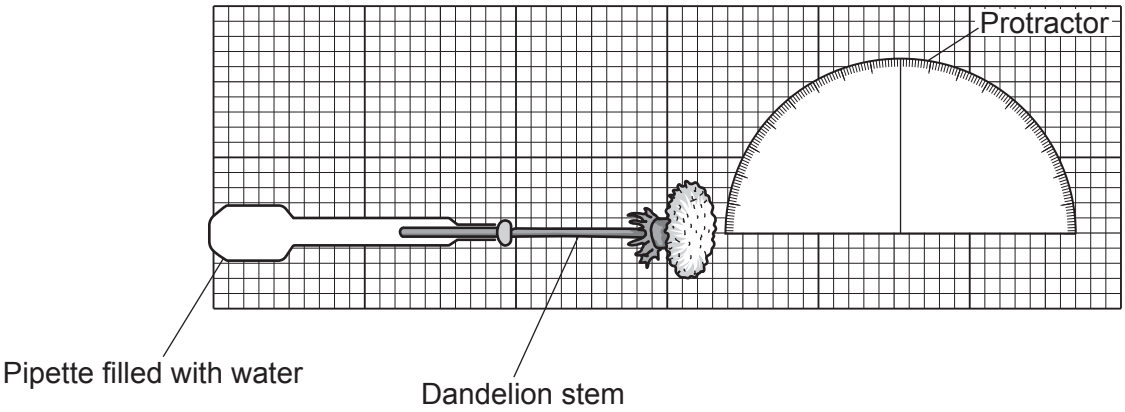
18 A student investigates the effect of gravity on dandelion stems.

The diagram shows the equipment they use.



- The student places the equipment in a dark room.
- The dandelion stem is horizontal at the start of the investigation.
- During the investigation the stem moves upwards.
- Each hour the student uses a protractor to measure the upward movement of the dandelion stem.

Their results are shown in the table.

Time (hours)	Amount of upward movement (°)
0	0
1	10
2	27
3	45
4	59
5	74
6	90

(a) Describe and explain the results of this experiment.

Use ideas about hormones.

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

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(b) The student is asked how long it took for the stem to reach an angle of 90°.

Their answer was 6 hours.

How could the student alter their investigation to provide a more accurate answer?

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

(c) Give **one** effect of the hormone gibberellin in plants.

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

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19 In 2018, a newspaper headline suggested that a cure for blindness had been found.

The newspaper was reporting on a study looking at operations in patients with age-related macular degeneration (AMD). In AMD, part of the retina is damaged.

(a) Describe the role of the retina **and** suggest why damage to this part of the eye could cause blindness.

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

(b) There are two types of AMD, wet and dry.

In wet AMD, tiny blood vessels 5 – 10 μm in size grow as the body tries to repair the retina.

Name the type of blood vessels that grow.

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

(c) During the study, researchers used embryonic stem cells to try to repair the sight of two individuals with wet AMD.

(i) One year later, both patients' eyesight had improved.

Explain why the newspaper headline claim of a cure may be misleading.

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

(ii) Suggest **one other** factor the researchers need to find out before this treatment is made widely available to all people with AMD.

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

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20 Hypothyroidism occurs when the body has an underactive thyroid gland.

(a) Explain why people with hypothyroidism can have less tolerance to cold conditions.

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

(b) Hypothyroidism can also change the way the body processes fat.

- This can cause high cholesterol levels that lead to deposits of cholesterol in the coronary artery.
- The coronary artery supplies blood to the cardiac muscle.

Suggest why cholesterol deposits could affect the correct functioning of the heart.

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

(c) In rare cases, hypothyroidism can lead to a condition called myxoedema coma.
In this condition, the body's temperature falls below 35 °C and the person becomes hypothermic.

Explain why hypothermia is harmful to the body.

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

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(d) The UK population is 68 million.
It is estimated that 2% of the UK population has hypothyroidism.

Calculate how many million people in the UK have hypothyroidism.

Number of people = ... million **[2]**

(e) Thyroxine can cause changes in heart rate and breathing rate.

Name another hormone that causes an increase in heart rate and breathing rate.

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

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21 (a) (i) Cellular respiration is an important biological process.

Describe what is meant by the term cellular respiration.

