Please write clearly, in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature _____

AS
BIOLOGY

Paper 2

Specimen materials (set 2) 1 hour 30 minutes

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

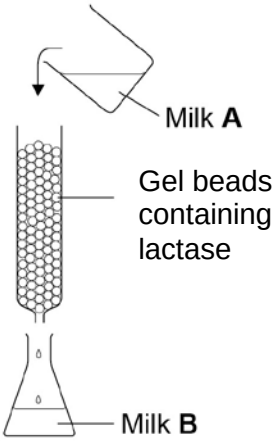
Instructions
- Use black ink or black ball-point pen.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

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

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

0 1 Many humans are unable to digest lactose. A scientist investigated the production of lactose-free milk. He produced gel beads containing the enzyme lactase and placed the beads in a column. He poured milk (Milk **A**) into the column and collected the milk (Milk **B**) after it had moved through the column over the beads. This is shown in **Figure 1**.

Figure 1



0 1 . 1 Milk **A** contains no glucose. Milk **B** contains glucose. Explain why Milk **B** contains glucose.

[1 mark]

0 1 . 2 The enzyme was trapped within the gel beads. Suggest **one** advantage of trapping the enzyme within the gel beads.

[1 mark]

The scientist varied the flow rate of the milk through the column. The effect of flow rate on the concentration of glucose in Milk **B** is shown in **Table 1**.

Table 1

Flow rate of milk through the column / cm^3 $minute^{-1}$	Concentration of glucose in Milk B / arbitrary units
50	45
100	6

0 1 . 3 Explain the difference in the results in **Table 1**.

[1 mark]

0 1 . 4 The gel beads were all similar sizes. Use the formula below to calculate the volume of one of the beads with a 3.0 mm diameter.

[1 mark]

Volume of sphere = $\frac{4}{3}\pi r^3$

Volume = _____ mm^3

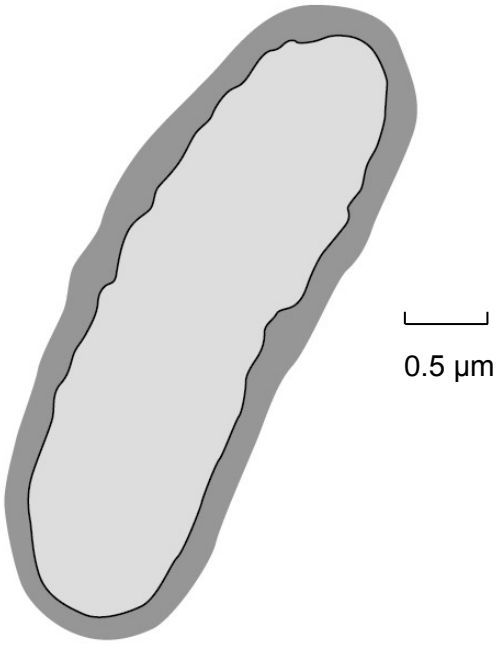
0 1 . 5 Galactose has a similar structure to part of the lactose molecule.
Explain how galactose inhibits lactase.

[2 marks]

6

0 2 A bacterium is shown in **Figure 2**.

Figure 2



0 2 . 1 Calculate the magnification of the image.

[1 mark]

Magnification = _____

0 2 . 2 Complete **Table 2** to show the features of a bacterium and a virus.
Put a tick (✓) in the box if the feature is shown.

[2 marks]

Table 2

Surface	Bacterium	Virus
Cell-surface membrane		
Nucleus		
Cytoplasm		
Capsid		

0 2 . 3 DNA and RNA can be found in bacteria.

Give **two** ways in which the nucleotides in DNA are different from the nucleotides in RNA.

[2 marks]

1 _____

2 _____

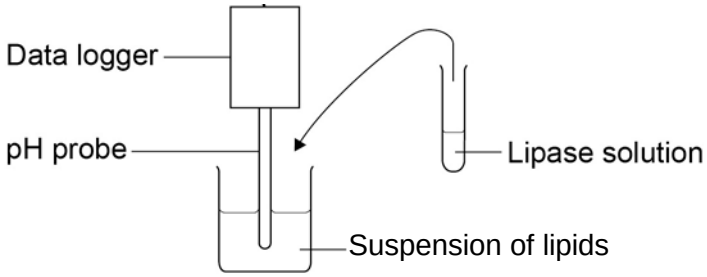
5

Turn over for the next question

0 3 A student investigated the effect of lipase concentration on the hydrolysis of lipids.

