OXFORD
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I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Tuesday 3 January 2023 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

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Answer **all** questions in the spaces provided.

0 1 Scientists study cells using microscopes, and by cell fractionation and ultracentrifugation.

0 1 . 1 An optical microscope has a resolution of 0.2 μm and a transmission electron microscope (TEM) has a resolution of 0.2 nm

Give the reason for the difference in resolution between the optical microscope and the TEM.

[1 mark]

_____

_____

_____

0 1 . 2 Give **two** limitations of using a TEM to investigate cell structure.

[2 marks]

1 _____

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2 _____

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Question 1 continues on the next page

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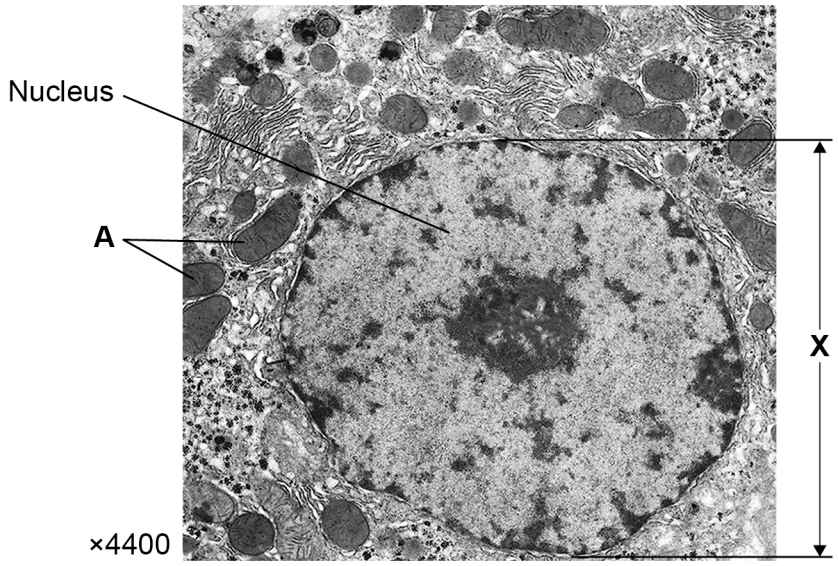
Figure 1 shows part of a cell from a liver as seen using a TEM.

Figure 1



0 1 . 3 Describe how the nucleus controls the activities of the cell.

[2 marks]

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0 1 . 4 Calculate the actual diameter, **X**, of the nucleus shown in **Figure 1**.

Give your answer in micrometres (μm), to 2 significant figures.

[2 marks]

Diameter = _____ μm

A liver cell synthesises many types of protein.

0 1 . 5 Describe how organelle **A**, shown in **Figure 1**, helps in protein synthesis.

[2 marks]

_____

_____

_____

_____

0 1 . 6 Name the type of reaction that joins amino acids together in protein synthesis.

[1 mark]

Tick (✓) **one** box.

Condensation	☐	Replication	☐
Hydrolysis	☐	Transcription	☐

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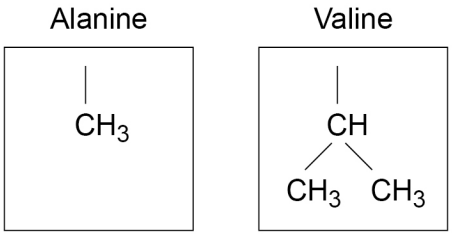
0 1 . 7 **Figure 2** shows the R-groups of two amino acids, alanine and valine.

Figure 2



Alanine and valine can join together to form a dipeptide.

Draw the complete structure of the dipeptide alanine–valine.

Use information from **Figure 2**.

[2 marks]

A scientist wants to study the nuclei of liver cells in more detail.

The scientist uses cell fractionation and ultracentrifugation to separate the nuclei from other organelles.

0 1 . 8 Explain how **ultracentrifugation** separates cell organelles.

[2 marks]

Do not write outside the box

0 1 . 9 The scientist obtains a sample containing nuclei.

The scientist analyses the DNA from the liver cell nuclei.

The DNA contains 20.5% cytosine bases.

Calculate the percentage of adenine bases you would expect in this DNA.

