OXFORD
INTERNATIONAL
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Please write clearly in block capitals.

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I declare this is my own work.

INTERNATIONAL AS
BIOLOGY (9610)

Unit 1 The Diversity of Living Organisms

Monday 3 January 2022 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	
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7	
8	
TOTAL	

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ANSWER IN THE SPACES PROVIDED

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

0 1 **Table 1** shows the number of carbon atoms found in some biological molecules.

Table 1

Molecule	Number of carbon atoms
Amino acid	2 to 11
Fructose	6
Glucose	
Ribose	
Sucrose	12

0 1 . 1 Complete **Table 1** to show the number of carbon atoms in glucose and ribose.

[2 marks]

0 1 . 2 Name **one** chemical element that is always found in an amino acid molecule but not in the other molecules shown in **Table 1**.

[1 mark]

_____

0 1 . 3 Give the reason why the number of carbon atoms can vary between different amino acids.

[1 mark]

_____

0 1 . 4 Describe a biochemical test that a student could use to show that sucrose is a non-reducing sugar.

[3 marks]

_____

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7

Turn over ►

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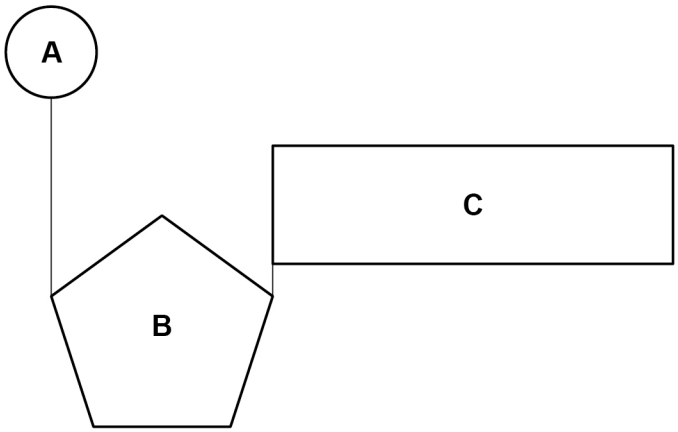
0 2 DNA is a polymer made of nucleotides.

Figure 1 shows the structure of one DNA nucleotide.

Figure 1



0 2 . 1 Name the parts of the structure labelled **A**, **B** and **C** in **Figure 1**.

[3 marks]

A _____

B _____

C _____

0 2 . 2 A section of DNA containing 1000 base pairs has a total length of 0.34 μm

In a human cell, the DNA in the nucleus contains 3.2×10^9 base pairs.

Calculate the length of DNA found in the nucleus.

Give your answer in millimetres (mm).

[2 marks]

Length of DNA = _____ mm

Do not write outside the box

0 2 . 3 The DNA in the mitochondria of a cell is shorter than the DNA in the nucleus.

Describe **two** other structural differences between the DNA in the mitochondria and the DNA in the nucleus.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 4 Describe the process of semi-conservative replication of DNA.

[5 marks]

_____

_____

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12

Turn over for the next question

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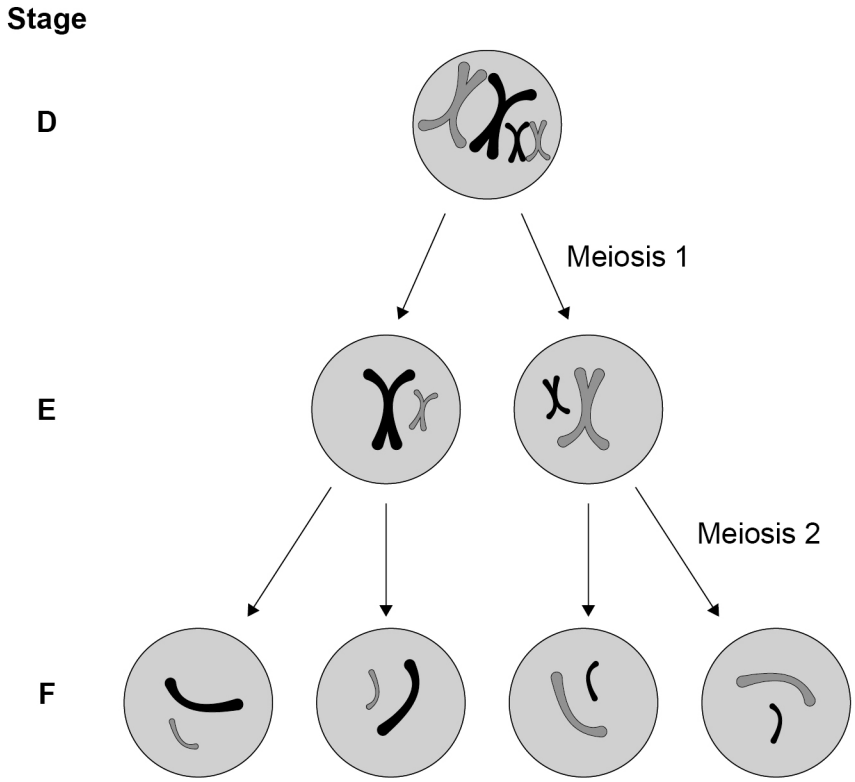
0 3 **Figure 2** shows the chromosomes in the nuclei of cells at different stages of meiosis.

