AQA

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.

Information
- The marks for the 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	
8	
9	
TOTAL	

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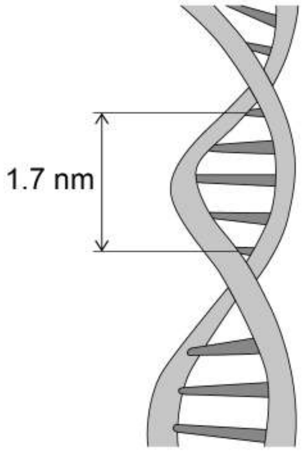
Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows part of a DNA molecule.

Figure 1



0 1 . 1 Name the type of bond between:

[2 marks]

complementary base pairs ____________________

adjacent nucleotides in a DNA strand ____________________

0 1 . 2 The length of a gene is described as the number of nucleotide base pairs it contains.

Use information in **Figure 1** to calculate the length of a gene containing 4.38×10^3 base pairs.

[2 marks]

Answer ________________ nm

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0 1 . 3 Describe **two** differences between the structure of a tRNA molecule and the structure of an mRNA molecule.

[2 marks]

1 ____

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2 ____

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0 1 . 4 In a eukaryotic cell, the structure of the mRNA used in translation is different from the structure of the pre-mRNA produced by transcription.

Describe **and** explain a difference in the structure of these mRNA molecules.

[2 marks]

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Turn over for the next question

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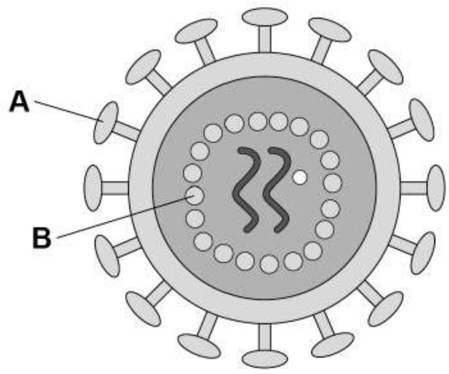
0 2 **Figure 2** shows the structure of the human immunodeficiency virus (HIV).

Figure 2



0 2 . 1 Name structures **A** and **B**.

[2 marks]

A ______________________________

B ______________________________

0 2 . 2 Describe how HIV is replicated.

[4 marks]

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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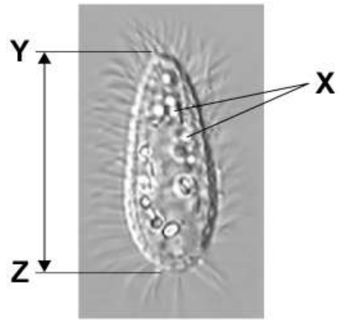
0 3 *Uronema marinum* is a single-celled eukaryotic organism. **Figure 3** is a photograph of *U. marinum* taken through an optical microscope.

Figure 3



0 3 . 1 Explain why it is not possible to determine the identity of the structures labelled **X** using an optical microscope.

[2 marks]

0 3 . 2 *U. marinum* cells ingest bacteria and digest them in the cytoplasm.

Describe the role of **one** named organelle in digesting these bacteria.

[3 marks]

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0 3 . 3 Calculate the actual length of the cell shown between **Y** and **Z** in **Figure 3**.

The magnification of the image is × 900

Give your answer in µm **and** to **2** significant figures.

Show your working.

[2 marks]

Answer ____________ µm

0 3 . 4 In large cells of *U. marinum*, most mitochondria are found close to the cell-surface membrane. In smaller cells, the mitochondria are distributed evenly throughout the cytoplasm. Mitochondria use oxygen during aerobic respiration.

Use this information and your knowledge of surface area to volume ratios to suggest an explanation for the position of mitochondria in **large** *U. marinum* cells.