[2 marks]

Percentage of adenine = _____ %

16

Turn over for the next question

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0 2 When a plant cell loses water, the cell surface membrane pulls away from the cell wall. This is called plasmolysis.

A student uses a microscope to investigate plasmolysis in onion cells.

The student:

- removes a thin layer of cells from a piece of onion
- cuts the thin layer of cells into a square 10 mm × 10 mm
- puts the square of cells on a microscope slide
- adds two drops of 0.1 mol dm^{-3} sodium chloride solution
- puts a cover slip over the cells
- leaves the slide for 20 minutes
- samples the cells and records the percentage of cells that are plasmolysed
- repeats for sodium chloride solution concentrations 0.2, 0.4, 0.5 and 0.6 mol dm^{-3}

Table 1 shows the student's results.

Table 1

Concentration of sodium chloride solution / mol dm^{-3}	% of cells that are plasmolysed
0.1	0
0.2	6
0.4	42
0.5	74
0.6	94

0 2 . 1 Describe how the student should sample the cells.

[2 marks]

Do not write outside the box

0 2 . 2 Explain the results for 0.2 mol dm^{-3} sodium chloride solution.

[3 marks]

0 2 . 3 Draw a graph of the student's results.

Use the data from **Table 1**.

[3 marks]

Do not write outside the box

0 2 . 4 'Incipient plasmolysis is when 50% of the cells are plasmolysed.'

Determine the sodium chloride concentration that causes incipient plasmolysis.

Use data from your graph in Question **02.3**.

[1 mark]

Concentration of sodium chloride = _____ mol dm^{-3}

0 2 . 5 The student's teacher says that the concentration of sodium chloride for incipient plasmolysis may not be accurate.

Describe an improvement to the student's method that would give a more accurate concentration.

[2 marks]

_____

_____

_____

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0 2 . 6 The student wants to use methylene blue to stain the onion cells in the 0.6 mol dm^{-3} sodium chloride solution to make them easier to count.

Suggest how using methylene blue could affect the results for the 0.6 mol dm^{-3} sodium chloride slide.

[1 mark]

_____

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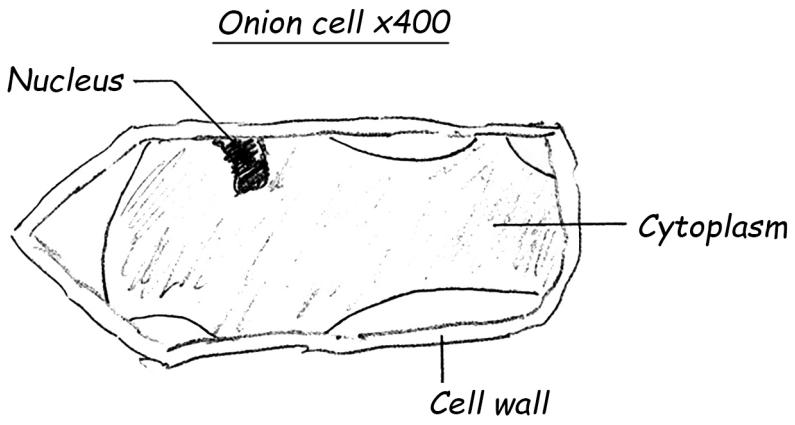
0 2 . 7 The student draws one cell viewed using the microscope.

Her drawing is shown in **Figure 3**.

Figure 3



Give **two** improvements the student should make to her drawing.

[2 marks]

1 _____

_____

_____

2 _____

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14

Turn over for the next question

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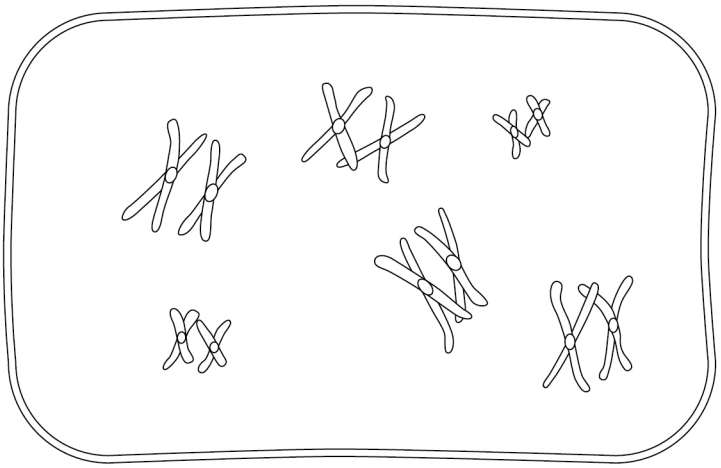
0 3 **Figure 4** shows a diagram of a cell from a plant.