He took a beaker containing a suspension of lipids. He placed a pH probe attached to a data logger into the beaker. After 5 minutes, he added the lipase solution. The data logger recorded the pH. The apparatus used is shown in **Figure 3**.

Figure 3



0 3 . 1 The student did **not** add a buffer to the lipase solution.

Explain why.

[1 mark]

0 3 . 2 Give **two** variables the student would have controlled in this investigation.

[2 marks]

1 _____

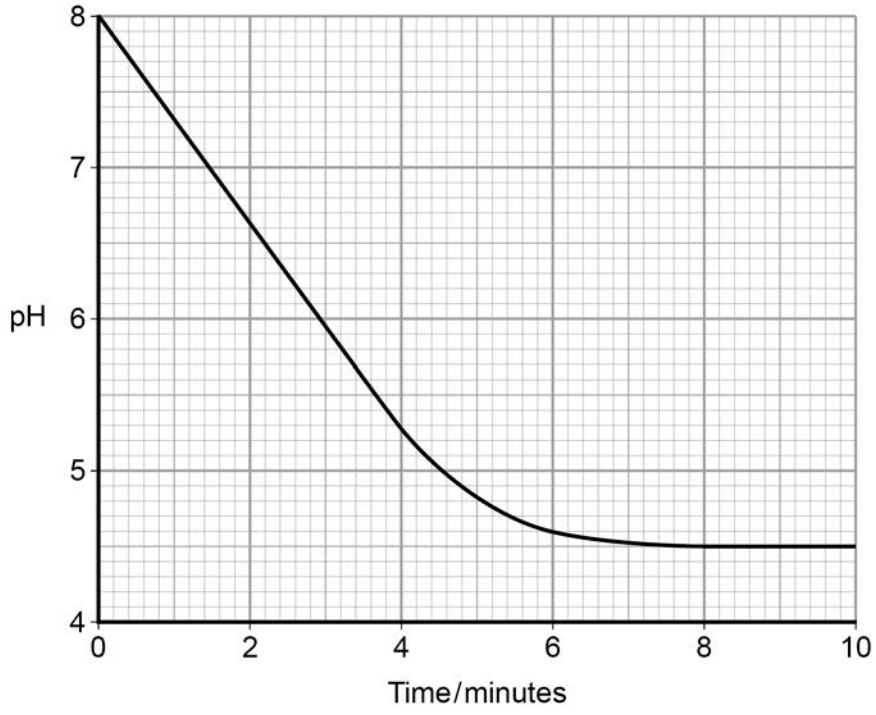
2 _____

0 3 . 3 Give the suitable control for this investigation.

[1 mark]

The data logger recorded the pH. **Figure 4** shows what happened after he added the lipase solution.

Figure 4



0 3 . 4 Draw a tangent on **Figure 4** and use it to calculate the rate of change at 5 minutes.

[2 marks]

Rate of change at 5 minutes = _____ pH minute^{-1}

0 3 . 5 Explain the results shown in **Figure 4**.

[2 marks]

_____

_____

_____

_____

_____

Question 3 continues on the next page

0 3 . 6 The student repeated the experiment with a higher concentration of lipase solution. Describe and explain the results you would expect him to get.

[3 marks]

11

0 4 In a eukaryotic cell, transcription results in a molecule of pre-mRNA that is modified to produce mRNA. In a prokaryotic cell transcription produces mRNA directly.

0 4 . 1 Explain this difference.

[2 marks]

0 4 . 2 Give **two** differences between the structure of mRNA and the structure of tRNA.

