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 2

Thursday 25 May 2023 Morning 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	
10	
TOTAL	

Do not write outside the box

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

0 1 . 1 Which statement about the function of ribosomes is correct?

Tick (✓) **one** box.

[1 mark]

- Site of transcription, catalyse the joining of amino acids by hydrolysis reactions ☐
- Site of transcription, catalyse the joining of nucleotides by condensation reactions ☐
- Site of translation, catalyse the joining of amino acids by condensation reactions ☐
- Site of translation, catalyse the joining of nucleotides by hydrolysis reactions ☐

0 1 . 2 Name **two** biological molecules that can be coded for by a gene.

Do **not** include a polypeptide or protein in your answer.

[1 mark]

1 _____

2 _____

Do not write outside the box

0 1 . 3 Scientists investigated the structure of the endoplasmic reticulum.

Table 1 shows some of the scientists' results.

Table 1

Type of endoplasmic reticulum	Percentage of endoplasmic reticulum made of phospholipids
Rough	46.8
Smooth	52.5

Use the data in **Table 1** to suggest how the structure of rough endoplasmic reticulum is different from the structure of smooth endoplasmic reticulum **and** how this is related to their functions.

[3 marks]

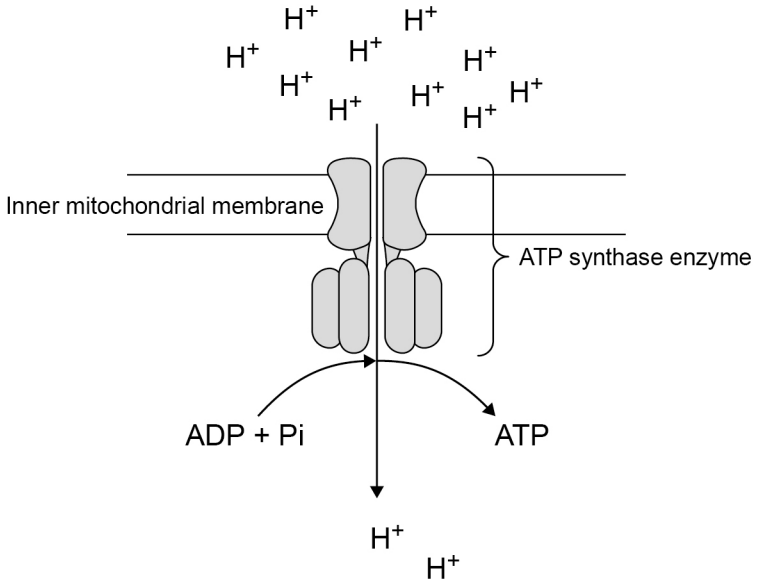
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Turn over for the next question

Do not write outside the box

0 2 . 1 **Figure 1** shows an ATP synthase enzyme in the inner mitochondrial membrane.

Figure 1



Complete the passage with the appropriate terms.

[2 marks]

ATP synthase comprises several polypeptides, so is said to have a _____ structure.

It catalyses the synthesis of an ATP molecule by a _____ reaction; this involves the _____ of a water molecule.

The ATP synthase in **Figure 1** is in a mitochondrion so would catalyse reactions during _____.

Do not write outside the box

0 2 . 2 As shown in **Figure 1**, ATP synthase has two functions.

- It catalyses the synthesis of ATP.
- It allows the movement of H^+ ions.

Suggest how the shape of the ATP synthase allows it to have these two functions.

Explain your answers.

[4 marks]

Catalyses the synthesis of ATP

Allows the movement of H^+ ions

6

Turn over for the next question

Do not write outside the box

0 3 Galacto-oligosaccharides (GOS) are polymers of galactose.

0 3 . 1 Explain why GOS are described as polysaccharides.

[2 marks]

0 3 . 2 Give **two** differences between the structures of GOS and lactose.

[2 marks]

1

2

0 3 . 3 Explain why amylase produced in the human digestive system does not digest GOS.

[2 marks]

Do not write outside the box

0 3 . 4 Prebiotics are foods used to promote good health in humans.

Prebiotics stimulate the growth of 'healthy' bacterial populations in the human digestive system.

The bacteria in these 'healthy' populations produce enzymes that hydrolyse GOS.

Suggest how GOS can work as a prebiotic.

[3 marks]

9

Turn over for the next question

Do not write outside the box

0 4 . 1 This question is about the flow of blood into and through the heart.

Add the numbers 1 to 6 to **Table 2** to give the order of structures through which blood will pass as it enters the heart and flows through the left ventricle.