Figure 4



0 3 . 1 State **two** pieces of evidence from **Figure 4** that show the cell is in the first division of meiosis.

[2 marks]

1 _____

_____

2 _____

_____

Do not write outside the box

0 3 . 2 Meiosis is a specialised type of cell division that results in genetic variation between gametes.

Explain **one** way that meiosis results in genetic variation.

[2 marks]

_____

_____

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_____

_____

_____

0 3 . 3 Complete the following passage using the most appropriate words.

[3 marks]

In eukaryotic cells, DNA is linear and is associated with proteins called _____. The DNA and proteins form structures called chromosomes that contain multiple genes.

A gene consists of coding regions called _____ and non-coding regions called _____.

7

Turn over for the next question

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0 4 Each year, ecologists sample the population size of fish in different rivers.

Table 2 shows the estimated population size for each species from one section of a river in 2020.

Table 2

Species name	**Common name**	**Estimated population size in 2020**
Rutilus rutilus	Roach	17
Abramis brama	Bream	9
Leuciscus leuciscus	Dace	16
Leuciscus cephalus	Chub	8
Perca fluviatilis	Perch	12
Sander lucioperca	Zander	4
Esox lucius	Pike	4

0 4 . 1 Calculate the index of diversity for this section of the river.

Use the formula:

$$d = \frac{N(N-1)}{\Sigma n(n-1)}$$

[2 marks]

d = _____

Do not write outside the box

0 4 . 2 Explain why ecologists find it more useful to calculate the index of diversity than to only record the number of species present.

[2 marks]

0 4 . 3 Suggest why the ecologists can only **estimate** the population sizes of the fish in this section of the river.

[1 mark]

0 4 . 4 State, with a reason, if any of the species are closely related.

Use information from **Table 2**.

[1 mark]

6

Turn over for the next question

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0 5 *Staphylococcus aureus* (*S. aureus*) is a common prokaryotic organism.

0 5 . 1 Prokaryotic cells have a cell wall made of murein (a type of peptidoglycan) which is **not** found in the walls of eukaryotic cells.

Name **two** other structures found in prokaryotic cells that are **not** found in eukaryotic cells.

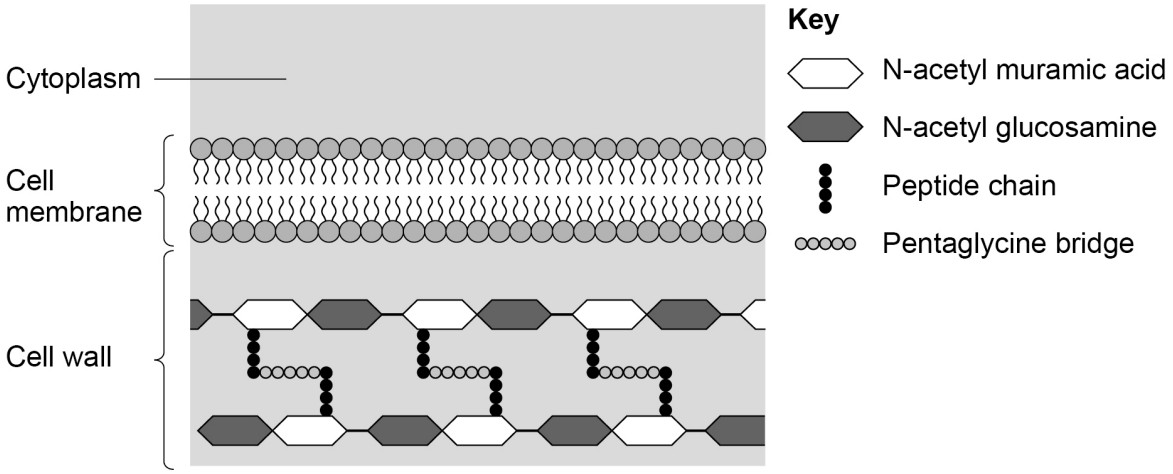
[2 marks]

1 _____

2 _____

Figure 5 shows a cross-section through the outer layer of a prokaryotic cell.