[2 marks]

1 _____

2 _____

4

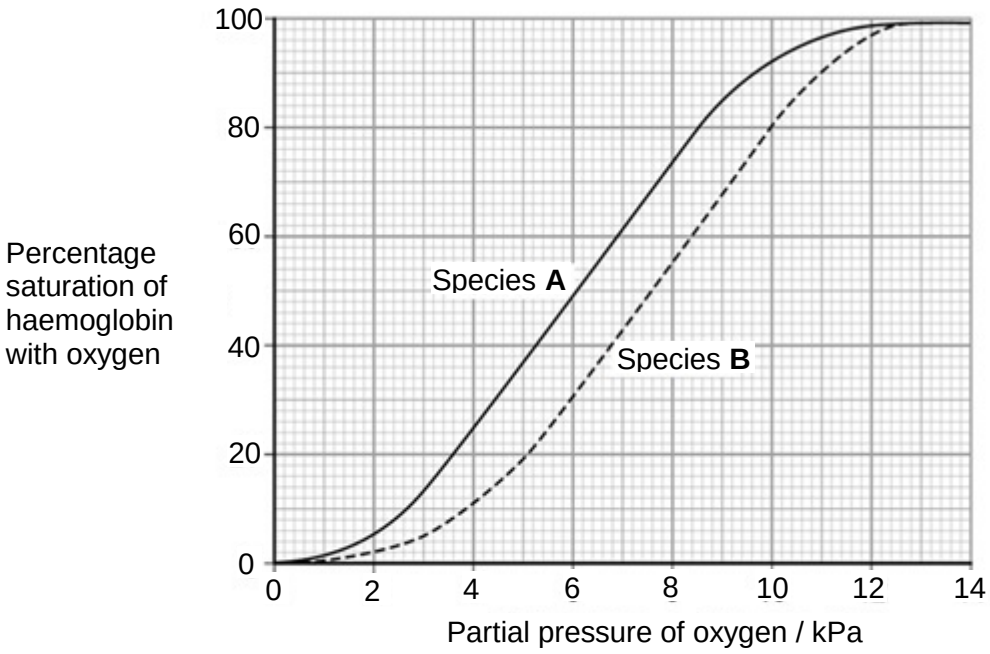
Turn over for the next question

0 5 . 1 Explain **four** ways in which the structure of the aorta is related to its function.

[4 marks]

Figure 5 shows the oxyhaemoglobin dissociation curves for two different species, **A** and **B**.

Figure 5

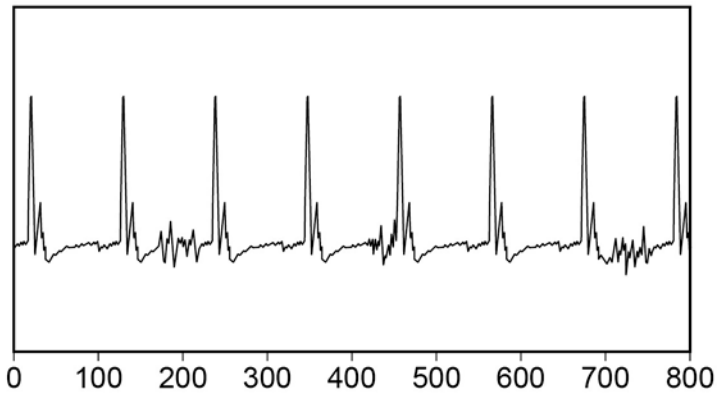


0 5 . 2 Species **B** is more active than species **A**. Use **Figure 5** to explain how the haemoglobin of species **B** allows a greater level of activity.

[4 marks]

0 5 . 3 An electrocardiogram (ECG) shows the electrical activity of the heart. **Figure 6** shows an ECG for an animal of species **B** at rest. Each large spike represents a contraction of the ventricles.

Figure 6



For species **B**, the mean voume of blood leaving the left ventricle during each contraction is 0.03 cm^3.

Calculate the mean volume of blood leaving the left ventricle per minute.

