OCR
Oxford Cambridge and RSA

Monday 12 May 2025 – Morning

AS Level Biology A

H020/01 Breadth in biology

Time allowed: 1 hour 30 minutes

You can use:
- a scientific or graphical calculator
- a ruler (cm/mm)

Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

Section A

You should spend a **maximum** of **25 minutes** on this section.

Write your answer for each question in the box provided.

1 Which statement correctly describes microscopes?

A Light microscopes can produce higher resolution images than electron microscopes.

B Scanning electron microscopes produce higher resolution images than transmission electron microscopes.

C Transmission electron microscopes can achieve higher magnifications than scanning electron microscopes.

D Transmission electron microscopes can be used to view living tissues.

Your answer ☐ **[1]**

2 Which statement correctly describes phosphorylated nucleotides?

A ADP can be hydrolysed to produce ATP.

B ADP can be phosphorylated to produce ATP.

C All phosphorylated nucleotides have three phosphate groups.

D Energy is released when ATP undergoes a condensation reaction to form ADP and P_i.

Your answer ☐ **[1]**

3 Which type of stem cell can become specialised into more than one cell type but is limited to a range of cell types?

A Embryonic

B Multipotent

C Pluripotent

D Totipotent

Your answer ☐ **[1]**

4 A student carries out a non-reducing sugar test on a sample of fruit juice.

What is the correct reason for heating the sample with hydrochloric acid?

A It breaks the ester bond between glucose and fructose

B It breaks the ester bond between glucose and sucrose

C It breaks the glycosidic bond between glucose and fructose

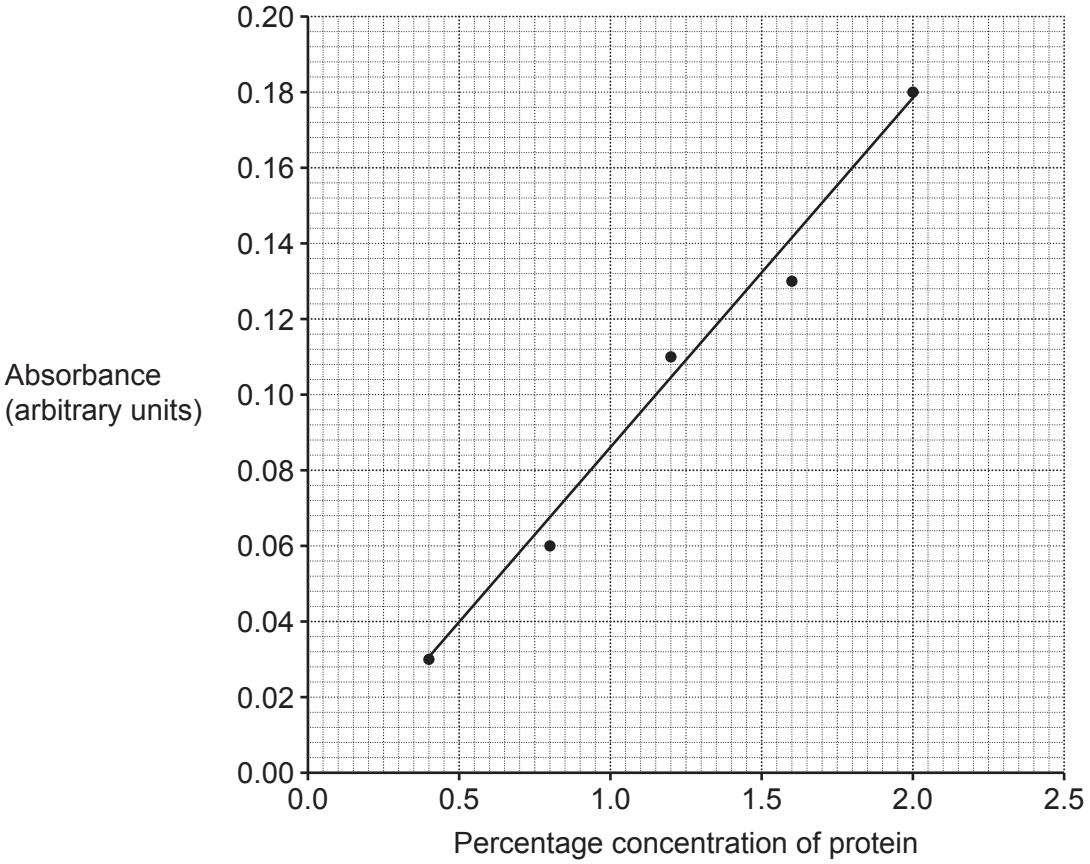
D It breaks the glycosidic bond between glucose and sucrose