Use each number only once. Number **4** has been done for you.

[2 marks]

Table 2

Aorta		Pulmonary vein	
Left atrioventricular valve		Left semi-lunar valve	
Right atrioventricular valve		Vena cava	
Left atrium		Left ventricle	**4**
Right atrium		Right ventricle	
Pulmonary artery		Right semi-lunar valve	

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Question 4 continues on the next page

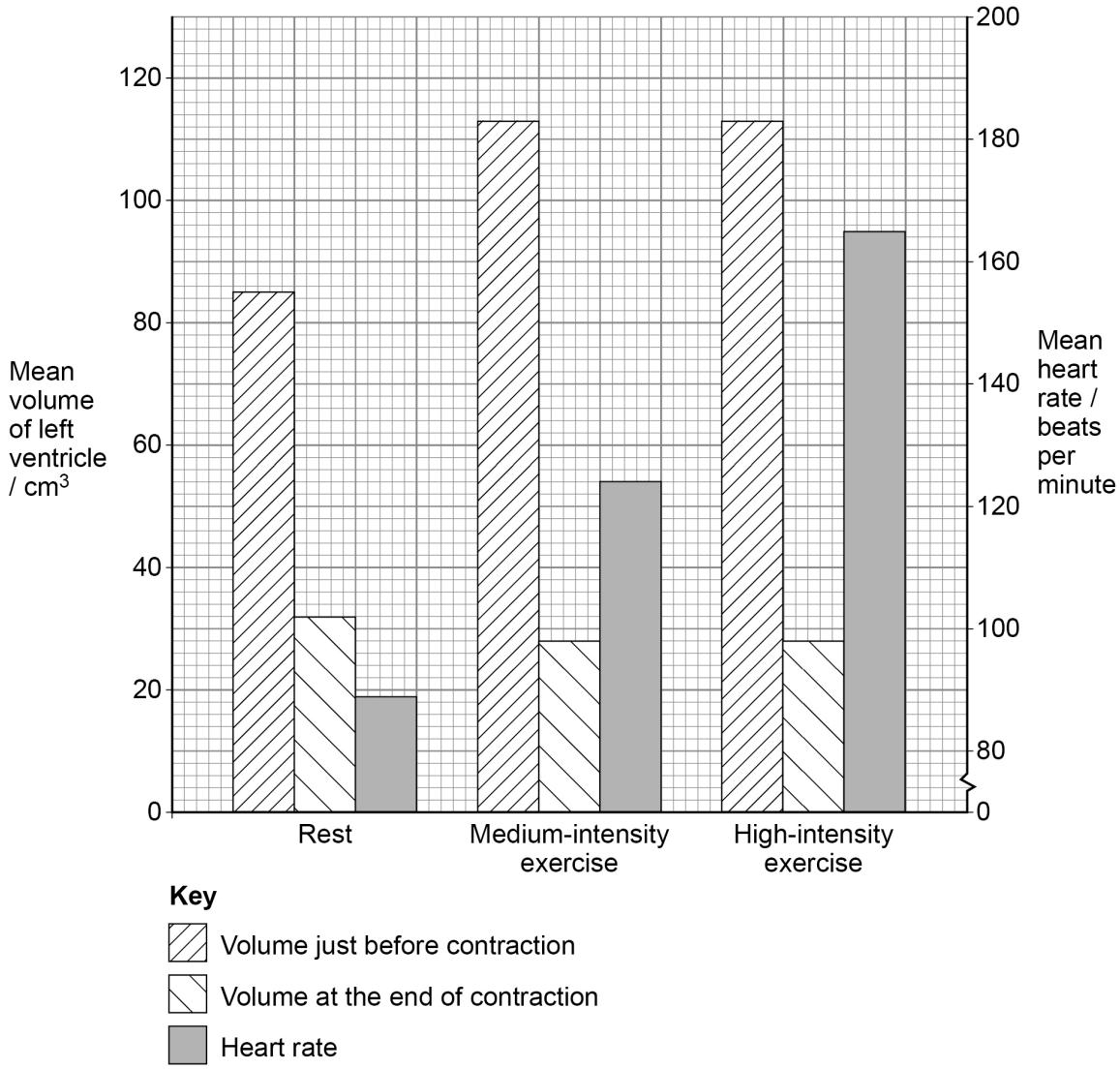
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ANSWER IN THE SPACES PROVIDED

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0 4 . 2 Scientists investigated the heart activity of humans at rest, during medium-intensity exercise and during high-intensity exercise.