Figure 2



Use the information in **Figure 2** to complete the following questions.

0 3 . 1 **Table 2** has information about the cell at stage **D**.

Complete **Table 2** by giving the number of chromosomes per cell and the mass of DNA per cell for stage **E** and for stage **F**.

[2 marks]

Table 2

Stage	Number of chromosomes per cell	Mass of DNA per cell / arbitrary units
D	4	800
E		
F		

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0 3 . 2 Describe what happens in meiosis 1 and meiosis 2 to produce 4 **haploid** cells.

Do **not** include processes that contribute to variation in your answer.

[2 marks]

Meiosis 1 _____

_____

_____

_____

Meiosis 2 _____

_____

_____

_____

0 3 . 3 Meiosis contributes to the genetic diversity of a species by producing genetically different daughter cells.

State **one** other process that increases the genetic variation within a species.

[1 mark]

_____

5

Turn over for the next question

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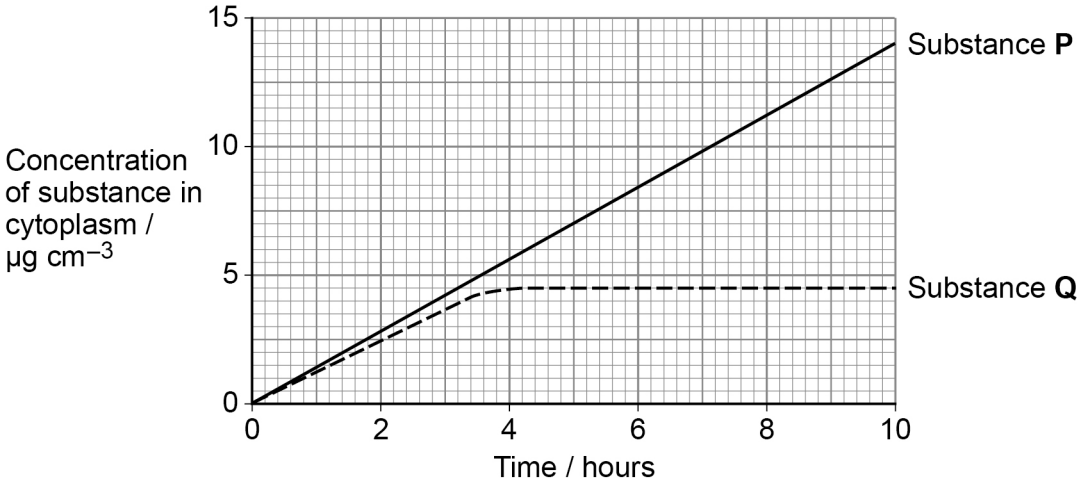
0 4 A scientist compares the uptake of two substances, **P** and **Q**, into human epithelial cells.

The scientist:

- puts the epithelial cells into a solution containing equal concentrations of substance **P** and substance **Q** and keeps them at 37 ºC
- measures the concentration of substance **P** and substance **Q** in the cytoplasm of the cells every 30 minutes for 10 hours.

Figure 3 shows the results.