Your answer [ ] **[1]**

5 A student is finding out the concentration of a sample of protein.

- They set up five solutions that have a range of different protein concentrations.
- They carry out a chemical test on each solution that produces a colour change.
- They use a colorimeter to find out the absorbance of light through each solution.

The graph shows the calibration curve they plotted for each concentration of protein.



They carry out the same chemical test on the sample of protein with the unknown concentration and measure the absorbance as 0.16 arbitrary units.

Which statement correctly describes the results of the experiment?

A The concentration of protein in the sample tested is 1.6%.

B The concentration of protein in the sample tested is too low to read from the graph.

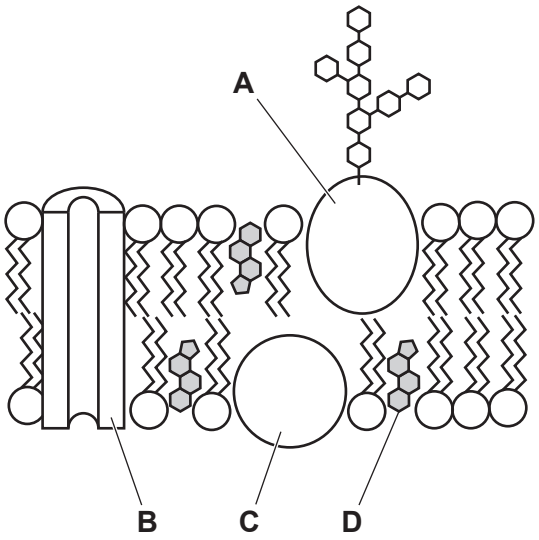
C The greater the concentration of protein, the less light is absorbed by the sample.

D The greater the concentration of protein, the less light is transmitted through the sample.

Your answer ☐ **[1]**

The diagram shows the structure of a cell surface membrane.

Use the diagram to answer questions **6** and **7**.



6 Which component acts as a transport protein?

Your answer ☐ **[1]**

7 Which component is made in the smooth endoplasmic reticulum?

Your answer ☐ **[1]**

8 Which option describes a role of membranes inside a cell?

A The cell surface membrane acts as a barrier between the cell and its environment.

B The inner membrane surrounding a mitochondrion allows the reactions of aerobic respiration to occur.

C The nuclear membrane has nuclear pores to allow DNA to move out of the nucleus.

D The outer surface of the plasma membrane has receptors for cell signalling.

