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AS Level Biology A

H020/01 Breadth in biology

Thursday 26 May 2016 – Afternoon

Time allowed: 1 hour 30 minutes

You may use:
- a scientific calculator
- a ruler (cm/mm)

First name	
Last name	
Centre number	Candidate number

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **24** pages.

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SECTION A

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

Answer **all** the questions.

Write your answer for each question in the box provided.

1 Microscopes vary in their magnification and resolution.

Which of the rows, **A** to **D**, in the table below is correct?

	Light microscope		Transmission electron microscope		Scanning electron microscope	
	Magnification	**Resolution (nm)**	**Magnification**	**Resolution (nm)**	**Magnification**	**Resolution (nm)**
A	× 1500	200	× 10 000	0.2	× 50 000	0.2
B	× 400	100	× 500 000	10.0	× 100 000	0.2
C	× 1500	200	× 500 000	0.2	× 100 000	0.2
D	× 1500	100	× 500 000	10.0	× 100 000	10.0

Your answer ☐ **[1]**

2 Carbohydrates, such as starch, are made from monosaccharides joined together.

Which of the bonds, **A** to **D**, joins monosaccharides together?

A ester

B glycosidic

C peptide

D phosphodiester

Your answer ☐ **[1]**

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3 Some inorganic ions have roles in enzyme-controlled reactions.

Which of the rows, **A** to **D**, in the table below is correct?

	Role of ion	
	Cofactor for amylase	**Prosthetic group for carbonic anhydrase**
A	Zn^{2+}	Cl^{-}
B	Zn^{+}	Cl^{-}
C	Cl^{2-}	Zn^{+}
D	Cl^{-}	Zn^{2+}

Your answer ☐ **[1]**

4 Which of the following statements, **A** to **D**, about the nature of the genetic code is **incorrect**?

A It is a degenerate code.

B It is a triplet code.

C It is overlapping.

D It is universal.

Your answer ☐ **[1]**

5 Ventilation involves various parts of the mammalian respiratory system.

Which of the following statements, **A** to **D**, describes **inhalation**?

A ribcage moves upwards and outwards; external intercostal muscles relax; diaphragm relaxes

B ribcage moves downwards and inwards; external intercostal muscles relax; diaphragm relaxes

C ribcage moves upwards and outwards; external intercostal muscles contract; diaphragm contracts

D ribcage moves downwards and inwards; external intercostal muscles contract; diaphragm contracts

Your answer ☐ **[1]**

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6 Which of the following structures, **A** to **D**, are found in prokaryotes **and** in eukaryotes?

A a cell wall made of peptidoglycan

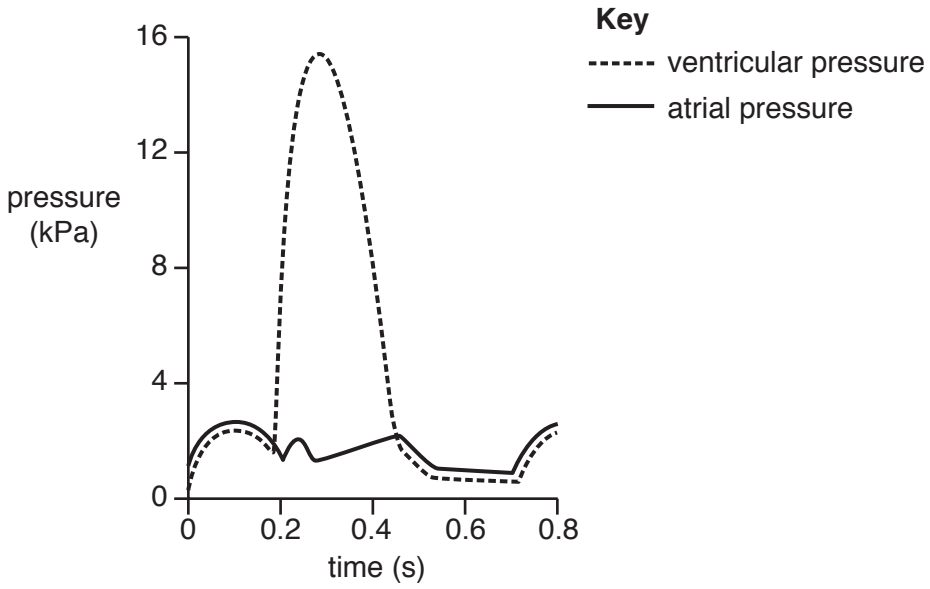
B circular genomic DNA

C a nucleus surrounded by a nuclear membrane

D ribosomes

Your answer ☐ **[1]**

7 The pressure changes in one mammalian cardiac cycle are shown in the graph below.



Which of the following time periods, **A** to **D**, shows ventricular systole?