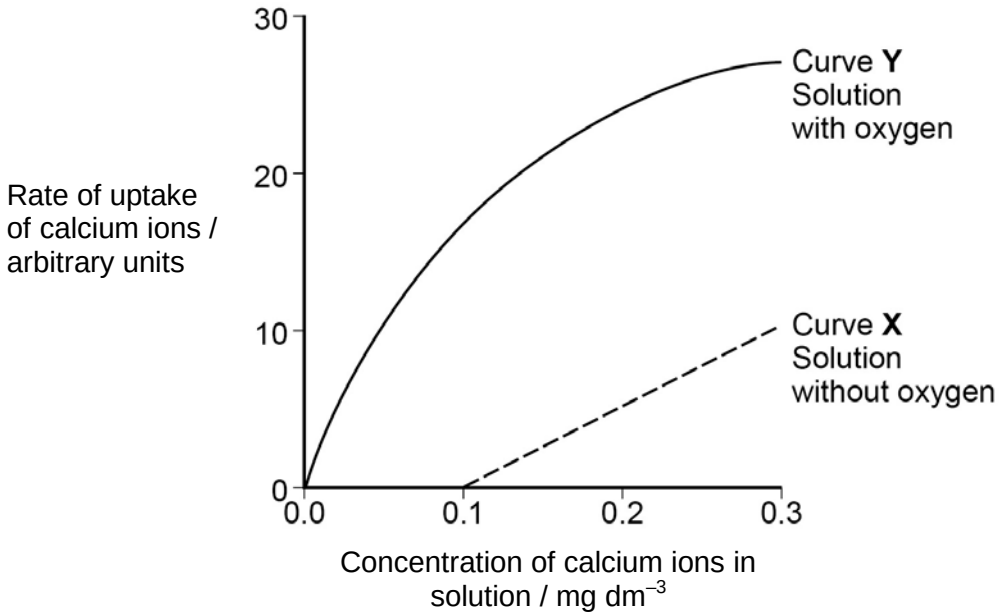
[2 marks]

Volume of blood = _____ cm^3 $minute^{-1}$

10

0 6 A scientist placed plant cells in solutions containing different concentrations of calcium ions. She measured the rate of uptake of calcium ions by plant cells.
Figure 7 shows her results.

Figure 7



0 6 . 1 What can you conclude from **Figure 7** about the processes involved in the uptake of calcium ions by these plant cells?
Use evidence from **Figure 7** to support your answer.

[5 marks]

0 6 . 2 Suggest **one** way in which the scientist could have ensured the solutions she used for curve **X** contained **no** oxygen.

[1 mark]

_____

_____

_____

6

Turn over for the next question

0 7 . 1 Name the monomers from which a maltose molecule is made.

[1 mark]

0 7 . 2 Name the type of chemical bond that joins the **two** monomers to form maltose.

[1 mark]

A student wanted to produce a dilution series of a maltose solution so he could plot a calibration curve. He had a stock solution of maltose of concentration 0.6 mol dm^{-3} and distilled water. He made a series of dilutions from 0.1 to 0.6 mol dm^{-3}.

0 7 . 3 Complete **Table 3** by giving all headings, units and the concentration of the maltose solution produced.

[2 marks]