Figure 2 shows the scientists' results.

Figure 2



Do not write outside the box

Stroke volume = volume of blood leaving a ventricle with each contraction
Cardiac output = stroke volume × heart rate

Use all the information to describe what causes the increase in cardiac output:

- from rest to medium-intensity exercise
- from medium-intensity exercise to high-intensity exercise.

You do **not** need to calculate cardiac output to answer this question.

[2 marks]

Rest to medium-intensity exercise

Medium-intensity exercise to high-intensity exercise

0 4 . 3 Name the type of blood vessel that controls blood flow to muscles **and** explain how these blood vessels change blood flow during exercise.

[3 marks]

Name of blood vessel

Explanation

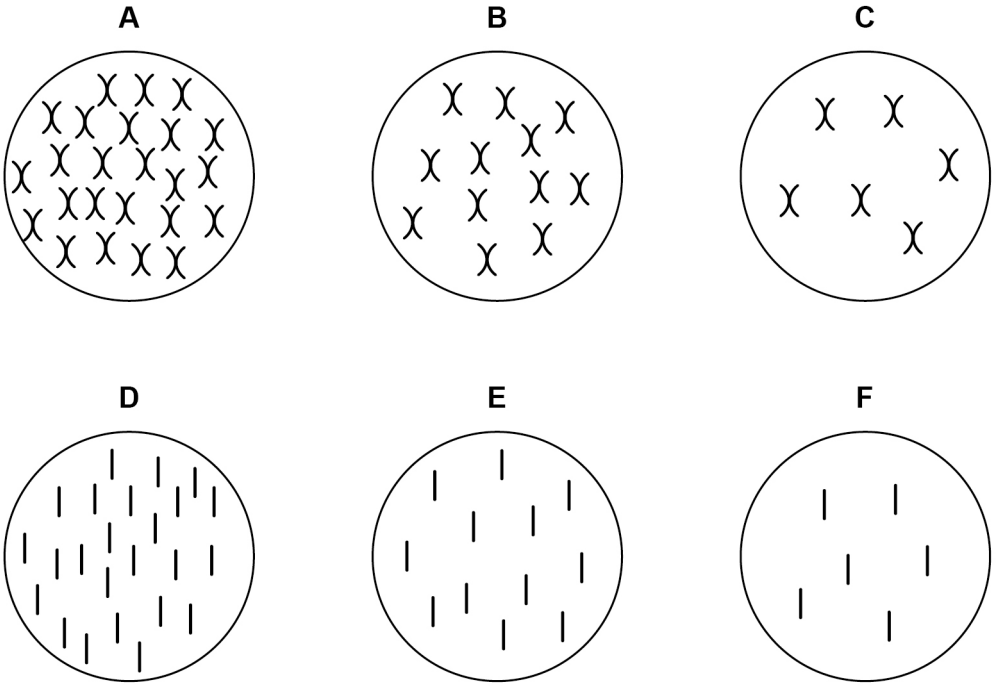
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Turn over for the next question

Do not write outside the box

0 5 . 1 **Figure 3** shows diagrams of six possible arrangements of chromosomes in cells.

Figure 3



Before meiosis, a cell of a rice plant has 12 pairs of homologous chromosomes (24 chromosomes in total).

Give the letter of the diagram from **Figure 3** that correctly shows the chromosome content of rice cells after the first meiotic division and after the second meiotic division.

[2 marks]

After first meiotic division _____

After second meiotic division _____

Do not write outside the box

0 5 . 2 Scientists have produced a mutated rice variety in which there is **no** crossing over.

A population of the mutant rice variety produced by sexual reproduction shows genetic variation. Populations of non-mutant rice varieties also show genetic variation.

Suggest and explain the similarities and differences in the causes of genetic variation within these rice populations.

[3 marks]

5

Turn over for the next question

Do not write outside the box

0 6 . 1 Describe the hydrolysis reactions involved in the digestion of triglycerides.

Do **not** write about the activity of lipase.

[2 marks]

0 6 . 2 All mammals produce a lipase called CEL.

CEL digests triglycerides.

CEL is activated by bile salts binding to the enzyme.

Describe **two** other functions of bile salts.

[2 marks]

1

2

Do not write outside the box

0 6 . 3 Mammals feed their young on milk. CEL digests the triglycerides in milk. The ability to produce CEL occurred due to a gene mutation.

Describe how natural selection may have led to all mammals in a population producing CEL.

