

N5

National Qualifications

2023

Biology

Section 2

Thursday, 27 April

Instructions to Candidates

Candidates should enter their surname, forename(s), date of birth, Scottish candidate number and the name and level of the subject at the top of their first answer sheet.

**[Braille page 2]** Section 2 — 75 marks

Attempt ALL questions

An owl in the margin indicates a new question.

Questions marked with an asterisk differ in some respect from those in the printed paper.

You must clearly identify the question number you are attempting on your answer sheet. Any rough work must be written on your answer sheet.

Tactile diagrams are produced in a separately bound booklet.

Marks are shown in square brackets at the end of each question or part question.

SECTION 2 — 75 marks

Attempt ALL questions

Q1. Cells vary in their size and structure.

(a) Both bacterial and fungal cells have a cell wall.

(i) Name one other structure that can be found in both bacterial and fungal cells. \_  
[1 mark]

(ii) Plant cells also have a cell wall. Name the material that plant cell walls are made of. \_ [1 mark]

The average size of different types of cell are shown in the table below.

[In the table, Cell type is followed by: Average size ( $\mu\text{m}$ )]

Animal: 32.0

Bacterial: 0.8

Fungal: 6.4

Plant: 52.0

(iii) Calculate how many times bigger the average plant cell is compared to the average bacterial cell. Give your answer as: \_ times bigger. [1 mark]

(iv) Apart from the difference in size, give one other difference between typical bacterial and plant cells. [2 print lines] [1 mark]

Q2. Plants transport water and mineral ions from their roots to the leaves.

(a) Mineral ions can move from the soil to the root cells by active transport.

Describe the process of active transport. [3 print lines] [2 marks]

(b) Water enters a plant by osmosis, which is an example of passive transport.

(i) State what this means in terms of the energy required for osmosis. [1 print line]  
[1 mark]

(ii) Name the vessels that transport water to the leaves. [1 print line] [1 mark]

(iii) When water enters a plant cell the vacuole fills and swells until no more water can enter. State the term used to describe a plant cell in this state. [1 print line] [1 mark]

**[Braille page 4]** ow 3. (a) The four DNA bases represented by A, C, G and T make up the genetic code. Part of the base sequence that codes for a protein is shown below.

---- G C A T A T G A ----

(i) Name base A and base C. Give your answer as: Base A is \_\_, Base C is \_\_ [2 marks]

(ii) The sequence shown is only 5% of the bases in this strand.

Calculate the total number of bases in this DNA strand. Give your answer as: \_\_ bases [1 mark]

(b) Name the type of molecule that proteins are made from. [1 print line] [1 mark]

ow \* 4. Pepsin is an enzyme involved in the digestion of proteins, which is a degradation reaction. Refer to the diagram for question 4.

The diagram represents three stages that occur in this reaction.

(a) (i) Using letters from the diagram, put the stages into the correct order to show this degradation reaction. Give your answer as;

stage \_\_     $\longrightarrow$     stage \_\_     $\longrightarrow$     stage \_\_ **[Braille page 5]** [1 mark]

(ii) Describe the feature of pepsin that allows it to bind to only one substrate. [2 print lines] [1 mark]

(b) Refer to the graph for question 4 (b). The graph shows the results of an experiment to investigate the effect of pH on pepsin activity. Use the graph to identify the optimum pH of pepsin.

Give your answer as: pH \_\_ [1 mark]

(c) Enzymes can be denatured by changes in pH. Give a reason why the rate of reaction will be affected. [2 print lines] [1 mark]

ow 5. Refer to the diagram for question 5. The diagram shows some of the stages in the transfer of a section of DNA from one cell to another.

(a) Name the process shown by the diagram. [1 print line] [1 mark]

(b) Name structure A. [1 print line] [1 mark]

(c) Describe what happens during stage 5. [2 print lines] [1 mark]

**[Braille page 6]** ow \* 6. An investigation was carried out into the effect of modifying cotton plants on the yield of cotton.

Three farms had two fields of cotton, one of each type: original and modified.

The yields of both types were recorded.

The results are shown in the table below.

[In the table, Farm is followed by: Yield of cotton - Original type (kg); Yield of Cotton - Modified type (kg).]

1: 340; 510.

2: 240; 348.

3: 380; 540.

(a) Calculate the percentage increase in yield when using modified cotton in farm 2.

Give your answer as: \_ % [1 mark]

(b) (i) Identify the variable altered in this investigation. [1 print line] [1 mark]

(ii) Suggest a variable that would have to be controlled to ensure validity. [1 print line] [1 mark]

(c) The fields planted with the original type of cotton were used as a **[Braille page 7]** control. Give a reason for using a control in this investigation. [2 print lines] [1 mark]

(d) Describe how the reliability of these results could be improved. [1 print line] [1 mark]

ow \* 7. Muscle cells can carry out different types of respiration.