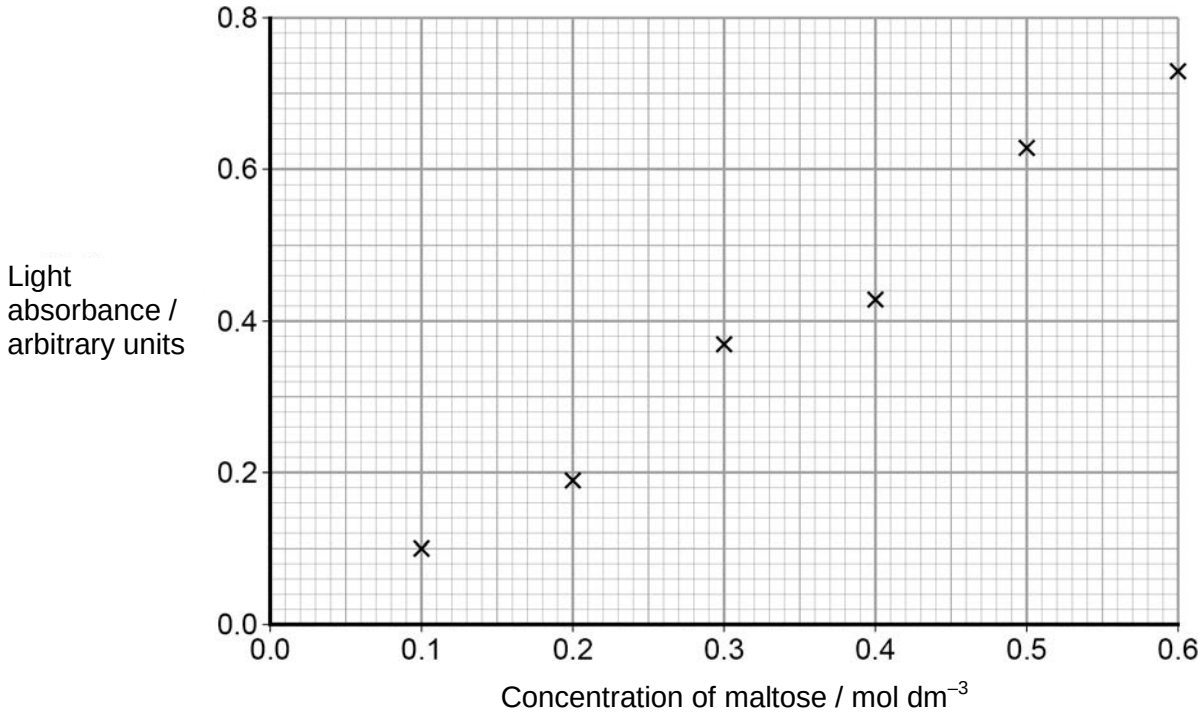
Table 3

Concentration of maltose solution / ……..	**Volume of 0.6 mol dm^{-3} maltose solution / cm^3**	**…….. / ……..**
……	5	10

The student performed the Benedict's test on six maltose solutions ranging from 0.1 mol dm^{-3} to 0.6 mol dm^{-3}. He placed a sample of each solution in a colorimeter and recorded the light absorbance.

His results are shown in **Figure 8**.

Figure 8



0 7 . 4 Explain how you would use **Figure 8** to determine the maltose concentration with a light absorbance of 0.45 arbitrary units.

[2 marks]

6

0 8 A student investigated the species richness and index of diversity of insects in three different habitats, a barley field, a wheat field and a hedge.

Her results are shown in **Table 4**.

Table 4

	Number of individuals of each insect species in each habitat		
Insect species	**Barley field**	**Wheat field**	**Hedge**
a	32	4	34
b	78	0	12
c	0	126	22
d	0	5	12
e	0	0	8
f	0	0	42
g	0	25	13
h	0	10	12
i	0	0	12
j	42	41	0
Species richness			
Total number of insects (N)			

0 8 . 1 Complete **Table 4** for species richness and the total number of insects of each habitat.
[2 marks]

0 8 . 2 Calculate the index of diversity of the wheat field.

[2 marks]

Use the following formula:

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

where N = total number of organisms

and n = total number of organisms of each species.

0 8 . 3 The index of diversity of the insects was higher in the hedge than in the barley field. Suggest why.

[3 marks]

7

Turn over for the next question

0 9 . 1 Name the process by which bacterial cells divide.

[1 mark]

A microbiologist investigated the ability of different plant oils to kill the bacterium *Listeria monocytogenes*. She cultured the bacteria on agar plates. She obtained the bacteria from a broth culture.

0 9 . 2 Describe **two** aseptic techniques she would have used when transferring a sample of broth culture on to an agar plate.
Explain why each was important.

[4 marks]

The microbiologist tested five different plant oils at two different temperatures and determined the minimum concentration of plant oil that killed the *L. monocytogenes.*

Table 5 shows her results.

Table 5

Plant oil	**Minimum concentration of plant oil that killed *Listeria monocytogenes* / percentage**	
	4 °C	**35 °C**
Bay	0.10	0.04
Cinnamon	0.08	0.08
Clove	0.05	0.05
Nutmeg	>1.00	0.05
Thyme	0.02	0.03

0 9 . 3 Which plant oil is least effective at killing *L. monocytogenes* at 35 °C?

[1 mark]

L. monocytogenes is a pathogen of great concern to the food industry, especially in foods stored in refrigeration conditions (4 °C) where, unlike most food-borne pathogens, it is able to multiply. It has been suggested that plant oils, together with refrigeration may help to reduce the growth of *L. monocytogenes*.

0 9 . 4 What conclusions can be drawn about the effectiveness of using plant oils with refrigeration to reduce food-borne infections caused by *L. monocytogenes*?

[3 marks]

Question 9 continues on the next page

0 9 . 5 Plant oils are hydrophobic and can cross the cell-surface membrane of the bacterium. The low temperature of 4 °C can slow the rate of entry of plant oils into the cells.

Suggest how the low temperature slows the rate of entry.

[1 mark]

10

1 0 . 1 Describe the appearance and behaviour of chromosomes during mitosis.

[5 marks]

[Extra space]

Question 10 continues on the next page

1 0 . 2 Describe and explain the processes that occur during meiosis that increase genetic variation.

[5 marks]

[Extra space]

10

END OF QUESTIONS

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