[4 marks]

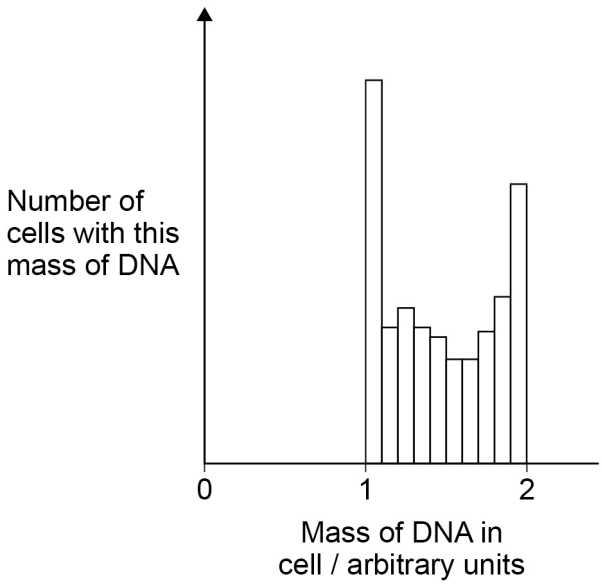
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Turn over for the next question

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0 7 . 1 **Figure 4** shows the mass of DNA present in a group of healthy cells.

Figure 4



Use your knowledge of the cell cycle to explain the results shown in **Figure 4**.

[3 marks]

Do not write outside the box

0 7 . 2 Suggest **one** way **Figure 4** would be different if these cells were tumour cells.

Justify your answer.

[2 marks]

0 7 . 3 Describe the behaviour of chromosomes in prophase and metaphase of mitosis.

[2 marks]

Prophase

Metaphase

Question 7 continues on the next page

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0 7 . 4 During anaphase, the spindle exerts 3×10^{-11} N of force on each chromatid. This force generates 6×10^{-19} W of power.

Calculate the speed of movement, in nm s^{-1}, of one chromatid during anaphase using the following equation:

$$P = F \times V$$

Where P = power in W
F = force in N
V = speed in m s^{-1}

Show your working.

[2 marks]

Answer _____ nm s^{-1}

9

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0 8 . 1 A student investigated a method for estimating the concentration of protein in solution by using a measure of the density of the solutions.

Copper sulfate solutions of different concentration have known densities, so they can be used to measure the density of other solutions.

The student prepared a dilution series of a copper sulfate solution.

Complete **Table 3** by giving all headings, units and volumes required to make 30 cm^3 of the concentration of the copper sulfate solution shown.

[2 marks]

Table 3

Concentration of copper sulfate solution / g kg^{-1}	**Volume of 100 g kg^{-1} copper sulfate solution /** _____	**Volume of water /** _____
75	_____	_____

Question 8 continues on the next page

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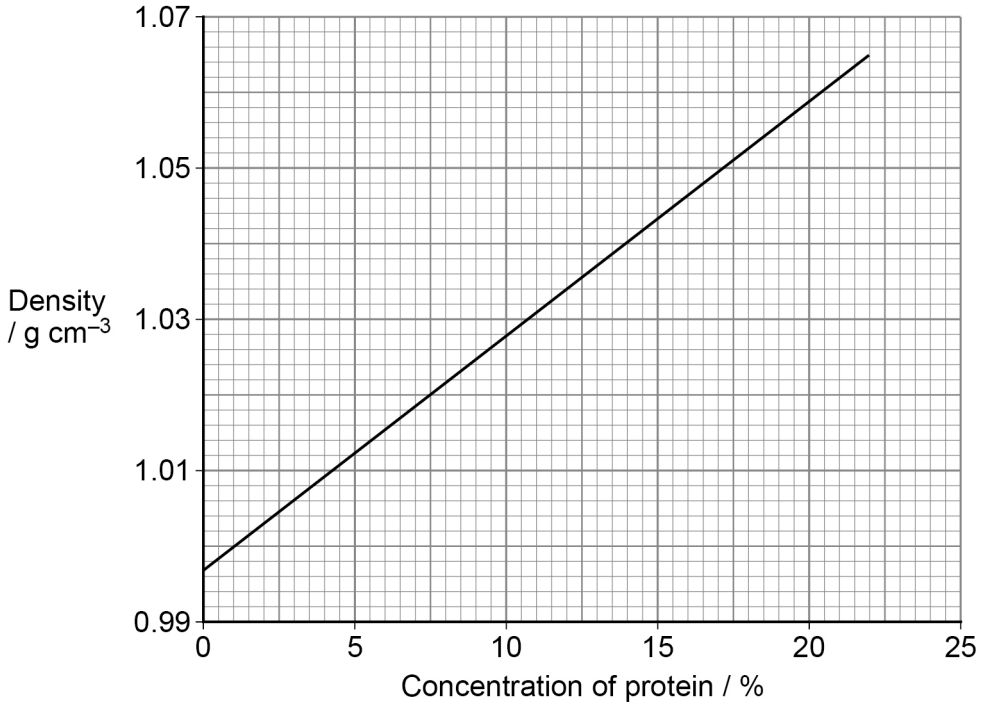
0 8 . 2 **Table 4** shows the densities of the dilution series of the copper sulfate solution.