(a) Name the type of respiration that yields the most ATP per glucose molecule. [1 print line] [1 mark]

(b) Refer to the diagram for question 7(b). The diagram shows a summary of one type of respiration in muscle cells.

(i) Name substance X. [1 print line] [1 mark]

(ii) Name the substance that must be present for stage 2 to occur. [1 print line] [1 mark]

**[Braille page 8]** (c) The number of mitochondria found in four different cells is shown in the table below.

[In the table, Cell is followed by: Number of mitochondria per cell]

Red blood:....0

Skin:.....800

Liver:.....1300

Muscle:....7000

(i) Calculate the simplest whole number ratio of mitochondria in muscle cells to skin cells. [1 mark]

Give your answer in the following format:

\_ (muscle): \_ (skin)

(ii) State why a muscle cell requires more mitochondria than a skin cell. [2 print lines] [1 mark]

ow \* 8. Tissue stem cells can be transplanted to replace blood cells.

(a) Describe the feature of stem cells that allows them to be used in this way. [2 print lines] [1 mark]

(b) To successfully treat a blood disorder, between 2 million and 4 million stem cells per kilogram of the patient's body mass are needed.

Calculate the minimum number of stem **[Braille page 9]** cells required to treat a patient with a mass of 78.5 kg. [1 mark]

Give your answer as: \_ million

(c) Refer to the graph for question 8(c). The graph shows the survival rates of patients with a blood disorder who have received a stem cell transplant.

(i) Identify the survival rate of patients 24 months after receiving a stem cell transplant. Give your answer as: \_ % [1 mark]

(ii) Describe the relationship between the number of months after receiving a stem cell transplant and the survival rate. [2 print lines] [1 mark]

(d) Other than tissue, name another type of stem cell. [1 print line] [1 mark]

ow \* 9. Refer to the graph for question 9. The graph shows the number of people in Scotland with type 2 diabetes over a period of nine years.

(a) (i) Identify the number of people with type 2 diabetes in 2012. [1 print line] [1 mark]

(ii) If the trend shown continued, predict the number of people that would be expected to have type 2 diabetes in 2018. [1 print line] [1 mark]

**[Braille page 10]** (b) Insulin is a hormone involved in the regulation of blood glucose.

(i) Insulin has an effect on cells in the liver. Explain why insulin does not affect cells in other organs. [2 print lines] [1 mark]

(ii) Describe the reaction that occurs in the liver cells in response to insulin. [1 print line] [1 mark]

(c) Name the type of glands that release hormones into the bloodstream. [1 print line] [1 mark]

ow \* 10. Refer to the diagram for question 10. The diagram shows a cross between a horse and a donkey and the resulting offspring. The diploid number of chromosomes for the horse and donkey are given on the diagram.

(a) The horse and the donkey produce gametes required for reproduction.

(i) Name the type of gamete produced by the female horse in this cross. [1 print line] [1 mark]

(ii) Name the organ where the gametes of the male donkey are produced. [1 print line] [1 mark]

(b) Name the cell produced when the nuclei of male and female gametes **[Braille page 11]** fuse. [1 print line] [1 mark]

(c) (i) State the diploid number of chromosomes in the offspring in this cross. \_ [1 mark]

(ii) This offspring is not fertile. Using this information, give a conclusion about horses and donkeys. [2 print lines] [1 mark]

ow 11. Faeces is the waste material that remains after food has been digested and the nutrients absorbed.

*Clostridium difficile* (*C. difficile*) is a bacterium found in the gut that is usually harmless. However, in some people there can be an overgrowth of *C. difficile*, resulting in persistent diarrhoea that can sometimes be life-threatening.

A recent study developed a capsule containing frozen faeces from healthy donors to treat diarrhoea caused by *C. difficile*.

Twenty patients with diarrhoea caused by *C. difficile* were each given 30 capsules over an eight-week period.

No serious side effects were reported in the study group, and diarrhoea was cured in 14 of the 20 patients. The 6 who did not respond were treated again in the same way **[Braille page 12]** and 4 of them were then cured. This was considered a success as 18 of the 20 patients no longer suffered from persistent diarrhoea.

(a) Using the information in the passage:

(i) identify the type of pathogen that causes persistent diarrhoea [1 print line] [1 mark]

(ii) suggest the aim of the study described in the passage. [2 print lines] [1 mark]

(b) Suggest why each patient was given the same number of capsules. [2 print lines] [1 mark]

(c) Calculate the percentage of patients who were cured after one treatment with the capsules. Give your answer as: \_% [1 mark]

(d) Name the system in the human body involved in destroying pathogens. [1 print line] [1 mark]

ow \* 12. High altitude training is an important part of athlete preparation for endurance sports such as long-distance running.

As altitude increases the oxygen concentration of the air decreases.

