

GCSE (9–1)

Examiners' report

GATEWAY SCIENCE BIOLOGY A

J247

For first teaching in 2016

J247/03 Summer 2022 series

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our [website](#).

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Paper 3 series overview

J247/03 is the first higher tier paper in the J247 Gateway Biology suite. J247/03 assesses content from specification topics B1-B3 and B7. Therefore, to perform well on this paper candidates need to have a sound knowledge of the theory covered in topics B1-B3 and be able to apply the skills and understanding that they have developed in the practical activities covered in topic B7. There are also questions involving the assessment of key mathematical requirements from Appendix 5e of the specification. This paper is not synoptic and so does not contain any material covered by topics B4-6.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
<ul style="list-style-type: none"> • performed calculations correctly, including the calculations of actual size in Question 22 (b) and manipulation of standard form in Question 24 (b) • showed a sound factual knowledge of the structure of lipids in Question 16 (a), the working of guard cells in Question 22 (a) and the features of the triplet DNA code in Question 23 (b) • described how to perform practical tasks, such as the test for glucose in Question 21 (b) (i) and the design of the experiment in Question 16 (b) • analysed and explained the results of novel scientific investigations, such as the geotropism shown in Question 18 (a) and the data about respiratory substrates in Question 21 (a) (ii). 	<ul style="list-style-type: none"> • confused the different parts of the lipid molecule in Question 16 (a) • used inaccurate terminology when describing which variables to control in Question 16 (b) • did not appreciate that the experiment in Question 18 was performed in the dark and so tried to explain the results in terms of phototropism • confused the blood supply to the cardiac muscle with the cardiac output of blood to the organs in Question 20 (b) • made errors in calculations, such as they did not give an answer in millions in Question 20 (d) and not taking into account that the number of red blood cells in Question 24 (b) is given in millions.

Section A overview

Candidates generally performed well on the multiple choice section of the paper. Questions 3, 6 and 9 proved to be particularly strong with many correct answers. Questions 7, 13 and 15 were good discriminators, with mainly higher ability candidates answering correctly. Question 14 was the most challenging question in this section, and many candidates did not recall the order of the stages in the cell cycle.

Question 1

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]

A significant number of candidates answered the first question incorrectly, believing that photosynthesis was exothermic and respiration endothermic and therefore choosing option D.

Question 3

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]

Question 6

6 Which hormone should be used to ripen fruit?

- A Ethene
- B FSH
- C Gibberellins
- D Thyroxine

Your answer

[1]

Question 7

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]

The majority of candidates answered this correctly. A small but significant number of candidates incorrectly chose option B as the answer, presumably confusing which cells are haploid and which are diploid.

Question 9

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]

Question 10

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

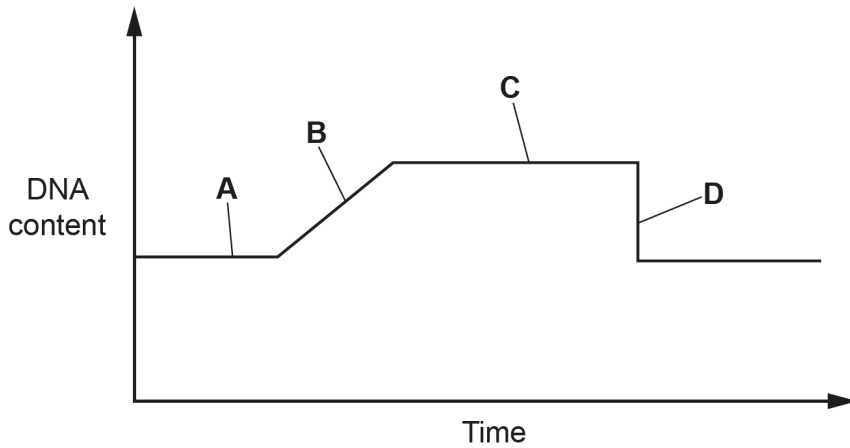
Your answer

[1]

The majority of candidates correctly identified FSH but of the incorrect answers, oestrogen was the most common.

Question 13

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]

The majority of candidates answered correctly. A small proportion of candidates answered incorrectly by choosing option C, even though this region of the graph does not show any increase in DNA content.