Table 4

Concentration of copper sulfate solution / g kg^{-1}	Density of solution / g cm^{-3}
0	0.997
25	1.014
50	1.030
75	1.048
100	1.065

Figure 5 shows the densities of protein solutions of different concentration.

Figure 5



Do not write outside the box

The student put one drop of 10% protein solution into each of the copper sulfate solutions shown in **Table 4**.

Using **Figure 5**, he predicted that the drop would sink in the 0 and 25 g kg^{-1} copper sulfate solutions and float in the 50, 75 and 100 g kg^{-1} copper sulfate solutions.

Give the density of the 10% protein solution **and** explain why the student predicted that the drop would sink in the 25 g kg^{-1} copper sulfate solution.

[2 marks]

Density of 10% protein solution _____ g cm^{-3}

Explanation _____

_____

_____

_____

_____

_____

0 8 . 3 State the range of possible concentrations of a protein solution that sinks in 75 g kg^{-1} copper sulfate solution and floats in 100 g kg^{-1} copper sulfate solution.

[1 mark]

Minimum concentration _____ %

Maximum concentration _____ %

Question 8 continues on the next page

Do not write outside the box

0 8 . 4 Blood donation involves healthy donors giving blood that can be used to treat hospital patients.

When donors arrive, the haemoglobin concentration of their blood is tested.

A sample of each donor's blood is added to a copper sulfate solution to determine whether the haemoglobin concentration is high enough to donate.

Errors sometimes occur with this test.

Tom has a concentration of haemoglobin high enough to donate.

Lucy has a concentration of haemoglobin too low to donate.

Evaluate the consequences of errors occurring when Tom's and Lucy's blood samples are tested.

[3 marks]

Consequences of measurement error for Tom's blood

Consequences of measurement error for Lucy's blood

8

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0 9 Scientists dissected gills from several species of fish. They recorded:

- the mass of the whole fish
- the total number of gill filaments
- the mean length of one filament
- the mean number of lamellae per mm
- the mean surface area of one lamella.

0 9 . 1 It was not possible for the scientists to measure the length of every filament and the surface area of every lamella.

Suggest how they collected data to give a reliable mean for these variables.

[2 marks]

0 9 . 2 From these measurements, the scientists calculated the total surface area of the gas exchange surface on the gills of each fish species.

Calculate the total surface area of the gills of a fish with the following measurements:

- total number of gill filaments = 595
- mean length of one filament = 2.86 mm
- mean number of lamellae per mm = 16
- mean surface area of one lamella = 0.66 mm^2

Give your answer in mm^2 **and** to an appropriate number of significant figures.

Show your working.

[2 marks]

_____ mm^2

Question 9 continues on the next page

Do not write outside the box

0 9 . 3 **Table 5** shows the scientists' data for two species of fish.

Table 5

Fish species	Mean fish mass / g	Mean total surface area of the gills / mm^2
Opsanus tau	305	46 100
Trachurus trachurus	250	252 500

One of these fish spends most of its time not moving, waiting to catch passing prey. The other species is very active, hunting mobile prey.

Suggest which of the species in **Table 5** is the very active fish species.

Explain your answer.

[2 marks]

Very active fish species _____

Explanation _____

_____

_____

_____

0 9 . 4 Complete **Table 6** to show the phylogenetic classification for these two species.

[2 marks]

Table 6

Taxon	*Opsanus tau*	*Trachurus trachurus*
		Animalia
	Chordata	
Class	Actinopterygii	Actinopterygii
	Batrachoidiformes	Carangiformes
Family	Batrachoididae	Carangidae
Genus		
Species	*tau*	*trachurus*

8

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1 0 . 1 Outline the similarities in, and the differences between, the structures of DNA and RNA molecules.

[6 marks]

Question 10 continues on the next page

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1 0 . 2 Outline the similarities in, and the differences between, the structures of chloroplasts and mitochondria.

[4 marks]

10

END OF QUESTIONS

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