A 0.0 to 0.1 s

B 0.2 to 0.3 s

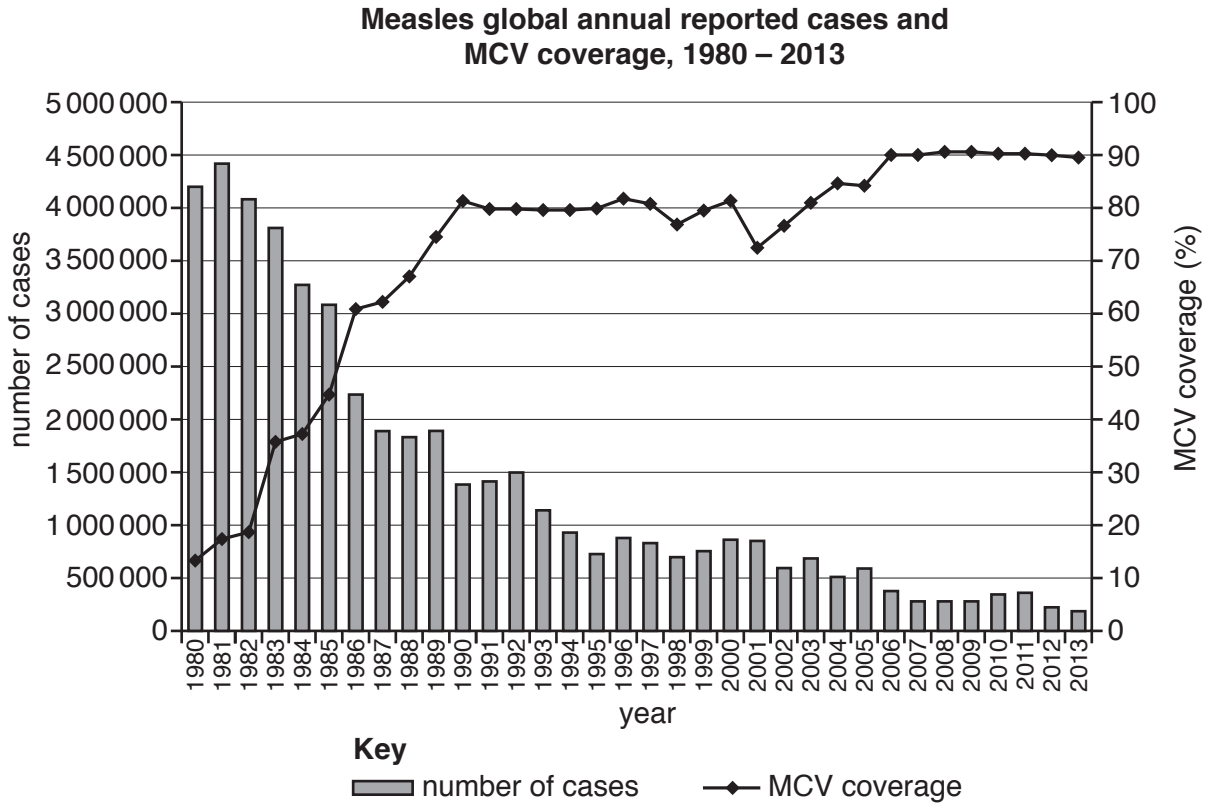
C 0.4 to 0.5 s

D 0.6 to 0.8 s

Your answer ☐ **[1]**

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8 Measles is a serious disease that can be prevented by vaccination. The chart below shows the Measles-containing Vaccine (MCV) coverage and annual reported cases of measles between 1980 and 2013.



Which of the following statements, **A** to **D**, is a correct interpretation of the chart?

A An increase in herd immunity resulted in fewer deaths from measles.

B The highest number of measles cases occurred when MCV coverage was at its lowest.

C A 90% MCV coverage resulted in fewer than half a million cases of measles each year.

D There is a positive correlation between the number of measles cases and the MCV coverage.

Your answer ☐ **[1]**

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9 Two different fields, field **G** and **H**, were sampled for three common species of wildflower. The results are shown below.

	Number of individuals	
Species	**Field G**	**Field H**
Daisy	300	20
Dandelion	335	49
Buttercup	365	931
Total	1000	1000

Which of the options, **A** to **D**, is correct?

A Field **G** will have a greater Simpson's diversity index.

B Field **H** has greater species evenness.

C Field **H** will have a greater Simpson's diversity index.

D Field **G** has greater species richness.

Your answer ☐ **[1]**

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10 Which of the following options, **A** to **D**, lists the three domains of life?

A Archaea, Bacteria and Eukaryota

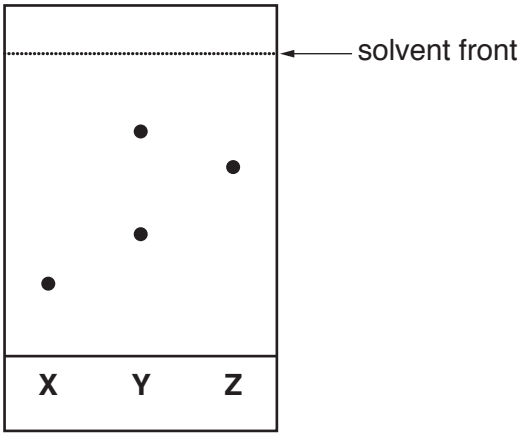
B Bacteria, Prokaryota and Eukaryota

C Prokaryotae, Protoctista and Eukaryota

D Protoctista, Plantaea and Animalia

Your answer ☐ **[1]**

11 A student investigates some solutions, **X**, **Y** and **Z**, using paper chromatography. The results are shown below.



