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 2

Thursday 23 May 2024 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	
TOTAL	

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

0 1 . 1 Water has a high heat capacity and a large latent heat of vaporisation.

Describe the importance of each of these properties to living organisms.

[2 marks]

High heat capacity _____

_____

_____

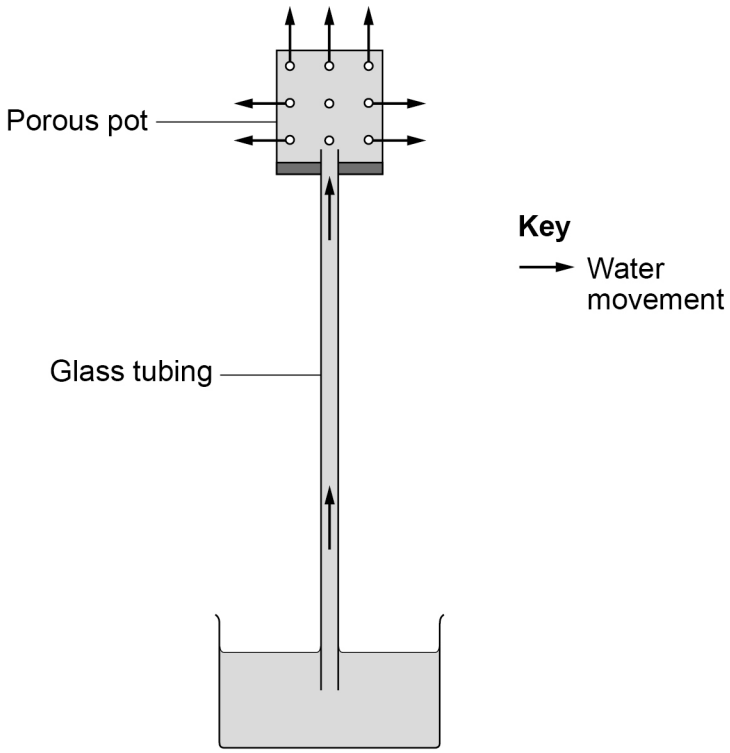
Large latent heat of vaporisation _____

_____

_____

0 1 . 2 **Figure 1** shows that water loss from a porous pot can cause the upward movement of water.

Figure 1



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Biologists have concluded that the experiment in **Figure 1** supports the cohesion–tension theory of water transport in the xylem.

Explain how this conclusion is supported by the experiment in **Figure 1**.

[3 marks]

0 1 . 3 An air bubble was introduced into the glass tubing in **Figure 1**. The air bubble moved a distance (d) of 1.5 cm in 120 minutes. The radius of the lumen (hole) of the glass tubing was 0.6 cm

Use this information and the formula $\pi r^2 d$ to calculate the rate of water movement in the glass tubing in $cm^3\ hour^{-1}$.

Use $\pi = 3.14$ in your calculation.

[1 mark]

Answer _____ $cm^3\ hour^{-1}$

6

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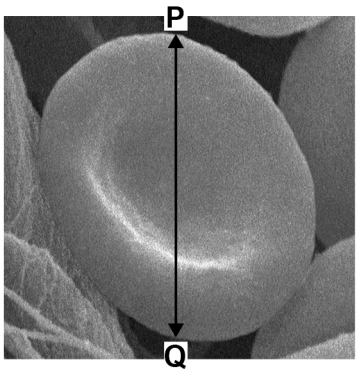
0 2 . 1 **Figure 2** shows an image of a red blood cell at a magnification of × 5500

Figure 2



Calculate the actual diameter in μm of the red blood cell between points **P** and **Q**.

Show your working.

[2 marks]

Answer _____ μm

Do not write outside the box

0 2 . 2 A haemocytometer is a special microscope slide that can be used to determine the mean number of red blood cells in 0.004 mm^3 of blood.

- A researcher prepared a 10^{-3} dilution of a sample of blood from an adult.
- Using a haemocytometer, the researcher determined that the mean number of red blood cells in 0.004 mm^3 of the diluted blood sample was 21

The volume of blood in the body of the adult was 4.8 dm^3

Calculate the total number of red blood cells in the body of this adult.