Figure 5



0 5 . 2 Give **one** piece of evidence from **Figure 5** that murein is a polymer.

[1 mark]

_____

_____

_____

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0 5 . 3 Some eukaryotic cells have a cell wall containing cellulose.

Name **one** chemical element found in murein that is not found in cellulose.

Use information from **Figure 5**.

[1 mark]

_____

0 5 . 4 *S. aureus* is a common cause of infections in humans.

A population of *S. aureus* doubles every 24 minutes in standard laboratory conditions.

A scientist investigating *S. aureus* counts 42 cells in 0.005 mm^3 of a solution.

Calculate the number of *S. aureus* cells in 1 mm^3 of the solution after 4 hours.

Give your answer in standard form.

[3 marks]

Number of cells = _____

0 5 . 5 Vancomycin is an antibiotic that can be used to treat *S. aureus* infections.

Vancomycin prevents the formation of pentaglycine bridges between peptide chains in murein.

Suggest how vancomycin prevents the growth of a population of bacteria.

[2 marks]

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9

Turn over ►

Do not write outside the box

0 6 Read the following passage:

Plants are complex multicellular organisms that contain tissues called phloem and xylem.

The phloem transports the products of photosynthesis from the leaves to the rest of the plant. Photosynthetic products transported in the phloem include amino acids and sucrose. Starch is stored as small grains in many parts of plants, including seeds and roots. Starch can easily be converted to maltose.

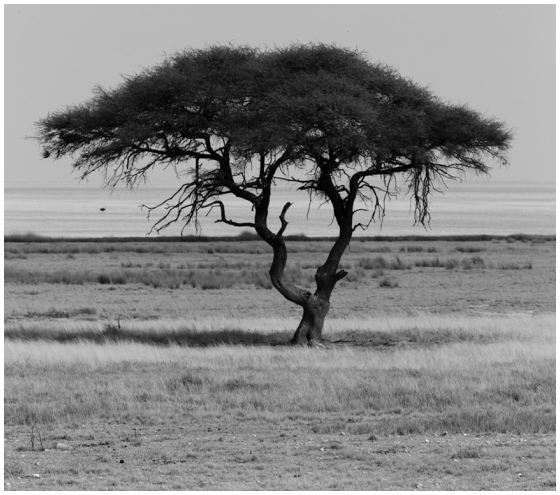
The xylem transports water and mineral ions from the roots to the leaves.

Xerophytic plants are adapted to live in extreme conditions.

Acacias are xerophytic plants found in Australia and Africa. Acacias have many small leaves with thick waxy cuticles. An acacia leaf has a surface area of $0.0008\ m^2$

Figure 6 shows an acacia in the African Savanna.

Figure 6



Palm trees are mesophytic plants. Mesophytic plants are not adapted to extreme conditions. The leaves of mesophytic plants are large to maximise light absorption and thin for rapid diffusion of carbon dioxide towards the chloroplasts. A palm tree leaf has a surface area of $4.5\ m^2$

Use the information from the passage and your own knowledge to answer the questions.

0 6 . 1 Acacias contain phloem and xylem tissues (lines 1 and 2).
Define the term tissue.

[1 mark]

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0 6 . 2 Explain why plants, including acacias, need a specialised tissue to transport the products of photosynthesis.

[2 marks]

_____

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0 6 . 3 Sucrose and maltose (lines 5 and 6) are both disaccharides, each formed by joining two monosaccharides together.

Give **two** other similarities and **one** difference between the structures of sucrose and maltose.

[3 marks]

Similarity 1 _____

_____

Similarity 2 _____

_____

Difference _____

_____

0 6 . 4 Acacias are xerophytic plants (line 9).

Name **one** environmental condition that xerophytic plants are adapted for.

[1 mark]

_____

0 6 . 5 Calculate the ratio of the area of a palm tree leaf to an acacia leaf.