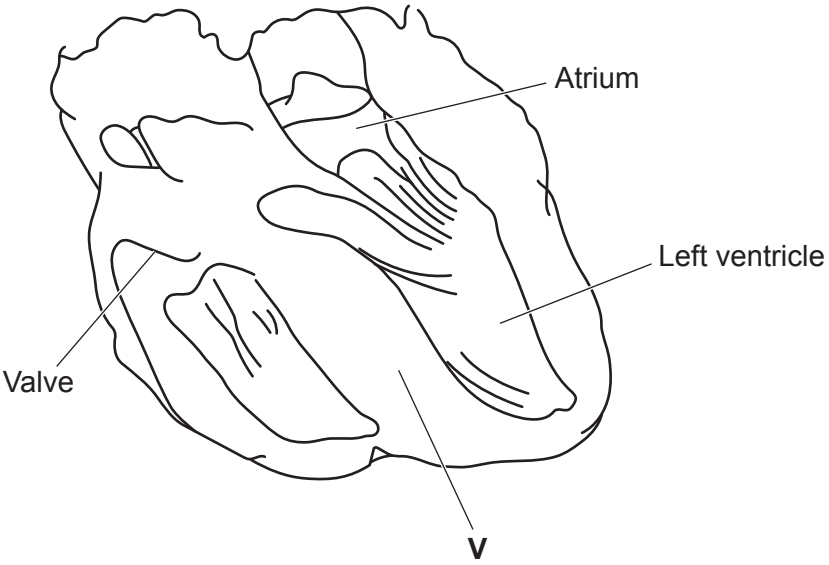
Your answer ☐ **[1]**

9 Which row of the table correctly compares the properties of glycogen and amylose?

	Glycogen	**Amylose**
A	Branched	Branched
B	Insoluble	Soluble
C	Insoluble	Insoluble
D	Unbranched	Unbranched

Your answer ☐ **[1]**

10 The diagram is of a dissected lamb heart.



What is the name of the structure labelled **V**?

A Aorta

B Apex

C Septum

D Vena cava

Your answer ☐ **[1]**

11 Carbon dioxide is transported around the body either in the blood plasma or inside erythrocytes.

Which statement is true about the transport of carbon dioxide?

A Excess carbon dioxide causes blood pH to increase

B Hydrogencarbonate ions are exchanged for hydrogen ions in erythrocytes

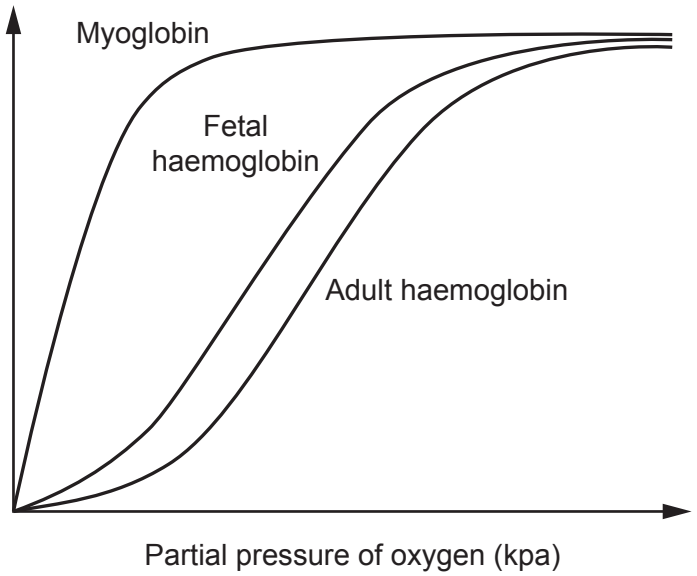
C Most carbon dioxide is transported in the blood plasma in the form of hydrogen carbonate ions

D Some carbon dioxide reacts with hydrogen ions to form haemoglobinic acid

Your answer ☐ **[1]**

12 The graph shows oxygen dissociation curves for adult haemoglobin, fetal haemoglobin and myoglobin.

Myoglobin is a respiratory pigment found in muscle that acts as an oxygen store.



Which statement correctly compares the dissociation curves?

A Adult haemoglobin has a higher affinity for oxygen when compared to fetal haemoglobin at most partial pressures of oxygen.

B Fetal oxyhaemoglobin dissociates from oxygen molecules less easily than myoglobin at most partial pressures of oxygen.

C Myoglobin has the highest affinity for oxygen at all partial pressures of oxygen.

D Myoglobin has the lowest affinity for oxygen at most partial pressures of oxygen.

Your answer ☐ **[1]**

13 Which option describes the Bohr effect?

A At the same partial pressure of oxygen, haemoglobin has a higher percentage saturation of oxygen.