Question 14

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]

This question proved to be challenging with many candidates choosing option D, even though in this response the movement of chromosomes does not appear after DNA replication, and there are two stages involving DNA replication.

Question 15

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]

A majority of candidates answered this question correctly. However, the majority of candidates who answered incorrectly gave option A and did not appreciate the need to square the distance.

Section B overview

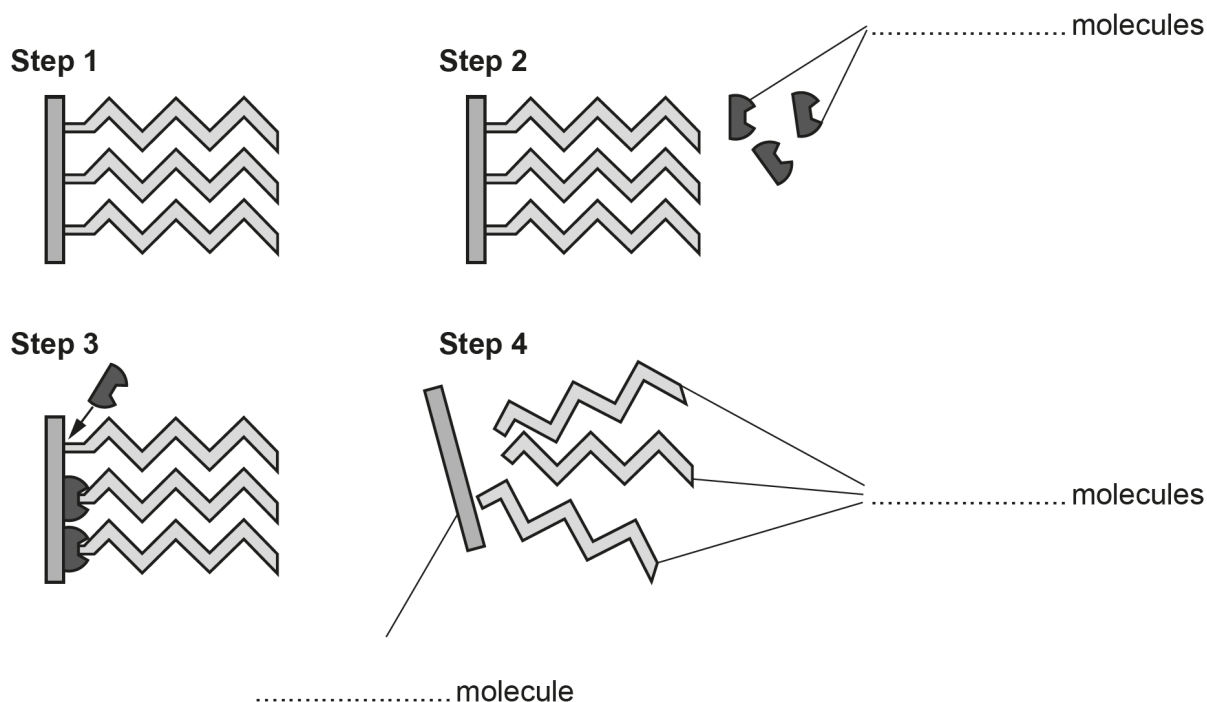
Many candidates scored well on the mathematical questions in this section, including being able to perform the calculation in Question 24 (b) involving standard form. There were also a high number of Level 3 answers to the level of response question, Question 24 (a). The mechanism of stomatal opening has proved challenging in previous series, and this was again the case here in Question 22 (a).

Question 16 (a)

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.