Show your working.

[2 marks]

Answer _____

0 2 . 3 The solution used to dilute the blood had to have the same water potential as the blood.

Explain why.

[2 marks]

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Question 2 continues on the next page

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0 2 . 4 There are four main blood groups in the human ABO blood group system.

Table 1 shows the basis on which each of these blood groups is classified.

Table 1

ABO blood group	Antigens present on red blood cells	Antibodies present in blood plasma
A	A	Anti-B
B	B	Anti-A
AB	A and B	No anti-A and no anti-B
O	No A and no B	Anti-A and anti-B

A transfusion of blood from a blood group **A** donor to a blood group **B** recipient would cause agglutination of the donated red blood cells.

Use information in **Table 1** to explain why.

[2 marks]

_____

_____

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0 2 . 5 Using **Table 1**, give the blood groups of people who could accept a donation of blood group **O** without causing agglutination of the **donated** red blood cells.

[1 mark]

Blood groups_____

9

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0 3 . 1 Describe how you would use cell fractionation and ultracentrifugation to obtain a sample of mitochondria from muscle tissue.

[4 marks]

Question 3 continues on the next page

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0 3 . 2 Mitochondrial respiratory capacity is a measure of maximum ATP production in a mitochondrion. Scientists investigated the effect of a resistance exercise training (RET) programme on the respiratory capacity of mitochondria in skeletal muscle tissue. RET develops muscle strength.

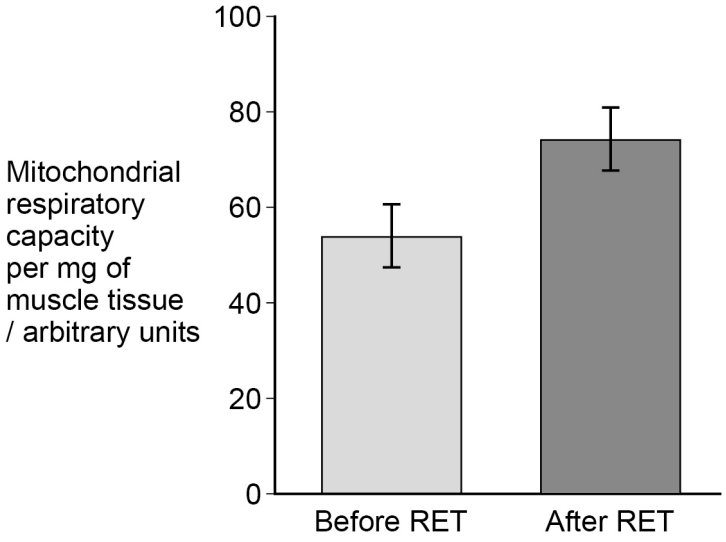
The scientists:

- took samples of muscle tissue from 11 young males before and after a 12-week RET programme
- recorded the respiratory capacity of the mitochondria in the samples of muscle tissue.

Figure 3 shows some of the scientists' results.

The error bars represent ± 2 standard deviations from the mean, which includes over 95% of the data.

Figure 3



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Using all the information, evaluate whether 12 weeks of RET would improve athletic performance in the general population.

[5 marks]

9

Turn over for the next question

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0 4 . 1 Where does transcription occur in a eukaryotic cell?

[1 mark]