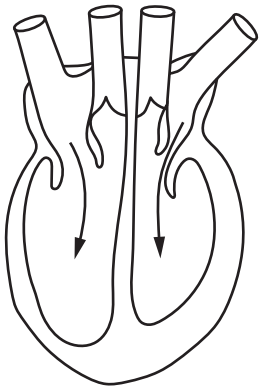
B Oxygen dissociates from oxyhaemoglobin more readily during exercise.

C The Bohr effect ensures muscles have less oxygen for aerobic respiration.

D The oxygen dissociation curve for haemoglobin shifts to the right in a mammal that is at rest.

Your answer ☐ **[1]**

14 The diagram shows a stage of the cardiac cycle.



What stage of the cardiac cycle is shown in the diagram **and** which valves are open?

A Atrial systole **and** atrioventricular valves

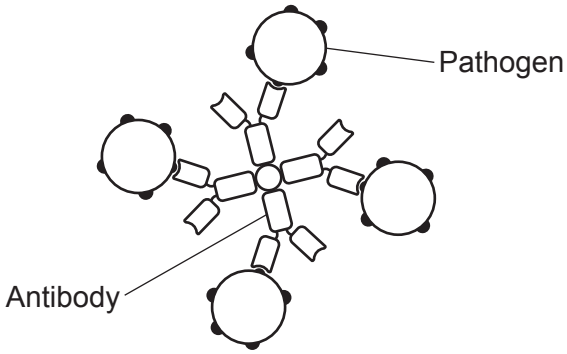
B Atrial systole **and** semilunar valves

C Ventricular systole **and** atrioventricular valves

D Ventricular systole **and** semilunar valves

Your answer ☐ **[1]**

15 The diagram shows an antibody attached to multiple pathogens.



What is the type of antibody shown?

A Agglutinin

B Antigen

C Anti-toxin

D Opsonin

Your answer ☐ **[1]**

16 Which of these descriptions is **not** a primary non-specific defence against pathogens?

A Blood clotting caused by a damaged blood vessel

B Expulsive reflexes caused by irritation of the lining of the airways

C Phagocytosis by neutrophils

D Wound repair to damaged skin

Your answer ☐ **[1]**

17 A pregnant woman is infected by a virus that causes the common cold.

She has an immune response and produces antibodies that are passed on to her fetus.

What type of immunity does her fetus have?

A Artificial active

B Artificial passive

C Natural active

D Natural passive

Your answer [ ] **[1]**

18 Scientists studied the genetic diversity of four different wolf populations in a national park in Canada.

The data are shown in the table.

Population	Number of genes studied	Number of polymorphic gene loci
A	8	1
B	14	7
C	4	1
D	19	9

Which population is the most vulnerable to environmental change?

Your answer [ ] **[1]**

19 What is the definition of species biodiversity?

A The distribution of different species in a habitat

B The number of different species in a population

C The species richness and species evenness in a habitat

D The variety of organisms in a habitat

Your answer [ ] **[1]**

20 Dachshunds are a breed of dogs which were bred for hunting badgers.

They have sharp front claws and a pointed snout to dig holes.

What term describes this type of adaptation?

A Anatomical

B Behavioural

C Environmental

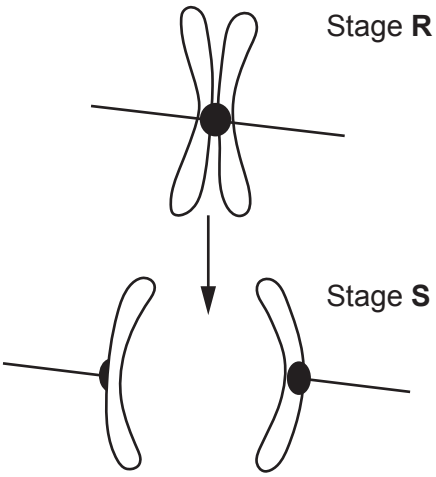
D Physiological

Your answer ☐ **[1]**

Section B

21

(a) The diagram below shows a chromosome going through two stages of meiosis 2.