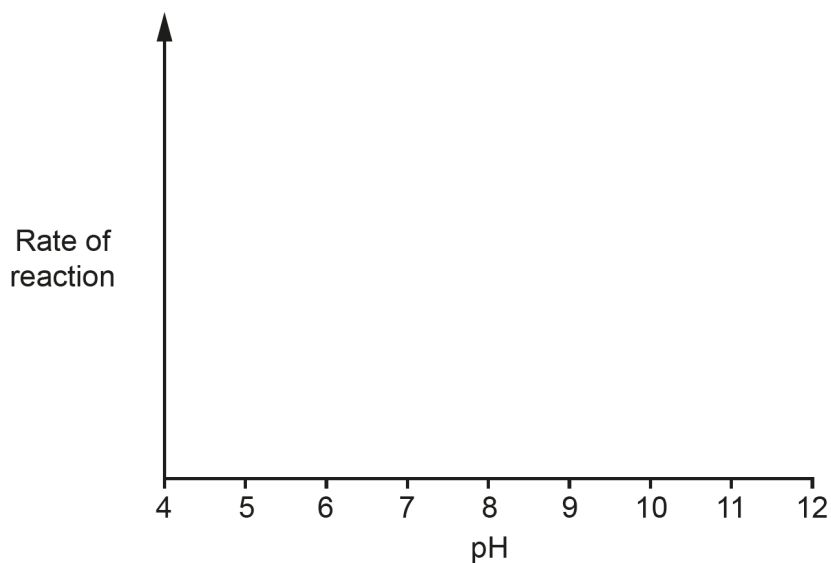
Fig. 16.1



- (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]

Many candidates correctly identified the enzyme molecule in part (i), but fatty acids and glycerol were often confused with each other, or with other molecules such as glycogen or glucose. In part (ii) credit was given for appreciating that the maximum of the graph should correspond to an alkaline pH, even if the graph drawn did not start to fall at high pH values.

Question 16 (b)

(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

.....

.....

.....

The observations I make will be to

.....

.....

.....

I will need to control

.....

.....

.....

[5]

The majority of candidates correctly identified temperature as being the independent variable and suggested changing it with a water bath. However, many were not given marks for the control of other variables as they were using vague terms such as 'amount' or were stating that the volume of lipids should be controlled, rather than the volume of milk.

OCR support



Our [Language of Measurement in context](#) resource can be used with candidates to help familiarise them with terms such as control variables, and where to identify them in a practical.

Assessment for learning



Candidates should be trained to use the terms 'concentration' or 'volume' when referring to solutions rather than vague references to 'amount'.

Question 17 (a) (i)

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

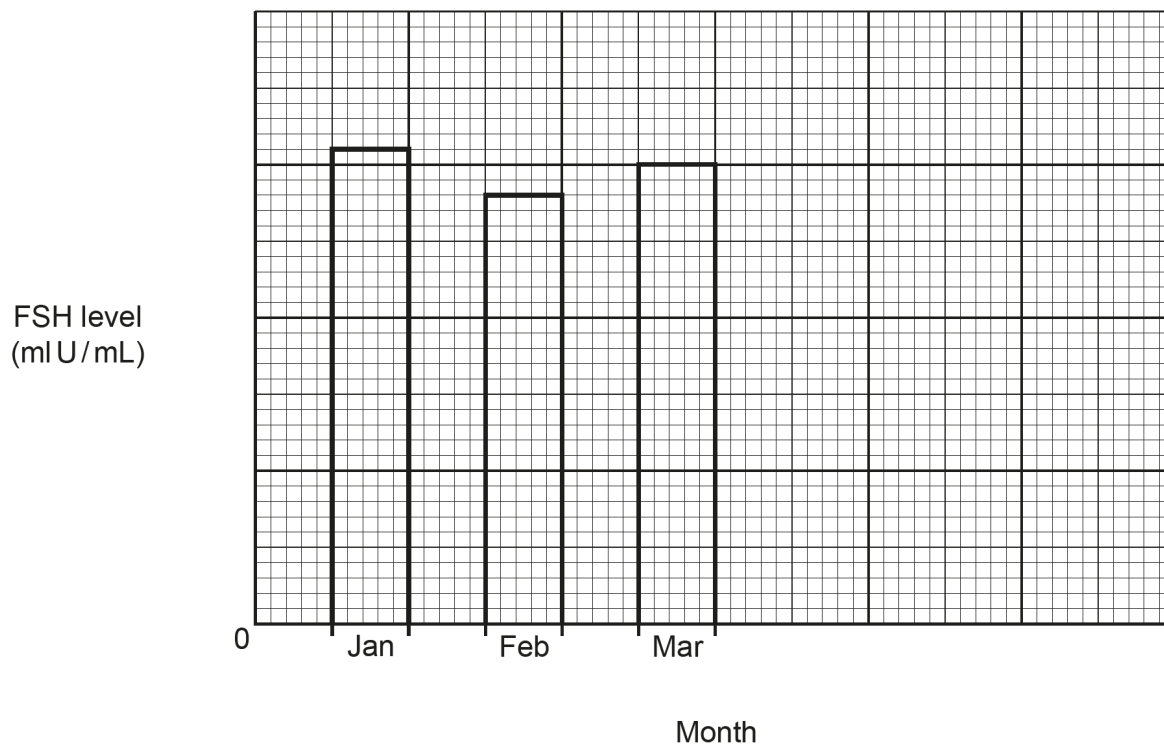
- Doctors can determine if a woman is going through menopause by measuring the level of FSH in their blood.
- If the FSH level goes above 30 mlU/mL, this indicates that menopause may have started.