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

(ii) Cells can use glucose, lipid or protein as respiratory substrates.

The respiratory substrates being used can be found using this ratio:

$$\frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen consumed}}$$

The table gives the ratio for three single respiratory substrates.

Substrate	Ratio
Glucose	1.0
Lipid	0.7
Protein	0.8

The ratio calculated from investigations often indicates that more than one respiratory substrate is being used at the same time.

In an investigation, these measurements were recorded.

- volume of oxygen consumed = 120 cm^3
- volume of carbon dioxide produced = 108 cm^3

Calculate the ratio and suggest which respiratory substrates were being used.

Ratio = ...

Respiratory substrates used ..... **[2]**

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(b) **(i)** Describe **one** biochemical test that can be used to test for the presence of glucose.

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

(ii) Suggest how this test could be used to compare how much glucose is present in two different tissues.

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

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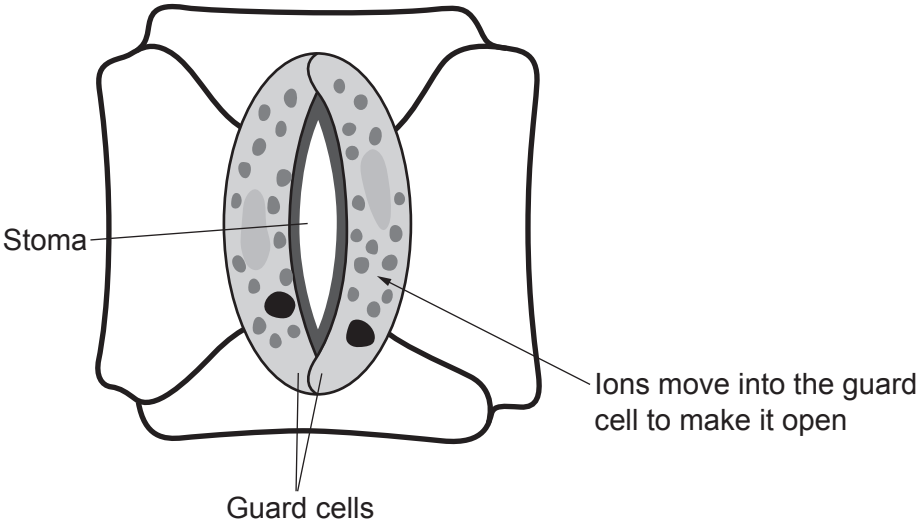
22 For gases to enter a leaf, the stomata must be open.

The diagram shows a stoma and two guard cells. When the stomata are open, the guard cells are described as being turgid (full of water).



(a) Explain how the guard cells help control the size of the stoma.
Use information from the diagram.

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

(b) The diagram has a magnification of ×400.
The width of the stoma is 5 mm.

Calculate the actual size of the stoma. Give your answer in micrometres.

(1 mm = 1000 micrometres)

Width of stoma = ... micrometres **[2]**

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(c) A student describes the structure and function of xylem to another student.

'Xylem vessels are made up of dead cells joined together end to end. The vessels are made of a waterproof material and transport sugars up and down the plant.'

They have made **two** mistakes in their description.

Write down the **two** mistakes they have made.

1 .....

2 .....

[2]

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23 **(a)** The statements **A**–**E** describe parts of the process of protein synthesis.
They are **not** in the correct order.

A A copy of DNA is formed during transcription; this is a molecule called mRNA.

B Amino acids are joined in the correct order during translation.

C DNA unzips and unwinds.

D The mRNA attaches to a ribosome in the cytoplasm.

E The mRNA leaves the nucleus.

Write **A**, **B**, **C**, **D** or **E** in each box to show their correct order in protein synthesis.

One letter has been done for you.

		E		

[2]

(b) Describe how the triplet code determines the structure of a protein.

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

(c) Scientists used to think that one gene coded for only one protein.

They have now discovered that one gene can code for more than one protein.

The diagram below shows the order of three sections of RNA.

(In RNA the base T is replaced with the base U.)

AUC	**CAG**
Section 1	

UAU	**CCG**
Section 2	

GCA	**AAU**
Section 3	

The order of these sections in a molecule of RNA made by transcription can be changed.

(i) Use the diagram to explain how changing the order of the sections would produce a different protein.