(i) State the names of stages **R** and **S**.

Stage **R** .....

Stage **S** .....

[1]

(ii) Describe **two** features of homologous chromosomes.

1 .....

.....

2 .....

.....

[2]

(iii) Describe what is happening during stage **S**.

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..... **[2]**

(b) Mitosis and meiosis are important processes in organisms.

Mitosis occurs to allow an organism to grow by making new cells and repair its tissues.

(i) State **one other** role of mitosis in organisms.

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..... **[1]**

(ii) Meiosis allows organisms to make gametes.

Describe the **three** processes that occur during meiosis to cause genetic variation in gametes **and** state the stage in which each process occurs.

Process 1 .....

Stage .....

Process 2 .....

Stage .....

Process 3 .....

Stage .....

[3]

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DO NOT WRITE ON THIS PAGE

22

(a) DNA is a molecule found in the nucleus of eukaryotic cells.

The passage below is about the structure and properties of DNA.

Complete the sentences using the most appropriate term(s).

A molecule of DNA is made from two polynucleotides twisted around each other in a shape known as a ..... . The two polynucleotides are held together by ..... between nitrogenous bases. Cytosine and guanine are more strongly bonded than adenine and thymine, as there are ..... bonds holding them together.

[3]

(b) DNA replication occurs in eukaryotic cells.

(i) The DNA in the nucleus of a eukaryotic cell is associated with histone proteins.

State **one other** feature of DNA in a eukaryotic cell that is different from DNA in a prokaryotic cell.

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..... **[1]**

(ii) Drugs that affect DNA replication are used to treat cancer.

Zelpolib is a drug that affects the enzyme DNA polymerase by binding to its active site.

Suggest explanations for how Zelpolib affects DNA replication.

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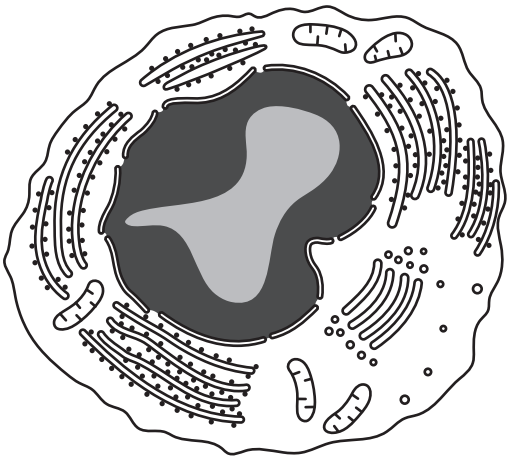
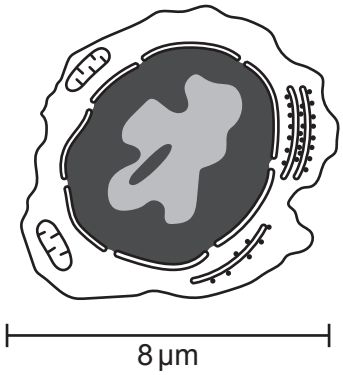
..... **[2]**

23

(a) The diagram below shows a drawing of a plasma cell and a B lymphocyte. The actual size of the diameter of each cell is shown with a scale bar.



Plasma cell



B lymphocyte

(i) Calculate the surface area to volume ratio (SA:V) of the plasma cell. Assume the plasma cell is spherical.

Use the formulas:

surface area of sphere = $4\pi r^2$

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

SA:V = ... **[2]**

(ii) Calculate the magnification of the B lymphocyte.

Give your answer to **2** significant figures.

Magnification = ... **[2]**

(iii) Using the diagram and your own knowledge, explain why plasma cells are usually larger than B lymphocytes.