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

Month	FSH level (mlU/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]

Most candidates correctly finished the scales and completed the plotting of the graph accurately. A very small number made errors on the y axis or omitted the scale on the y axis all together.

Question 17 (a) (ii)

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

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

A small number of candidates corrected calculated the mean of the readings and pointed out that it was greater than 30. They were given a mark for this approach. The most common error made here was to refer to the readings of 30 as being an indicator of the menopause, even though the information stated that the reading had to be over 30.

Question 17 (a) (iii)

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

Suggest what further evidence the doctor should collect.

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

There were many successful responses here, either referring to taking readings over a longer time scale or measuring the levels of other named hormones.

Question 17 (b)

- (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.

.....

.....

.....

.....

.....

..... [3]

Candidates were expected to use the information provided to link the risks of HRT to the specific features of this patient. The more successful answers also highlighted the need to balance the risks of HRT with the gains from the treatment.

Some candidates gave excellent answers referring to the mechanism of geotropism as controlled by uneven distribution of auxins, leading to cell elongation. However, there was some confusion with phototropism and light. This is shown in Exemplar 1.

Exemplar 1

Stems are negatively gravitropic, so grow away from direction of gravity. Auxin moves to the shaded side of the stem, promoting stem growth. This causes the stem to grow upwards. Therefore, over 6 hours the stem moves 90° as auxins cause ^{the stem} to grow upwards.

The candidate is given two marks for stating that the response is negative geotropism resulting in the stem growing upwards. However, the auxin moves to the lower part of the stem and not the shaded side as the whole experiment is carried out in the dark.

Question 18 (b)

(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?

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

Many candidates correctly suggested taking results at smaller time intervals but only the most successful answers highlighted that this needed to be between five and six hours.

Question 18 (c)

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

..... [1]

There are a wide range of acceptable answers to this question, but some answers were too vague to be given a mark, e.g. 'allows plants to germinate' or 'makes plants grow'.

Question 19 (a)

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.

.....

.....

.....

..... [2]

A significant number of candidates think that the retina is responsible for either refracting light in the eye or for restricting the intensity of light entering the eye. This is seen in this exemplar, which was not given any marks.

Exemplar 2

The retina controls how much light enters the eye. If the retina is damaged it is unable to let any light through and therefore the patient can't see as the cones and rods are unable to pick up light. [2]

Exemplar 2 states that the retina controls how much light enters the eye, and they were not given any marks for this.

Question 19 (b)

(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]

Most answers correctly stated capillaries.

Question 19 (c) (i)

(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.

.....

.....

.....

..... [2]

There were a number of acceptable answers here, but the most popular reference was to the fact that the claim stated a cure, but the information only stated that an improvement had been seen.

Question 19 (c) (ii)

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

.....

..... [1]

As a suggest question, there are a range of acceptable factors that could be given marks. Refences to possible side effects was the most common correct answer.

Question 20 (a)

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

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

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

This was a higher demand question, requiring candidates to have knowledge of the function of thyroxine in the control of the metabolic rate. This then needed to be linked to heat generation. Only the most successful answers managed to include both of these aspects.

Question 20 (b)

(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.

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

The main issue here was candidates did not differentiate between the blood supply to the cardiac muscle being blocked or the blood supply to the whole heart. This is seen in this exemplar which did not score.

Exemplar 3

Cholesterol deposits could affect the correct functioning of the heart by slowing the flow of blood through the coronary artery which will slow the flow of blood into ~~the~~ ^{the} heart [2]

Exemplar 3 was not given any marks for this response.

Question 20 (c)

- (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.

.....

.....

.....

.....

