Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS BIOLOGY

Paper 1

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator.

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).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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

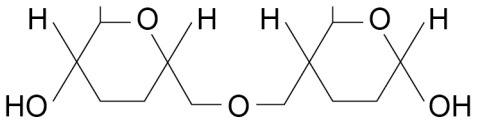
Answer **all** questions in the spaces provided.

Do not write outside the box

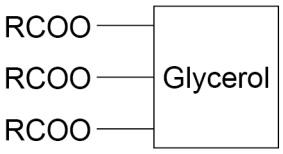
0 1 . 1 **Figure 1** shows the structure of some biological molecules.

Figure 1

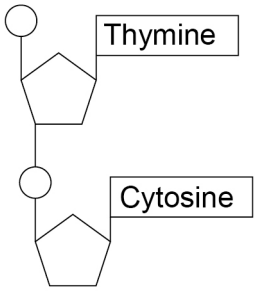
A



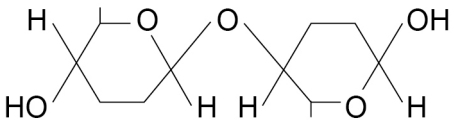
B



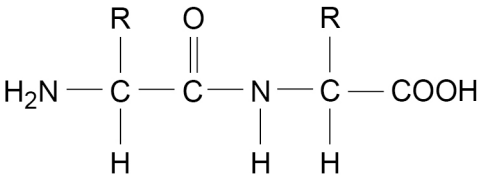
C



D



E



Do not write outside the box

Complete **Table 1** by writing the correct letter, **A**, **B**, **C**, **D** or **E**, in the box next to each statement. Each letter may be used once, more than once, or not at all.

[4 marks]

Table 1

Letter	Statement
	is hydrolysed in the ileum and a product of this hydrolysis is found in micelles
	is formed by a condensation reaction between two α-glucose molecules
	is formed by the action of DNA polymerase
	gives a positive result in an emulsion test

0 1 . 2 Describe the mechanism for the absorption of amino acids in the ileum.

[4 marks]

8

Turn over for the next question

Do not write outside the box

0 2 . 1 Give the **two** types of molecule from which a ribosome is made.

[2 marks]

1 _____

2 _____

0 2 . 2 Complete **Table 2** to give **four** structural differences between a DNA molecule and an mRNA molecule.

[4 marks]

Table 2

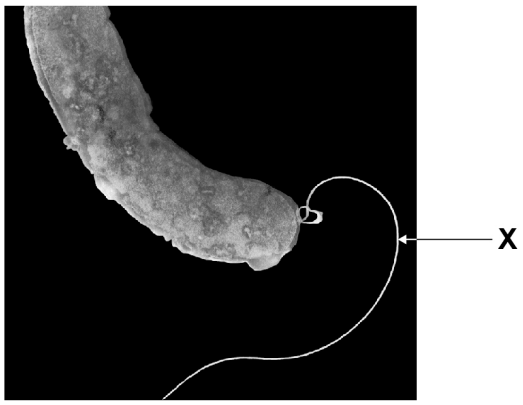
	DNA structure	mRNA structure
1		
2		
3		
4		

6

Do not write outside the box

0 3 . 1 **Figure 2** is an image of a bacterium obtained using a scanning electron microscope.

Figure 2



Name the structure labelled **X**.

[1 mark]

0 3 . 2 **Figure 2** is different from an image of this bacterium obtained using a transmission electron microscope.

Describe and explain **one** difference between these images.

[2 marks]

Description

Explanation

0 3 . 3 The resolution of an image obtained using an electron microscope is higher than the resolution of an image obtained using an optical microscope.

Explain why.

[1 mark]

Question 3 continues on the next page

Do not write outside the box

0 3 . 4 A student determined the size of a cell structure from a photograph obtained using a microscope.

He used a ruler and a calculator and gave the answer in μm

Describe how the student determined the size of the structure.

[2 marks]

0 3 . 5 Name **two** structures found in **all** bacteria that are **not** found in plant cells.

[2 marks]

1 _____

2 _____

0 3 . 6 Name **two** features of HIV particles that are **not** found in bacteria.

Do **not** include attachment protein in your answer.