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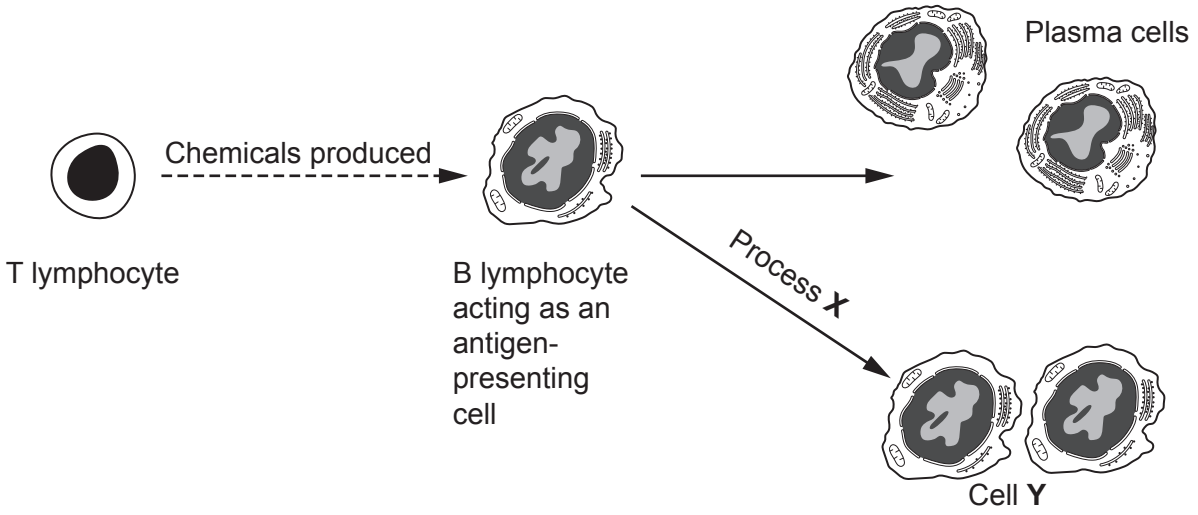
..... **[3]**

(b) The diagram below shows some of the processes involved in the activation of B lymphocytes.



(i) Name the type of T lymphocyte shown in the diagram.

..... **[1]**

(ii) Describe the role of process **X** in producing cell **Y** to fight future infections by the same pathogen.

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..... **[2]**

(c) Plasma cells can be a target for treating autoimmune diseases such as systemic lupus erythematosus (SLE).

SLE causes widespread inflammation in the body and particularly affects the skin, joints, and internal organs.

Scientists investigated the effects of two drugs on reducing the numbers of plasma cells in humans. The two drugs used were:

- mycophenolate mofetil (MMF)
- cyclophosphamide (CYC)

SLE patients were given either MMF, CYC or no drug for a period of 10 weeks.

The table shows the results of the investigation.

Drug treatment	Number of patients	Median plasma cell number (mm^{-3})
MMF	25	55.6
CYC	20	31.2
No drug	22	103.0

(i) Some students choose to carry out a Student's *t*-test to analyse the data for the drug treatment.

With reference to the data, suggest whether a Student's *t*-test is an appropriate choice of statistical test.

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..... **[2]**

(ii) The students conclude that CYC is the most effective drug in reducing plasma cell numbers.

Identify **two** reasons why the conclusion might **not** be supported.

1 .....

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2 .....

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[2]

24

(a) The cell surface membrane of companion cells has a key role in the loading of sucrose into phloem sieve tubes.

A student wrote three incorrect statements as a part of their revision notes on this topic.

For each statement, state the error **and** write a correction.

Statement 1: The cell surface membrane of the companion cell contains channel proteins for pumping protons.

Error .....

Correction .....

Statement 2: The cell surface membrane of the companion cell contains cotransporter proteins for protons and glucose.

Error .....

Correction .....

Statement 3: Cotransporter proteins in the companion cell surface membrane use ATP to change shape to transport sugar molecules against their concentration gradient.

Error .....

Correction .....