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

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(ii) Write down how many different proteins could be made from the three sections of RNA.

Number of proteins = ... **[1]**

(d) Compare the DNA found in eukaryotic and in prokaryotic cells.

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

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24 **Fig. 24.1** shows how stem cells in bone marrow differentiate into red blood cells.

Fig. 24.2 shows how the concentration of RNA and haemoglobin changes as the stem cell differentiates and the area of the nucleus changes.

Fig. 24.1

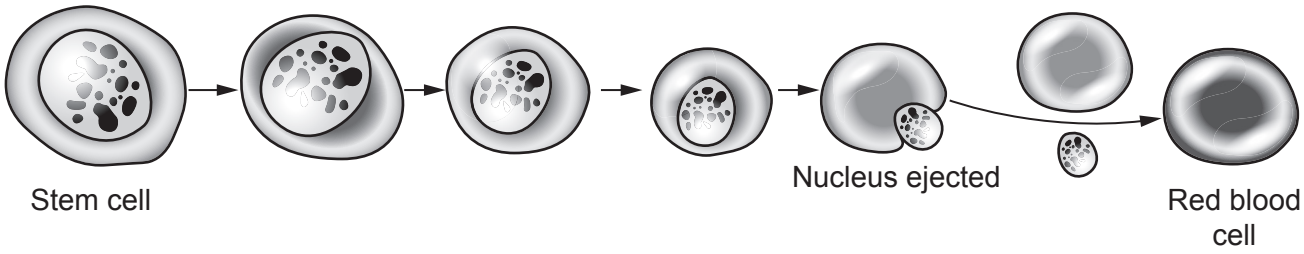
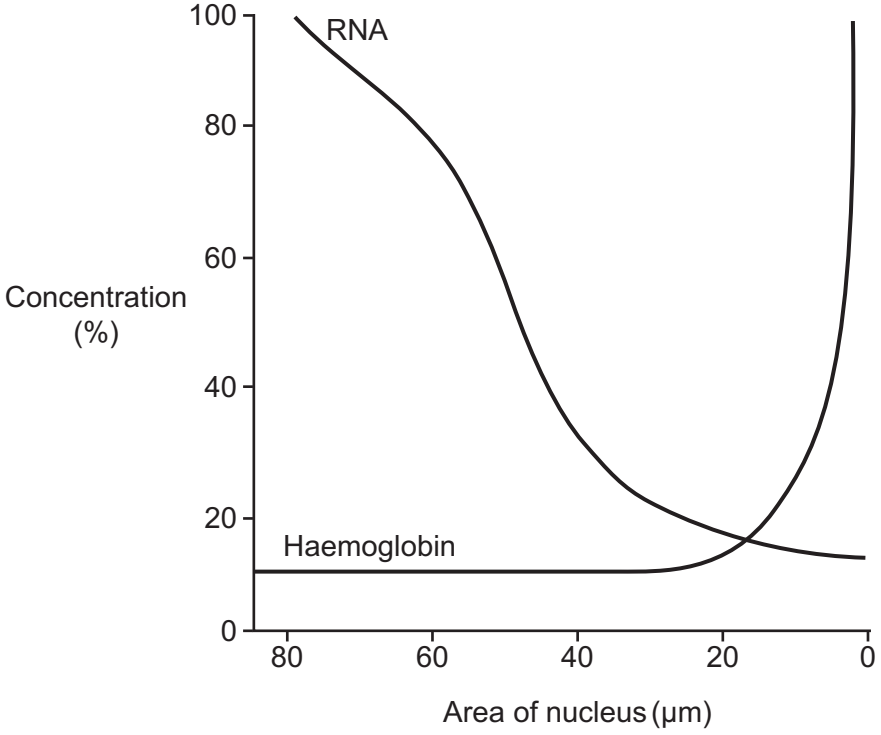


Fig. 24.2

Red blood cell development



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(a)* Use **Fig. 24.1**, **Fig. 24.2** and your knowledge of cell differentiation to describe and explain the formation of red blood cells.

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

(b) A male has:

- 4.7 million red blood cells per microlitre of blood.
- 4.5 litres of blood.

(1 litre = 1 000 000 microlitres)

Calculate how many red blood cells are in his blood.

Give your answer in standard form.

Number of red blood cells = ... **[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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