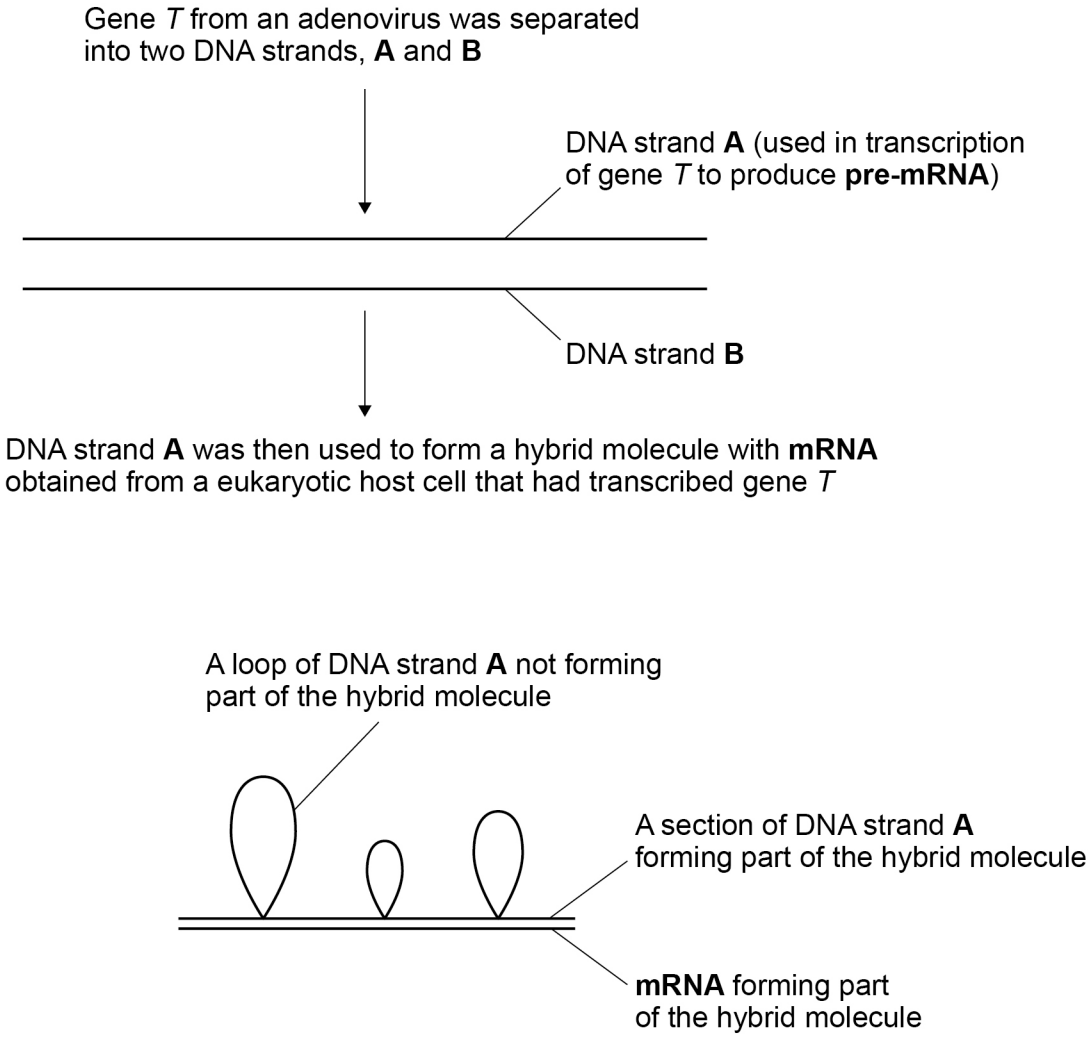
_____

0 4 . 2 The genome of an adenovirus is a single, linear molecule of double-stranded DNA. Adenoviruses use eukaryotic host cells to transcribe their genes in protein synthesis. The process of transcription of adenovirus genes is similar to the process of transcription of genes in eukaryotes.

Scientists investigated the process of transcription of this viral DNA.

Figure 4 shows one of the experiments carried out by these scientists.

Figure 4



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Looking at the results of the experiment in **Figure 4**, the scientists concluded that splicing had taken place.

Use **Figure 4** to describe and explain why the scientists' conclusion was justified.

[3 marks]

0 4 . 3 Describe and explain how the results of the experiment in **Figure 4** would differ if the scientists had used prokaryotic DNA.

[2 marks]

0 4 . 4 Errors in the precise location of splicing in the DNA molecule can lead to mutations.

Explain why.

[1 mark]

7

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0 5 . 1 Orchids form a large family of flowering plants. Scientists analysed genes coding for ribosomal RNA in orchids.