[2 marks]

1 _____

2 _____

10

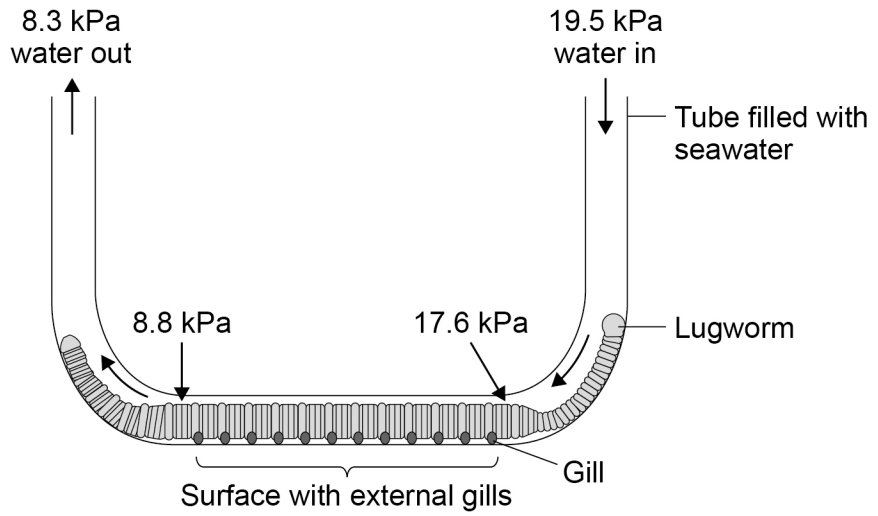
Do not write outside the box

0 4 . 1 Lugworms create tubes in the sand on seashores. The tubes are filled with seawater.

A scientist measured the partial pressure of dissolved oxygen (pO_2) in seawater at different places in a tube with a lugworm inside.

Figure 3 shows her results.

Figure 3



The pO_2 of dissolved oxygen in lugworm blood is < 2.7 kPa

Using the data in **Figure 3**, what can you conclude about the uptake of oxygen over the entire body of the lugworm?

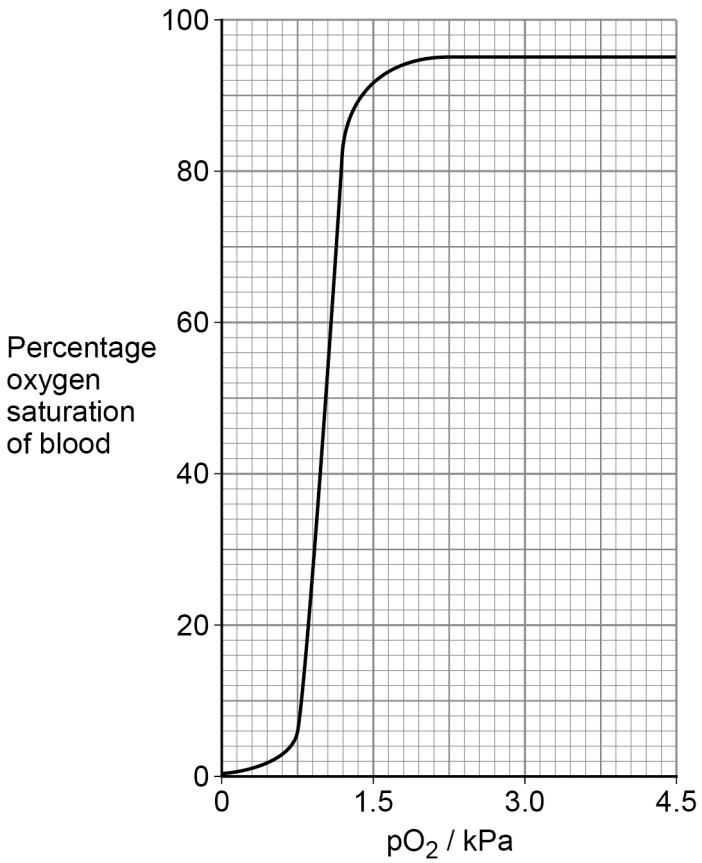
[4 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 2 **Figure 4** shows the oxyhaemoglobin dissociation curve for a lugworm.

Figure 4



Do not write outside the box

The oxygen saturation in the blood of a lugworm is 92%

The lugworm has 0.2 cm^3 of blood.

Calculate the volume of dissolved oxygen in the blood of this lugworm using this equation

$$pO_2 = \frac{CdO_2}{0.000\ 031}$$

CdO_2 is the concentration of dissolved oxygen in the blood, with units cm^3 oxygen per cm^3 of blood.

Show your working.