[2 marks]

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Turn over for the next question

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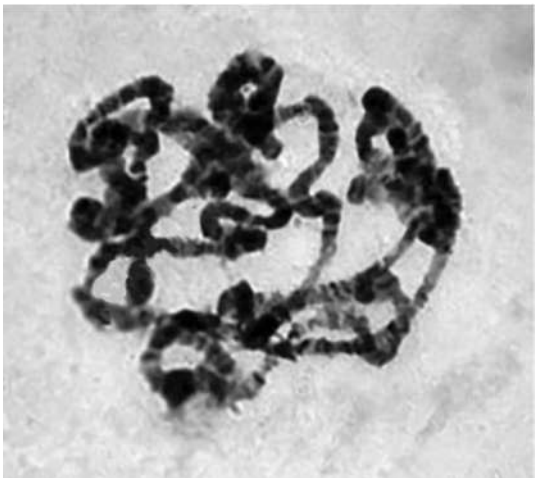
0 4 This question is about mitosis in cells.

Figure 4 shows the arrangement of the genetic material in a cell during prophase.

Figure 4



0 4 . 1 Describe and explain the arrangement of the genetic material shown in **Figure 4**.

[2 marks]

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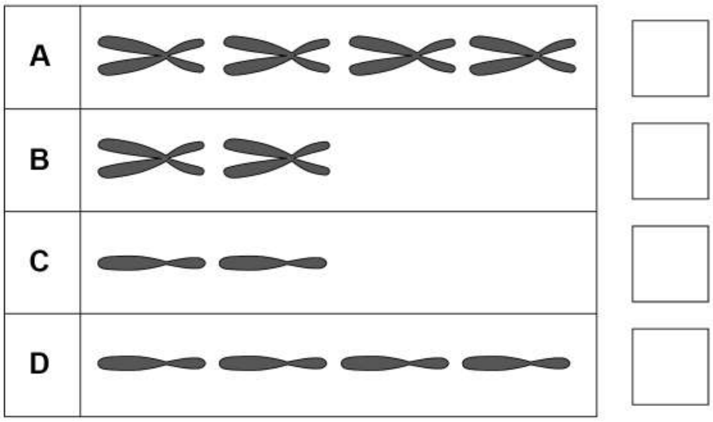
0 4 . 2 The diploid number of chromosomes in the body cell of an insect species is four.

Tick (✓) the box next to the diagram **A**, **B**, **C** or **D** that represents the appearance of chromosomes in a cell during metaphase in this species.

[1 mark]



0 4 . 3 Name the fixed position occupied by a gene on a DNA molecule.

[1 mark]

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0 4 . 4 Describe how a gene is a code for the production of a polypeptide. Do **not** include information about transcription or translation in your answer.

[3 marks]

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Turn over ►

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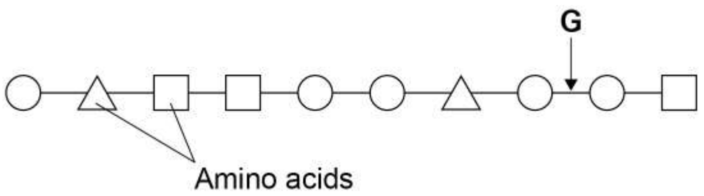
0 5 . 1 Describe how the structure of glycogen is related to its function.

[4 marks]

Figure 5 shows the primary structure of part of a polypeptide. Each shape represents an amino acid. Identical amino acids have the same shape.

Figure 5



0 5 . 2 Name the type of peptidase which will hydrolyse the bond labelled **G** in **Figure 5**.

[1 mark]

0 5 . 3 Give the number of different **R** groups in the polypeptide shown in **Figure 5**.

[1 mark]

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A scientist used an enzyme to digest a polypeptide containing 101 amino acids. The digestion produced a range of smaller polypeptides.

The scientist determined the number of amino acids in each of the polypeptides produced. He also counted the number of polypeptides of each length.

Table 1 shows some of the scientist's results.

Table 1

Number of amino acids in polypeptide	Number of polypeptides of each length
5	2
6	
15	3
20	

0 5 . 4 Use the information in **Table 1** to calculate the number of polypeptides:

[2 marks]

6 amino acids in length ____________________

20 amino acids in length ____________________

8

Turn over for the next question

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0 6 . 1 Give the pathway a red blood cell takes when travelling in the human circulatory system from a kidney to the lungs.

Do **not** include descriptions of pressure changes in the heart or the role of heart valves in your answer.

[3 marks]

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Figure 6 shows a section through two types of blood vessels observed using an optical microscope.