Explain how this analysis allowed the scientists to determine the phylogenetic relationships between species of orchids.

[2 marks]

0 5 . 2 Suggest **one** reason why analysing genes coding for ribosomal RNA allows phylogenetic relationships to be studied between all cellular organisms.

[1 mark]

0 5 . 3 Most orchid species are found in tropical rainforests. Two common features found in many of these species are:

- they grow up trees to reach the upper branches
- they only open their stomata at night.

Suggest how each of these **two** features benefits these orchids.

[2 marks]

They can reach the upper branches of trees

They only open their stomata at night

Do not write outside the box

0 5 . 4 A student used an optical microscope to observe a piece of tissue from the lower surface of an orchid leaf.

The piece of leaf tissue observed was very thin.

Explain why this was important.

[2 marks]

0 5 . 5 The student produced a biological drawing of the leaf tissue they viewed through an optical microscope.

Give **three** ways the student could ensure they produce a correct biological drawing of the leaf tissue.

Assume the student uses a sharp pencil.

[3 marks]

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0 6 . 1 Disinfectants are used to kill microorganisms on non-living surfaces. A student investigated the effect of different concentrations of disinfectant **X** on the growth of *Bacillus subtilis*.

The student:

- added 5 cm^3 of a different concentration of disinfectant **X** to 5 different test tubes
- added 5 cm^3 of distilled water to another test tube
- added 2 cm^3 of a culture of *B. subtilis* to all 6 test tubes
- incubated the test tubes at 25 °C for 24 hours
- used a colorimeter to record the percentage of light absorbed by the contents of each tube.

Table 2 shows the student's results.

Table 2

Percentage concentration of disinfectant X	0	20	40	60	80	100
Percentage light absorbance	100	100	87	52	10	10

The student prepared the different concentrations of disinfectant **X**.

Describe how the student made 5 cm^3 of the 60% concentration using distilled water and undiluted disinfectant.

[1 mark]

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0 6 . 2 The student used a sterile pipette with 0.1 cm^3 graduations to transfer 2 cm^3 of *B. subtilis* into each test tube.

What is the uncertainty in measuring 2 cm^3 with this pipette?

Calculate the percentage uncertainty of this 2 cm^3 measurement.

[2 marks]

Uncertainty _____ cm^3

Percentage uncertainty _____

0 6 . 3 Use **Table 2** to evaluate the effectiveness of disinfectant **X** at killing microorganisms on non-living surfaces.

[4 marks]

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7

Turn over ►

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0 7 . 1 Edwards' syndrome is a condition resulting from an extra chromosome 18.
A chromosome mutation in the second meiotic division is the most frequent cause of Edwards' syndrome.

Explain how a chromosome mutation in the second meiotic division could result in an extra chromosome 18.

In your answer, **name** the type of chromosome mutation which would result in the extra chromosome.

[2 marks]

0 7 . 2 Complete trisomy 18 is the most common type of Edwards' syndrome. This occurs when all the cells of the body have an extra chromosome 18.

Explain why all the cells of the body have an extra chromosome 18.

[2 marks]

Do not write outside the box

0 7 . 3 Mosaic trisomy 18 is another type of Edwards' syndrome. This occurs due to a chromosome mutation after fertilisation.

In mosaic trisomy, the body has cells with an extra chromosome 18 **and** cells with the correct number of chromosomes.

Explain how cells with different numbers of chromosomes are produced in mosaic trisomy.

[1 mark]

_____

_____

_____

0 7 . 4 The age of the female parent is a factor linked to the risk of a child having Edwards' syndrome.

Which statistical test should be used to test whether this link is statistically significant?

Tick (✓) **one** box.

[1 mark]

Correlation coefficient ☐

Chi-squared ☐

Student's t-test ☐

Question 7 continues on the next page

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0 7 . 5 A ventricular septal defect (VSD) is a common feature of Edwards' syndrome.

A VSD is a hole in the wall between the two ventricles of the heart. A VSD can cause higher blood pressure in the lungs.