[3 marks]

Answer _____ cm^3

0 4 . 3 The intensity of the red colour in blood is affected by the pO_2 of the blood.
The intensity of the colour in a solution is measured using a colorimeter.

The scientist used a colorimeter to measure the intensity of red colour in samples of lugworm blood with different pO_2 values. She prepared a calibration curve with this information.

Describe how the scientist will use information from the colorimeter and her calibration curve to determine the pO_2 in a sample of lugworm blood.

[2 marks]

_____

_____

_____

_____

_____

9

Do not write outside the box

0 5 . 1 Describe how monomers join to form the primary structure of a protein.

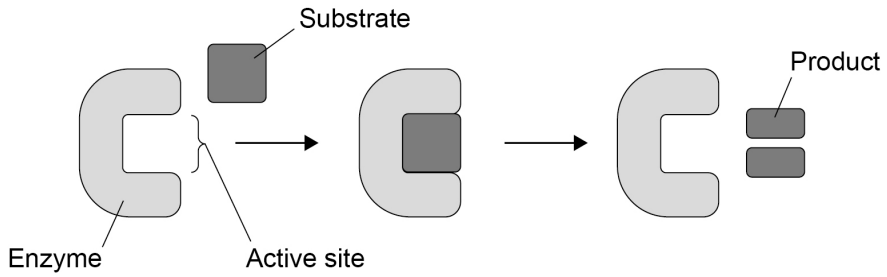
[3 marks]

0 5 . 2 Many proteins are enzymes.

In 1894, a scientist suggested the lock and key model of enzyme action.

Figure 5 shows the lock and key model.

Figure 5



Describe **one** similarity and **one** difference between the induced-fit model of enzyme action and the lock and key model of enzyme action.

[2 marks]

Similarity

Difference

Do not write outside the box

0 5 . 3 State how enzymes help reactions to proceed quickly at lower temperatures.

Do **not** write about active sites in your answer.

[1 mark]

0 5 . 4 The enzyme maltase catalyses the hydrolysis of maltose to glucose.

A scientist investigated maltase activity in two different maltose solutions, **G** and **H**.

For each solution, he measured:

- the total number of glucose molecules produced by complete hydrolysis of the maltose
- the time taken for the complete hydrolysis of the maltose.

Table 3 shows his results.

Table 3

Solution	Total number of glucose molecules produced	Time taken for complete hydrolysis of maltose / s
G	4×10^7	20
H	6×10^8	

Complete **Table 3** by calculating the time taken for the complete hydrolysis of the maltose in solution **H**. Assume the rate of maltase activity is the same in solution **G** and in solution **H**.

Show your working.

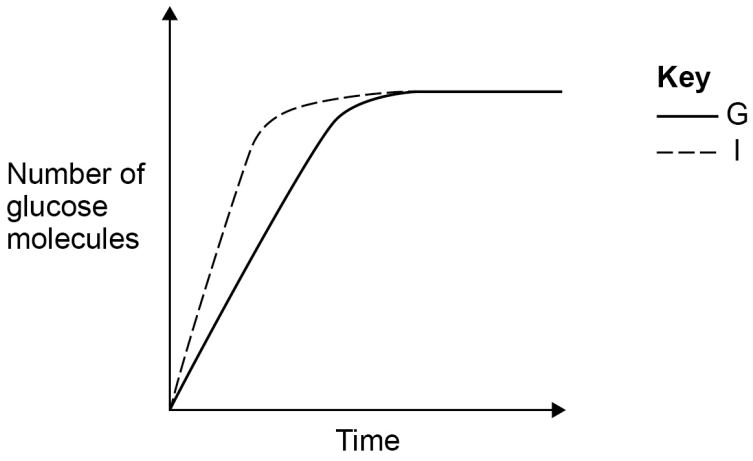
[2 marks]

Question 5 continues on the next page

Do not write outside the box

0 5 . 5 **Figure 6** shows the scientist's results for solution **G**. Curve **I** shows the results of a similar investigation in which he changed one independent variable.

Figure 6



Tick (✓) **one** box next to the statement that describes the independent variable that the scientist changed to give the results shown by curve **I** in **Figure 6**.