Figure 3



0 4 . 1 Compare the uptake of substance **P** and substance **Q** during the 10 hours.

Use data from **Figure 3**.

[3 marks]

Do not write outside the box

The scientist concludes that substance **P** is taken up by active transport and substance **Q** is taken up by diffusion.

0 4 . 2 Describe **two** differences between active transport and diffusion.

[2 marks]

1 _____

_____

2 _____

_____

0 4 . 3 Explain how the results support the conclusion that substance **P** is entering the cells by active transport, not diffusion.

Use information from **Figure 3**.

[2 marks]

_____

_____

_____

_____

_____

_____

0 4 . 4 Explain why the temperature was kept at 37 ºC during the experiment investigating **active transport** in human epithelial cells.

[2 marks]

_____

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9

Turn over for the next question

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0 5 Humans have specialised gas exchange surfaces to ensure the efficient supply of oxygen to their respiring cells.

0 5 . 1 The body of a human has a skin surface area of 2.0 m^2 and a total volume of 0.062 m^3.

Calculate the surface area to volume ratio of a human.

Give your answer to 2 significant figures.

[2 marks]

Surface area : volume = _____ : 1

0 5 . 2 Bacteria have a surface area to volume ratio of approximately 6 000 000 : 1

Humans need a specialised gas exchange system but bacteria do not.

Explain why bacteria do **not** need a specialised gas exchange system.

[2 marks]

_____

_____

_____

_____

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Do not write outside the box

0 5 . 3 Explain how human lungs maximise the rate of diffusion of oxygen into the blood.

[3 marks]

7

Turn over for the next question

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0 6 A scientist investigates the roles of organelles in the synthesis and transport of polypeptides through cells.

The scientist:

- isolates cells and incubates them in a liquid containing radioactively labelled amino acids
- leaves the cells for 80 minutes so that they have time to absorb the radioactively labelled amino acids and synthesise polypeptides
- measures the radioactivity of 3 different types of organelle at 5-minute intervals
- calculates the percentage of the total cell radioactivity in each type of organelle.

0 6 . 1 Explain why the scientist:

[2 marks]

- uses radioactively labelled amino acids

_____

_____

- calculates the radioactivity in each type of organelle as a percentage of the total cell radioactivity.

_____

_____

0 6 . 2 Polypeptides are synthesised from the radioactive amino acids.

Name the stage of protein synthesis that joins amino acids to form polypeptides.

[1 mark]

_____

Do not write outside the box

0 6 . 3 After polypeptides are formed, they are folded.

Describe what happens during folding.

[3 marks]

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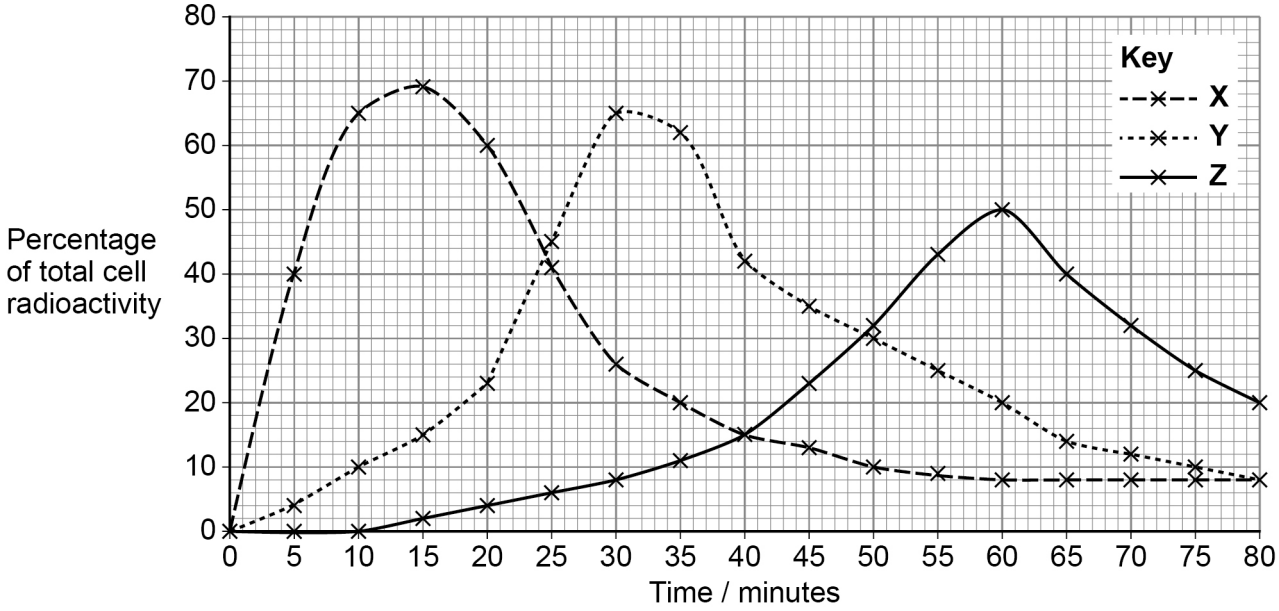
Figure 4 shows the scientist's results for the three different types of organelle (**X**, **Y** and **Z**).