[3]

(b) A group of students use beetroot to investigate the effects of the solvent ethanol on the permeability of the cell surface membrane.

This is the method they use:

1. Set up six test tubes of ethanol of different concentrations (0%, 20%, 40%, 60%, 80% and 100%).
2. Add a piece of beetroot to each test tube.
3. After 10 minutes, remove the beetroot from the test tube. If membrane damage has occurred the solution in the test tube is a purple colour.
4. Use a green filter in a colorimeter to measure the absorbance of the ethanol solution. The absorbance is proportional to the level of membrane damage.
5. Repeat the experiment.

(i) State **two** variables that were **not** controlled in this experiment.

1 .....

2 .....

[2]

(ii) One of the students suggests using a red filter in the colorimeter because this is what they had used for a Benedict's test.

Suggest why the student is **incorrect** to suggest using a red filter.

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..... **[1]**

(iii) Explain how the students can process their data to assess repeatability.

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..... **[3]**

25

(a) The Asian elephant, *Elephas maximus*, is the largest land mammal in Asia. It is an endangered species.

Asian elephants need a transport system because they are a very large mammal and diffusion distances are too long.

Explain **two other** reasons why an Asian elephant has a transport system.

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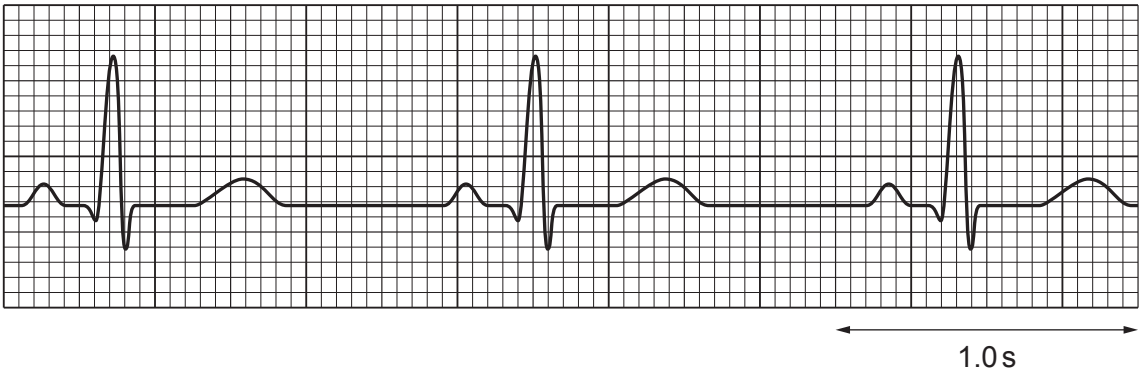
..... **[2]**

(b) Name an international agreement that might use data about the changing numbers of the Asian elephant to monitor its conservation status.

..... **[1]**

(c) This is an electrocardiogram (ECG) trace of an Asian elephant.



(i) Calculate the heart rate of the Asian elephant.

Give your answer to the nearest whole number.

Heart rate = ... beats per minute **[2]**

(ii) Describe how the ECG trace would appear differently if the elephant had tachycardia.

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..... **[2]**

26

(a) Bone marrow contains stem cells which can only differentiate into blood cell types including erythrocytes and neutrophils.

Complete the table to show which statements about both erythrocytes and neutrophils are true and which are false.

Tick (✓) **one** box in each row.

Statement	True	False
They both contain mitochondria		
They both contain enzymes		
They can both undergo mitosis		

[2]

(b) A student is studying erythrocytes and neutrophils in a blood sample.

They smear a drop of the blood sample across a microscope slide and place it under a light microscope.

They focus the microscope using a high power but cannot see any white blood cells.

Suggest **and** explain why the student cannot see any white blood cells on the slide.

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..... **[2]**

(c) One area of potential use for stem cells is in medicine, for example, to repair damaged tissues and to treat neurological conditions.

State **one other** potential use of stem cells.

..... **[1]**

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.