Figure 6

0 6 . 2 Identify the type of blood vessel labelled **M** in **Figure 6**.

Explain your answer.

[2 marks]

Type of blood vessel ______________________________

Explanation ______________________________

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Question 6 continues on the next page

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0 6 . 3 Tissue fluid is formed from blood at the arteriole end of a capillary bed.

Explain how water from tissue fluid is returned to the circulatory system.

[4 marks]

9

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0 7 A meadow is an area of grassland with a wide range of plant and animal species.
A student investigated whether cutting some of the plants in a meadow had any effect on the biodiversity of insects in that meadow.

The student created two sample areas, called plots, in the meadow. Each plot measured 10 m × 5 m

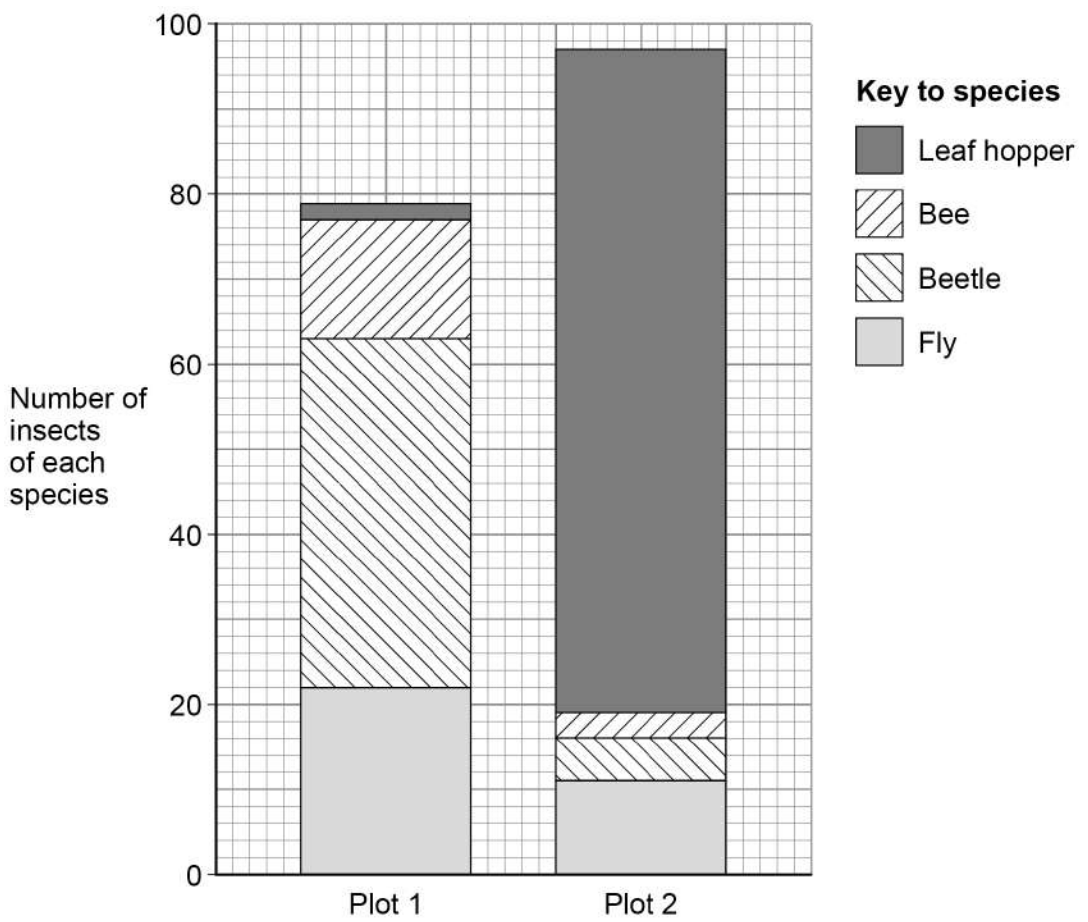
The student:

- did not cut plants in **plot 1**
- cut the plants in **plot 2** with a lawn mower once a week.

After 10 weeks, the student captured all of the organisms of four insect species found in each of these plots.

Figure 7 shows the student's results.

Figure 7



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0 7 . 1 Use the information in **Figure 7** to calculate the index of diversity for the insects captured in **plot 1**.