..... [3]

There were many answers correctly referring to the effect of a decrease in enzyme activity linked to reduction in the rate of reactions such as respiration. However, a number of candidates lost marks by stating that enzymes would be denatured by the fall in temperature.

Question 20 (d)

- (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]

This calculation was very accessible, although some candidates were unable to give the answer in millions. Candidates writing 1 360 000 were given 1 mark.

Question 20 (e)

- (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]

Most candidates answered correctly.

Question 21 (a) (i)

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

Describe what is meant by the term cellular respiration.

.....

.....

.....

..... [2]

There was some confusion here between the processes of cellular respiration and that of breathing. Some candidates also incorrectly referred to energy being created by the process.

Question 21 (a) (ii)

- (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 cm³
- volume of carbon dioxide produced = 108 cm³

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

Ratio =

Respiratory substrates used [2]

The majority of candidates correctly manipulated the data, produced a correct ratio and then interpreted it.

Question 21 (b) (i)

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

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

There was some confusion over this basic biochemical test. A number of candidates gave the correct reagent but did not mention the need to heat it. Others gave incorrect reagents such as Iodine solution.

Question 21 (b) (ii)

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

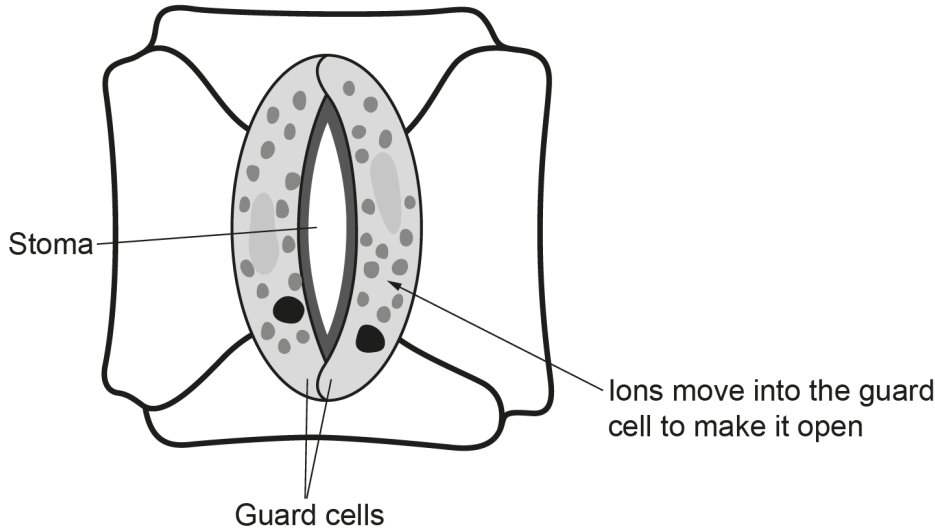
.....
.....
..... [1]

The most common error here was to suggest timing how long the Benedict's solution takes to change colour rather than looking for the degree of colour change. The more successful answers listed the range of colours from blue, to green and through to red.

Question 22 (a)

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]

The mechanism for stomatal opening has been examined before but it still proves to be problematic for candidates. Many simply repeated the information that was provided in the question and did not explain how an increase in turgidity of the guard cells causes the stoma to open.

Question 22 (b)

- (b) The diagram has a magnification of $\times 400$.
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]

Most candidates correctly calculated the width of the stoma.

Question 22 (c)

- (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]

Most candidates realised that xylem transports water rather than sugar and many correctly pinpointed the direction of passage. However, a number incorrectly stated that the xylem is not made up of dead cells joined end to end.

Question 23 (a)

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]

Generally, correctly answered.

Question 23 (b)

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

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.....

.....

..... [2]

Higher demand questions about the genetic code have appeared before in previous examinations and continue to be challenging. Candidates often confuse bases with amino acids in their answer or state that there are 20 amino acids in a protein.

Misconception



A common error that was seen in answers to this question and previous similar questions is the idea that the triplet code is responsible for the production of amino acids.

Question 23 (c) (i)

(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.)



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.

.....

.....

.....

..... [2]

If candidates correctly understood the importance of the triplet code, they often went on to correctly explain the effects of changing the order of the sections. Incorrect answers often stated that different amino acids would be coded for rather than the order being changed.

Question 23 (d)

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

.....

.....

.....

.....