[1 mark]

Addition of a competitive inhibitor ☐

Increased maltase concentration ☐

Increased maltose concentration ☐

Reduced temperature ☐

9

Do not write outside the box

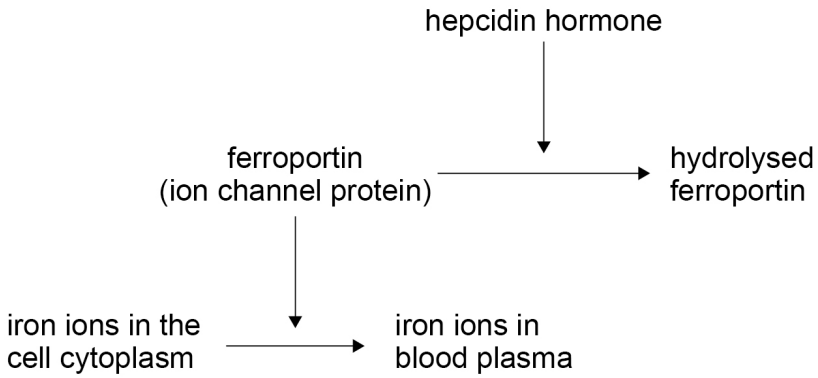
0 6 . 1 Explain a property of iron ions that enables these ions to carry out their role in red blood cells.

[2 marks]

0 6 . 2 The hormone hepcidin controls the iron ion concentration in blood plasma. Hepcidin affects ferroportin, the iron ion channel protein in cell-surface membranes.

Figure 7 shows how hepcidin controls the iron ion concentration in plasma.

Figure 7



People with the disease haemochromatosis do **not** produce hepcidin.

Use information in **Figure 7** to explain why the iron ion concentration is higher in the plasma of people with haemochromatosis.

[3 marks]

Turn over ►

Do not write outside the box

0 6 . 3 The mass of iron ions in the plasma of a person with haemochromatosis is 6104 μg
The iron ion concentration in the plasma of a healthy person is 50 μg dm^{-3}
The volume of blood in each of these people is 4000 cm^3

Calculate the ratio of the mass of iron ions in the plasma of the person with haemochromatosis to the mass of iron ions in the plasma of the healthy person.

[2 marks]

Answer _____

7

Do not write outside the box

0 7 . 1 What is a tumour?

[2 marks]

0 7 . 2 Describe how you would determine a **reliable** mitotic index (MI) from tissue observed with an optical microscope.

Do **not** include details of how you would prepare the tissue observed with an optical microscope.

[3 marks]

Question 7 continues on the next page

Tumours detected under the skin can be a symptom of cancer.
Scientists investigated the link between the MI of tumours and skin cancer in dogs.

They found the MI of tumours in many dogs and recorded:

1. the tumour grade
2. the median survival time after the tumour is detected.

Tumour grade can be measured using this scale:

- grade 1 – low level cancer
- grade 2 – medium level cancer
- grade 3 – high level cancer.

The scientists used a statistical test to calculate the probability (P) of the difference between median survival time in dogs with MI < 5 and dogs with MI > 5 being caused by chance.

Figure 8 and **Table 4** show the scientists' results.

Figure 8

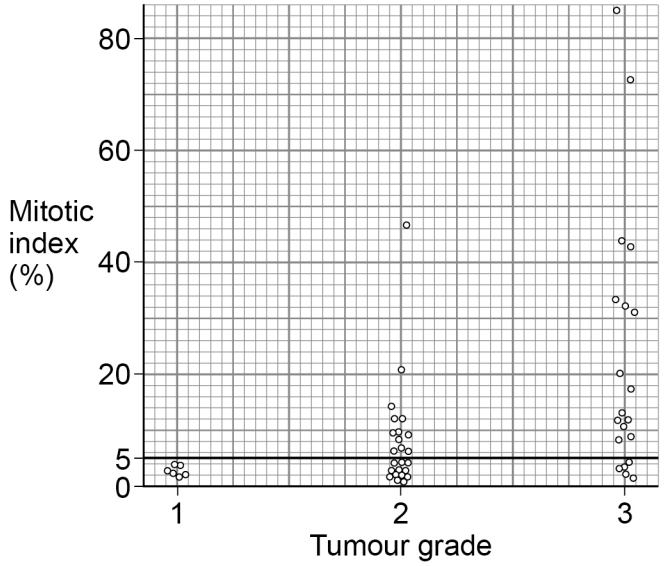


Table 4

Mitotic index (%)	Median survival time / months	Probability (P value)
< 5	70	< 0.001
> 5	2	

Key

◦ represents one dog

Do not write outside the box

0 7 . 3 The scientists concluded that MI > 5 is a reliable indicator of how serious the cancer is in a dog.

Use information from **Figure 8** and **Table 4** to evaluate this conclusion.