Give your answer in the form **x**:1
x should be given to 2 significant figures.

[1 mark]

Answer = _____ :1

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0 6 . 6 Acacias have small leaves with thick, waxy cuticles (lines 9 and 10).

Suggest why having small leaves and thick waxy cuticles could be a **disadvantage** to acacias.

[2 marks]

0 6 . 7 Leaves contain a mixture of pigments. Different plant species may have different combinations of pigments.

A student extracts the pigments from the leaves of two different plants, one xerophytic and one mesophytic.

Describe how the student could use chromatography to compare the pigments.

[5 marks]

15

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0 7 Humans take air into the lungs where oxygen combines with haemoglobin in the blood to be transported to all the cells of the body.

0 7 . 1 Describe how the diaphragm causes air to move into the lungs.

[2 marks]

0 7 . 2 Describe the structure of haemoglobin.

[2 marks]

Question 7 continues on the next page

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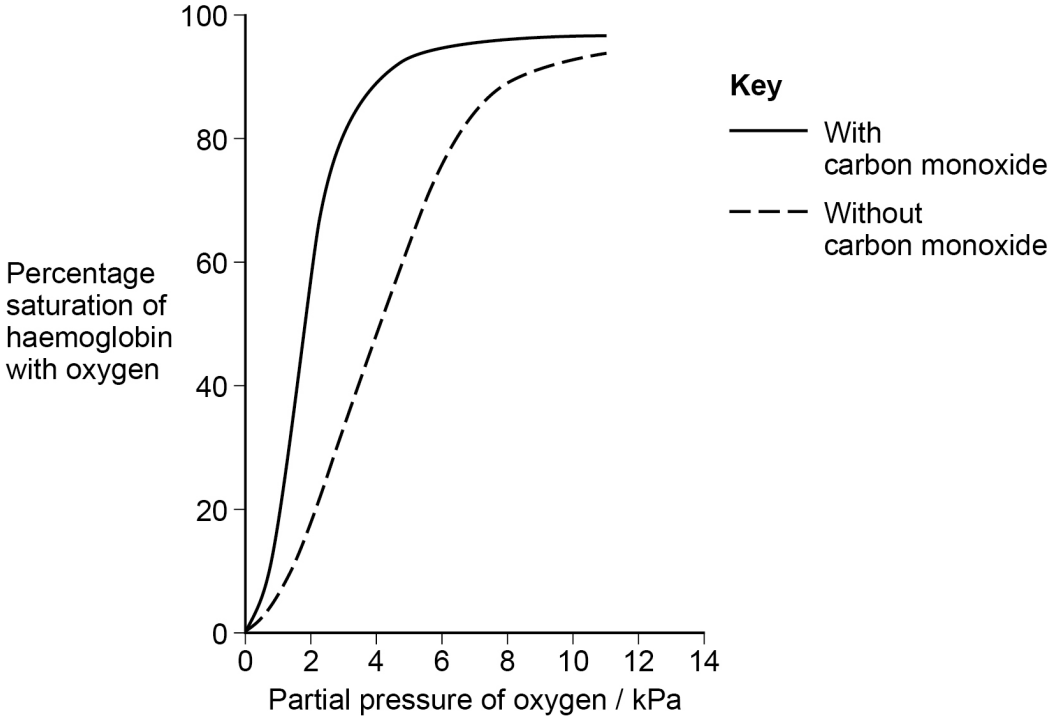
Exhaust fumes from motor vehicles contain the gas carbon monoxide.

Carbon monoxide is poisonous if inhaled.

Carbon monoxide binds to haemoglobin.

Figure 7 shows the effect of carbon monoxide on an oxygen dissociation curve.

Figure 7



0 7 . 3 **Figure 7** shows that carbon monoxide causes the oxygen dissociation curve to shift to the left.

Explain how this affects the supply of oxygen to the tissues.

[2 marks]

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0 7 . 4 Carbon monoxide attaches to oxygen-binding sites on haemoglobin.

Carbon monoxide poisoning is treated in hospital using pure oxygen.

Explain why the binding of carbon monoxide to haemoglobin is an example of competitive inhibition.

[2 marks]

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8

END OF QUESTIONS

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