Figure 4



0 6 . 4 Organelle **Y** is the Golgi apparatus.

Identify organelles **X** and **Z** in **Figure 4**.

[1 mark]

Organelle X _____

Organelle Z _____

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0 6 . 5 Give the reason for the increase of radioactivity in the Golgi apparatus (organelle **Y**).

[1 mark]

_____

_____

_____

0 6 . 6 Calculate the mean rate of change in percentage radioactivity from 60 to 80 minutes for organelle **Z**.

Use data from **Figure 4**.

[1 mark]

Change in percentage radioactivity = _____ % min^{-1}

0 6 . 7 Suggest why the radioactivity in organelle **Z** decreased from 60 to 80 minutes.

[2 marks]

_____

_____

_____

_____

_____

_____

11

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0 7 In many countries, dairy milk is a food source that contains nutrients including triglycerides. Milk needs to be stored correctly so that it does not start to decompose.

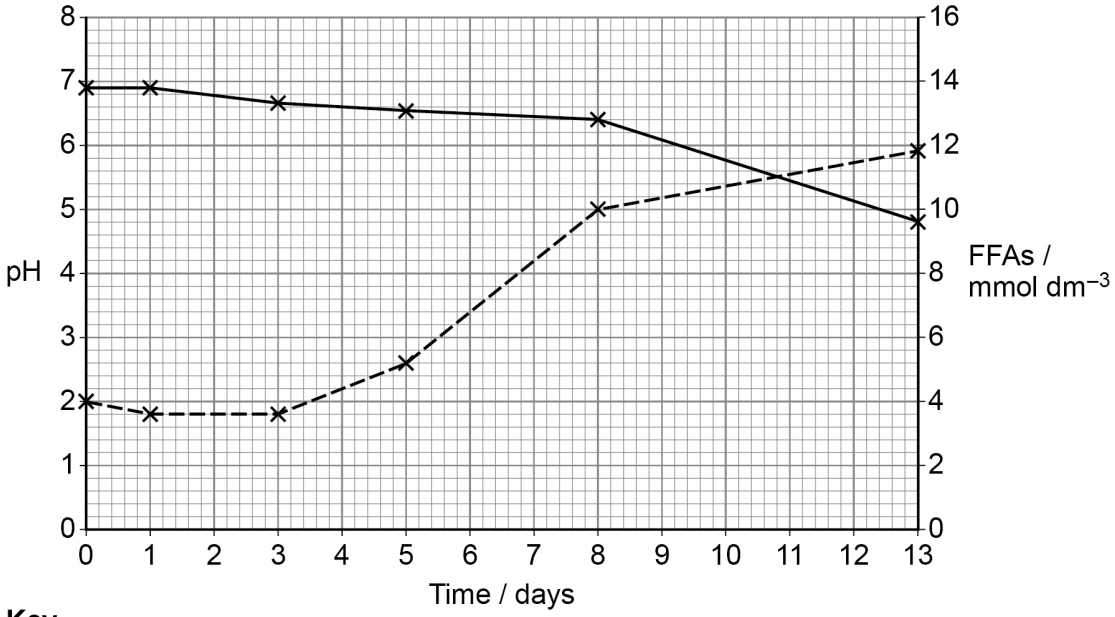
During decomposition, the triglycerides are hydrolysed, releasing free fatty acids (FFAs). Hydrolysis of the triglycerides is catalysed by enzymes in the milk.