[4 marks]

9

Turn over for the next question

Do not write outside the box

0 8 A student investigated the effect of two antimicrobial substances, **J** and **K**, on the growth of *E. coli* bacteria.

She transferred *E. coli* cells using a sterilised pipette to make three identical cultures, **1**, **2**, and **3**. She then added:

- no antimicrobial substance to culture **1**
- antimicrobial substance **J** to culture **2**
- antimicrobial substance **K** to culture **3**.

She incubated the cultures for 24 hours, after which she determined the number of cells per mm^3 in each culture.

0 8 . 1 The student used a sterilised pipette to transfer *E. coli* into each culture.

Suggest why the number of *E. coli* cells per mm^3 in each culture after 24 hours might have been lower if the student had **not** used a sterilised pipette. Explain your answer.

[2 marks]

0 8 . 2 The student diluted 3 cm^3 of culture **1** with 12 cm^3 of water. She observed a sample of this diluted mixture using an optical microscope and counted 24 cells in 0.000 25 mm^3 of the diluted mixture.

Use this information to calculate the number of cells per mm^3 in **undiluted** culture **1**.

[2 marks]

Number of cells = _____ per mm^3

Do not write outside the box

0 8 . 3 After 24 hours, the student compared the number of cells per mm^3 in cultures **1**, **2** and **3**. She found:

- substance **J** killed 80% of the cells
- substance **J** killed twice as many cells as substance **K**.

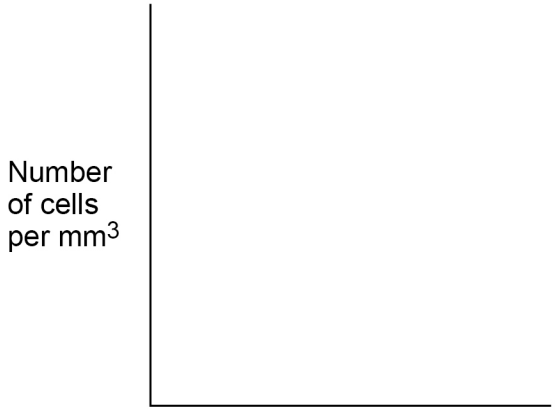
Using the axes shown in **Figure 9**, **sketch** a bar chart showing the results the student obtained from cultures **1**, **2** and **3**.

Do **not** draw a grid on the chart.

Do **not** include figures for the number of cells per mm^3

[3 marks]

Figure 9



7

Turn over for the next question

Do not write outside the box

0 9 Read the following passage.

The placenta is a specialised exchange surface.

In the placenta, substances are exchanged between the blood of a fetus and the blood of its mother. Gas exchange for the fetus occurs in the placenta.

There is also transfer of IgG antibodies in the placenta between the mother's blood and fetal blood. These IgG antibodies protect the fetus against the pathogens that infect its mother during pregnancy. The IgG antibodies can circulate at high concentration in the mother's blood for months or years. A fetus does not produce IgG antibodies.

The UK immunisation programme vaccinates as many babies as possible to protect the UK population against pathogens such as measles viruses and tetanus bacteria. Measles viruses spread quickly from infected people. Despite the efforts of the NHS, there has been a recent increase in the number of children catching measles.

Tetanus bacteria enter the body through skin wounds. Tetanus bacteria do not spread from infected people. In order to develop good immunity against tetanus, children are given three tetanus vaccinations at regular intervals before they reach their first birthday.

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

0 9 . 1 Gas exchange for the fetus occurs in the placenta (line 3).

Describe how the composition of blood in the pulmonary artery of a fetus is different from the composition of blood in the pulmonary artery of its mother.

Give **one** reason for this difference.

[2 marks]

Do not write outside the box

0 9 . 2 Explain how a fetus is protected against the pathogens that infect its mother during pregnancy (lines 5–6).

Do **not** give details of an active immune response in the mother.

[3 marks]

0 9 . 3 Suggest how vaccinating as many babies as possible protects the UK **population** against pathogens such as measles viruses and tetanus bacteria (lines 9–11).

[2 marks]

Protection against measles

Protection against tetanus

Question 9 continues on the next page

Do not write outside the box

0 9 . 4 Suggest why there has been a recent increase in the number of children catching measles (lines 12–13).

[1 mark]

0 9 . 5 Explain why giving children more than one tetanus vaccination develops good immunity against tetanus (lines 15–17).

[2 marks]

10

END OF QUESTIONS

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