The formula to calculate the index of diversity (d) is

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

where N is the total number of insects of all species and n is the total number of insects of each species.

Give the answer to **2** significant figures and show your working.

[2 marks]

d ____________________

0 7 . 2 The student concluded that cutting plants with a lawn mower increased the species richness of insects in that meadow.

Use information in **Figure 7** to explain why the student's conclusion is incorrect.

[1 mark]

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Question 7 continues on the next page

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0 7 . 3 The student wanted to use the data from **plot 1** to estimate the total number of the beetle species in the meadow.

Suggest how the student should use the data from **plot 1** and other information provided to estimate the total number of the beetle species in the meadow.

[4 marks]

7

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0 8 An unfertilised chicken egg is a single cell surrounded by a shell.

A student investigated osmosis in chicken eggs. She dissolved the shells of two eggs without damaging the cell contained inside the shells. She then:

- measured the mass of each egg without its shell
- covered one egg with vinegar and covered the other egg with a sugar solution
- kept both eggs covered at 30 °C for 24 hours.

After 24 hours, she measured the mass of each egg.

The student designed **Table 2** and added her results to this table.

Table 2

Initial mass of egg / g	Final mass of egg / g	Name of solution covering egg	Ratio of final mass to initial mass
66	85	Vinegar	1.29:1
60	43	Sugar	0.7:1

0 8 . 1 Suggest **one** improvement to the design of **Table 2** and **one** improvement to the way she presented the data contained in **Table 2**.

[2 marks]

Improvement to design of table ____________________

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Improvement to presentation of data ____________________

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0 8 . 2 Suggest and explain an advantage of carrying out this investigation at 30 °C rather than at 20 °C.

[2 marks]

0 8 . 3 The student concluded from the information in **Table 2** that the water potential of the solution inside the egg is higher than the water potential of the vinegar.

Is the student's conclusion correct? Justify your answer.

[3 marks]

Question 8 continues on the next page.

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0 8 . 4 The student wanted to determine the water potential of chicken eggs. She:

- produced a dilution series of sugar solution
- followed the procedure described on **page 20**.

She calculated the final mass to initial mass ratio of the egg covered in each sugar solution.

How would you advise the student to use her calculated ratios to determine the water potential of the eggs?

In your answer state the independent variable in the student's investigation.

[4 marks]

11

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0 9 Read the following passage.

Kidney cells produce a glycoprotein hormone called erythropoietin (EPO). An EPO molecule contains 165 amino acids and approximately 50% of its mass is carbohydrate.

EPO is transported in the blood and stimulates the bone marrow to produce red blood cells. In this way, enough red blood cells are produced to maintain the blood's oxygen-carrying capacity.

Some athletes choose to increase their blood EPO concentration by injecting synthetic EPO. This practice is called blood boosting and is banned in sport as a form of drug abuse. Athletics' authorities use a programme of drug testing to detect athletes who have injected EPO. In this programme, an ELISA test is performed on urine samples to measure the concentration of EPO in the athlete.

Two types of monoclonal antibody are used in this ELISA test:

- anti-human EPO antibody, prepared by injecting human EPO into mice
- anti-mouse antibody, prepared by injecting anti-human EPO antibody into goats. An enzyme is attached to the anti-mouse antibody.

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

0 9 . 1 Kidney cells produce a glycoprotein called erythropoietin (EPO) (line 1).

Identify **two** organelles in kidney cells that enable the production of EPO.

[1 mark]

1 ____________________

2 ____________________

0 9 . 2 Explain the biological advantage to athletes of injecting synthetic EPO (lines 7–8).

[2 marks]

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0 9 . 3 Describe how mice injected with human EPO produce anti-human EPO antibody (line 14).

[3 marks]

0 9 . 4 Describe the roles of anti-human EPO antibody and anti-mouse antibody with enzyme attached (lines 14–16) in producing a positive result for EPO in the ELISA test.

[3 marks]

Role of anti-human EPO antibody

Role of anti-mouse antibody with enzyme attached

0 9 . 5 Some people object to using monoclonal antibodies in testing programmes. Use information in the passage to suggest why.

[1 mark]

10

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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