..... [3]

Most candidates appreciated that the DNA in eukaryotes is contained in the nucleus and in prokaryotes it is free in the cytoplasm. There were also correct references to plasmids in prokaryotes. The main confusion seemed to be concerning the structure of DNA. A number of candidates thought that it was a double helix in eukaryotes but not in prokaryotes.

Question 24 (a)

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

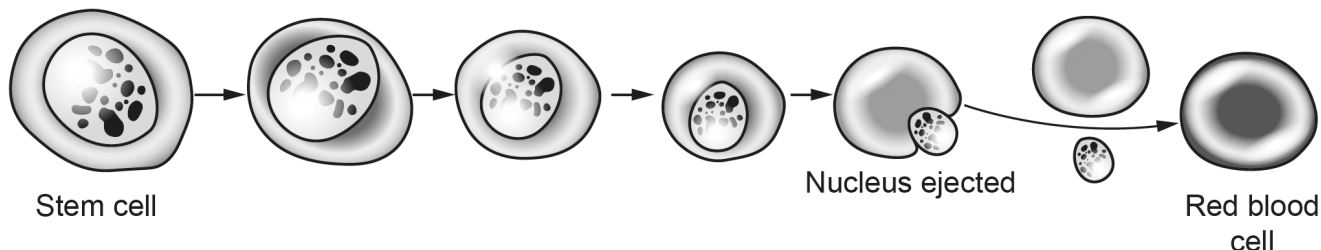
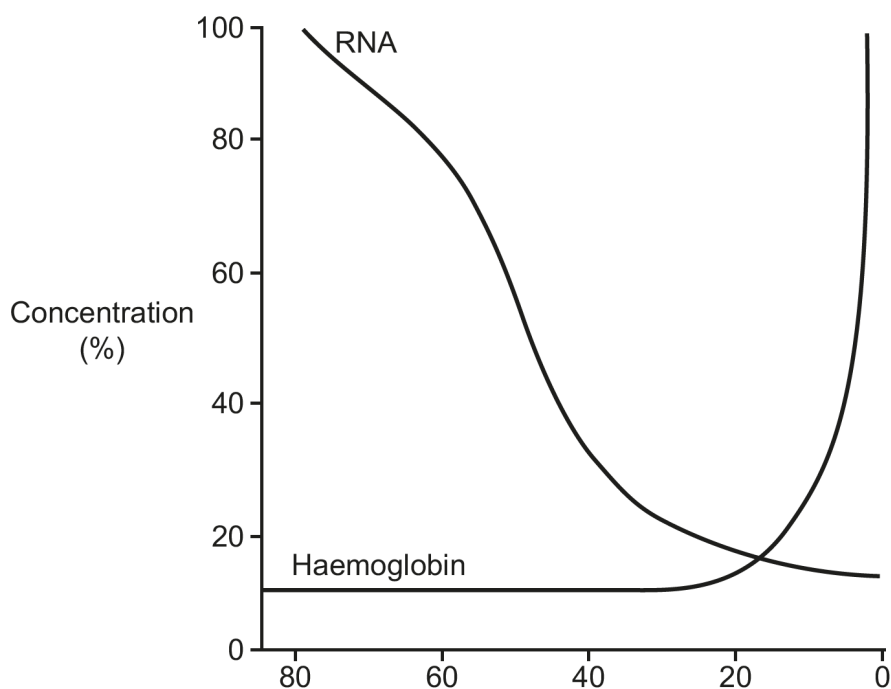


Fig. 24.2

Red blood cell development



(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]

This was the level of response question on this paper. To obtain Level 3, candidates had to discuss the importance of stem cells in forming specialised cells. They then had to explain how red blood cells become specialised by losing the nucleus in order to allow more room for haemoglobin.

A common misconception in some answers was the idea that the fall in mRNA in the cell made more room for haemoglobin. Also, there was confusion concerning the loss of the nucleus. Many candidates correctly referred to the increase of space for haemoglobin but others said that this would increase the surface area to volume ratio of the cell.

Question 24 (b)

(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]

Many of the candidates coped well with the conversion to standard form. However, a number of candidates did not take into account the fact that the number of red blood cells was given in millions, so their final answer was 10^6 out. These candidates were still given 2 out of 3 marks, for two correct stages in their calculations.

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