Explain how a VSD can cause higher blood pressure in the lungs.

[2 marks]

8

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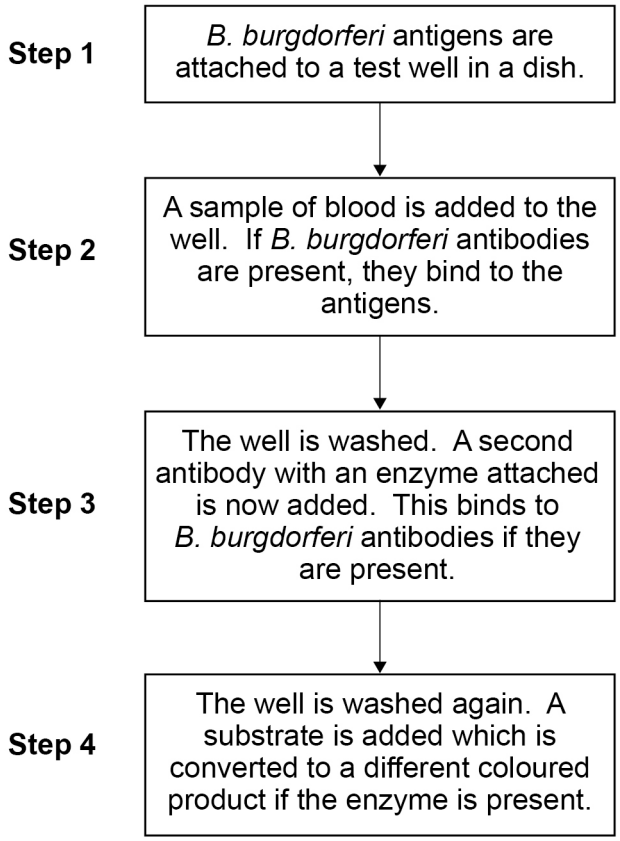
0 8 Lyme disease is most frequently caused by the bacterium *Borrelia burgdorferi*. Lyme disease can be difficult to diagnose.

Figure 5 shows an ELISA test that is used to find out if a person has antibodies to *B. burgdorferi*.

Figure 5



A false positive in this test is a result which incorrectly indicates that antibodies to *B. burgdorferi* are present.

0 8 . 1 Failure to thoroughly wash the well in **Step 4** can result in a false positive.

Explain why.

[2 marks]

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Turn over ►

Do not write outside the box

0 8 . 2 A false positive can be produced if a person has been infected by another bacterium that causes a disease called syphilis.

Suggest why.

[1 mark]

0 8 . 3 A false **negative** in this test is often produced if a person is tested within 2 weeks of being infected with *B. burgdorferi*.

Explain why.

[2 marks]

0 8 . 4 Sometimes, symptoms of Lyme disease can persist for 6 months following antibiotic treatment. This condition is known as Post-Treatment Lyme Disease Syndrome (PTLDS).

Scientists investigated the symptoms experienced by a large number of PTLDS patients and a control group. During a 2-week period, they asked all the participants:

- if they had experienced symptoms of PTLDS
- to record the intensity of these symptoms.

The scientists used a statistical test to determine if there was a difference in the intensity of symptoms of PTLDS between these two groups.

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Table 3 shows some of the scientists' results, including the probability (P) values obtained using the statistical test.

Table 3

Symptom	Percentage of PTLDS group experiencing symptom	Percentage of control group experiencing symptom	P value for difference in the intensity of symptoms
Fatigue	100	57	<0.001
Joint pain	96	32	<0.001
Depression	40	4	<0.005
Fever	35	3	<0.005
Muscle pain	86	62	<0.001

The scientists concluded that more PTLDS patients than the control group experienced:

- symptoms
- greater intensity of symptoms.

Evaluate the scientists' conclusions.

[4 marks]

9

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0 9 . 1 Describe the role of haemoglobin (Hb) in the loading, transport and unloading of oxygen.

[5 marks]

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0 9 . 2 Describe how a polypeptide is produced by translation of mRNA.

[5 marks]

10

END OF QUESTIONS

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