**[Braille page 13]** The table below shows the effect of training at different altitudes on athletes' red blood cell count.

[In the table, Altitude (km) is followed by: Average red blood cell count (million/ml of blood)]

0 : 4.5

0.5: 5.0

1.0: 5.5

2.5: 6.0

3.5: 7.5

5.0: 9.0

5.5: 9.5

Refer to the graph for Question 12. A student plotted these results as a line graph.

(a) (i) 1 - State the label that should be added to the y-axis. [1 mark]

2 - Select the altitude in kilometres for the result that the student incorrectly plotted. Give your answer as: \_ km [1 mark]

(a) (ii) Describe the relationship between altitude and red blood cell count. [2 print lines] [1 mark]

(a) (iii) Using information from the table, predict the average red blood **[Braille page 14]** cell count of an athlete training at an altitude of 3.0 km.

Give your answer as: \_ million/ml of blood [1 mark]

(b) Red blood cells are important for transporting oxygen.

(i) In what form is oxygen transported by red blood cells? [1 print line] [1 mark]

(ii) Give one structural feature of a red blood cell that allows it to carry out its function efficiently. [1 print line] [1 mark]

ow \* 13. Refer to the diagram for Question 13. The food web represents a marine ecosystem in the west coast of Scotland.

(a) Give an ecological term that describes the sea urchins. [1 print line] [1 mark]

(b) Pollution from microplastics has led to a decline in the mussel population.

Predict the effect of a decrease in mussels on the sea otter population and explain your answer. [2 marks]

Effect on sea otter population: [1 print line]

Explanation: [2 print lines]

(c) Marine biologists investigated the effect of salt concentration on the number **[Braille page 15]** of microplastic particles in mussel body tissue.

The results are shown in the table below.

[In the table, Salt concentration (ppb) is followed by: Number of microplastic particles per 1 g of mussel body tissue]

31: ..4

33: ..8

36: 20

A mussel with a mass of 5 g was found to contain 20 particles of microplastics in its body tissue.

Identify the salt concentration the mussel was found in.

Give your answer as: \_ ppb [1 mark]

**[Braille page 16]** ow \* 14. Students surveyed an area of woodland and recorded the tree species growing there.

(a) The table below shows some features that can be used to identify the trees.

[In the table, Tree is followed by: Needle colour; Needle arrangement; Cones]

Scots pine: blue-green; in pairs; point outwards from stem tip

Norway spruce: green underside; around the branch; point downwards

Douglas fir: grey underside; around the branch; point downwards

Larch: light green; in clusters; point outwards along the stem

Yew: green; in two rows along the branch; absent



Use the information in the table to complete the key at (i), (ii) and (iii). [3 marks]

1. Cones are absent: Yew

Cones are present: go to 2

2. Cones point downwards: (i)

Cones do not point downwards: go to 4

3. Underside of the needle is grey: (ii)

Underside of the needle is green: **[Braille page 17]** Norway spruce

4. Needles arranged in pairs: Scots pine

(iii): Larch

(b) The students also investigated the effect of soil moisture on the number of Scots pine seedlings growing on the woodland floor.

(i) The students recorded the soil moisture and number of seedlings at 10 sample sites in the woodland. Suggest why 10 sample sites were used. [2 print lines] [1 mark]

(ii) The students used a moisture meter to measure the soil moisture.

Describe what the students should have done each time they used this apparatus to minimise error. [2 print lines] [1 mark]

ow \* 15. Refer to the diagram for Question 15. Farmers use fertilisers with a high nitrate content to increase the yield of crops. The diagram shows two possible fates of nitrates in fertilisers.

Describe how the leaching of nitrates can result in a reduction in the number of freshwater organisms in lochs. [10 print lines] [4 marks]

ow \* 16. Photosynthesis is a two-stage process that takes place in the **[Braille page 18]** leaves of green plants.

(a) State the source of energy for the first stage. [1 print line] [1 mark]

(b) (i) Name the process by which oxygen moves out of the leaf through stomata. [1 print line] [1 mark]

(ii) The number of stomata on both surfaces of five leaves was counted and averages calculated.

The results are shown in the table below.

[In the table, Leaf is followed by: Number of stomata on upper surface; Number of stomata on lower surface]

1: .....4; 12

2: .....20; 23

3: .....8; 15

4: .....12; 22

5: .....16; \_\_\_\_

Average..12; 18

Calculate the number of stomata on the lower surface for leaf 5. This value is missing in the table. [1 mark]

(iii) Name a substance that enters the leaf through stomata. [1 print line] [1 mark]

(c) (i) Describe how sugar is produced in the second stage of **[Braille page 19]** photosynthesis. [2 print lines] [1 mark]

(ii) Name one substance that the sugar produced could be converted into. [1 print line] [1 mark]

[END OF QUESTION PAPER]