Milk can be pasteurised so that it can be stored for a longer time. Pasteurised milk has been heated to 72 °C for 20 seconds and then rapidly cooled.

Scientists investigate the effect of pasteurisation and storage time on the pH and concentration of FFAs in pasteurised milk and in milk that has **not** been pasteurised.

Figure 5 shows the change in the concentration of FFAs and the pH in milk that has **not** been pasteurised.

Figure 5



Key

—×— pH

– –×– – FFAs / mmol dm^{-3}

0 7 . 1 Use **Figure 5** to calculate the percentage decrease in pH from day 0 to day 13

[2 marks]

Answer = _____ %

Do not write outside the box

0 7 . 2 Give the reason why the pH of the milk decreases from day 0 to day 13

[1 mark]

_____

_____

0 7 . 3 Suggest how the pH may have been measured in this experiment.

[1 mark]

_____

0 7 . 4 Suggest **one** control variable for the scientists' investigation.

[1 mark]

_____

0 7 . 5 The concentration of FFAs did **not** increase after 13 days.

Give **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

Question 7 continues on the next page

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Hydrolysis of the triglycerides in milk is catalysed by lipase enzymes. One type of lipase is found naturally in milk and one type is secreted by bacteria living in the milk.

Table 3 shows the concentration of FFAs and pH during storage of **pasteurised** milk.

Table 3

Time / days	Concentration of FFA / mmol dm^{-3}	pH
0	4.0	6.8
2	4.0	6.8
4	4.0	6.8
6	4.0	6.8
8	4.0	6.8
10	4.1	6.3
12	4.3	6.2

0 7 . 6 Pasteurised milk contains fewer living bacteria than milk that has **not** been pasteurised.

Explain the differences in results between **Figure 5** (on page 16) and **Table 3**.

[2 marks]

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0 7 . 7 The lipase enzyme naturally present in milk that has **not** been pasteurised can be extracted, and the effect of its concentration on rates of reaction can be investigated.

Describe an experiment to investigate the effect of lipase concentration on the rate of triglyceride hydrolysis.

[5 marks]

14

Turn over for the next question

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0 8 Read the following passage:

The gentoo penguin (*Pygoscelis papua*) shares the same taxonomic group with three other *Pygoscelis* species. Gentoo penguins are found in breeding colonies spread across many of the sub-Antarctic islands as well as the Antarctic Peninsula. Over time, these breeding colonies have become geographically isolated and gentoo penguins from separate colonies can no longer interbreed. 5

A recent study collected data about the genetic diversity of gentoo penguins from four separate colonies. The data were used to propose a new evolutionary tree to understand the relationship between the different populations. Additional evidence was collected using museum specimens of penguins from the four colonies. Measurements of the beak size and body size of these museum specimens were taken and compared. The study concluded that there are enough physical and genetic differences between the populations to classify them as four separate species. The scientists believe that this reclassification will give conservationists a better chance of protecting the diversity of gentoo penguins. 10

There is debate over whether this study is correct in proposing the existence of four separate species as it does not give enough evidence to support the general concept of a species. 15

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

0 8 . 1 The gentoo penguin (*Pygoscelis papua*) shares the same taxonomic group with three other *Pygoscelis* species (lines 1–2).

Explain what this information tells you about the evolution and classification of these four species.

[2 marks]

Do not write outside the box

0 8 . 2 A recent study collected data about the genetic diversity of gentoo penguins (lines 6–7).

Give **three** ways that genetic diversity between the separate colonies of gentoo penguins could be compared.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 8 . 3 Suggest **two** reasons why the study used measurements taken from museum specimens and not measurements from penguins in the wild (lines 8–11).

[2 marks]

1 _____

_____

2 _____

_____

0 8 . 4 Scientists say that classifying the penguins as four separate species gives conservationists a better chance of protecting their diversity (lines 13–14).

Suggest why.

[1 mark]

_____

_____

_____

Question 8 continues on the next page

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0 8 . 5 Suggest what further evidence would be needed to prove that the four populations of penguins are separate species.

[2 marks]

10

END OF QUESTIONS

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