Which of the following options, **A** to **D**, is the Rf value of **Z**?

A 0.63

B 1.6

C 0.85

D 0.25

Your answer ☐ **[1]**

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12 Pressure varies in different parts of the mammalian circulatory system.

	Blood in aorta	Tissue fluid	Lymph	Blood in vena cava
Pressure				

Which of the following options, **A** to **D**, correctly completes the table above?

A high high low low

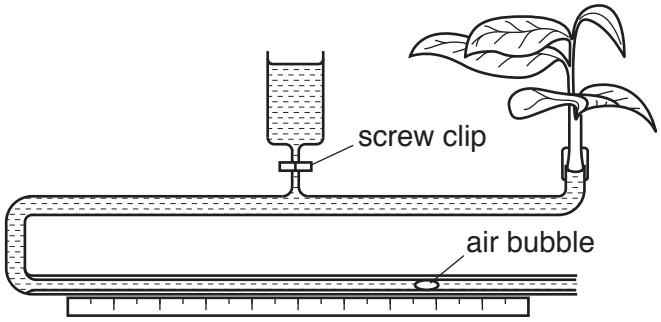
B high low high low

C high low low low

D high low low high

Your answer ☐ **[1]**

13 A diagram of a potometer is shown below.



Which of the following options, **A** to **D**, is a precaution that is **not** needed when setting up a potometer?

A Remove excess water from the surface of the leaves before readings are taken.

B The screw clip must be opened while taking the readings.

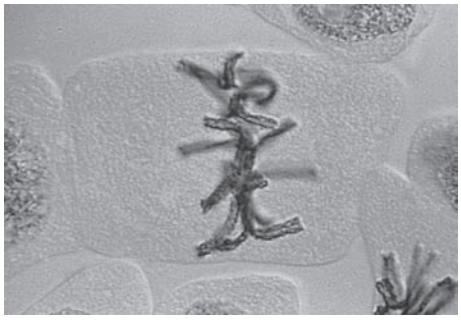
C The shoot should be cut whilst under water.

D There should be no extra air bubbles.

Your answer ☐ **[1]**

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14 The image shows a stage in mitosis.



Which of the following options, **A** to **D**, is the stage of mitosis shown above?

A anaphase

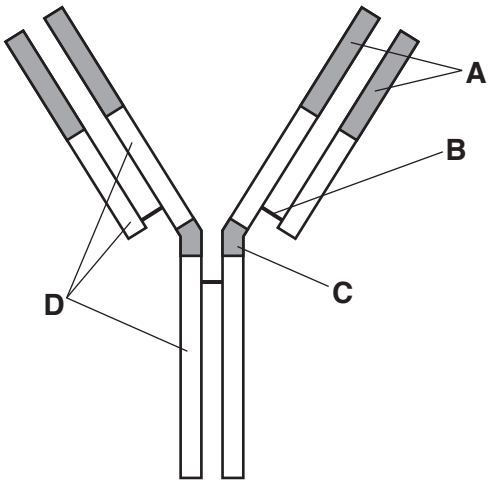
B metaphase

C prophase

D telophase

Your answer ☐ **[1]**

15 The diagram below shows the simplified structure of an antibody.

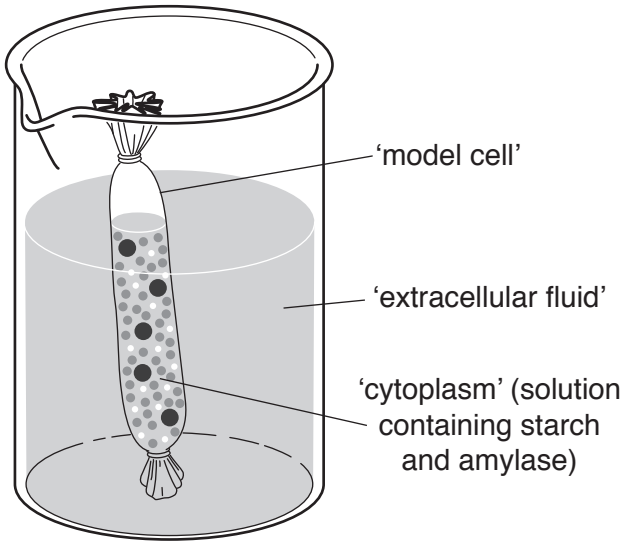


Which of the letters, **A** to **D** identifies the region of the antibody that allows the distance between the antibody binding sites to vary.

Your answer ☐ **[1]**

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16 A group of students were investigating the diffusion of molecules across membranes using a 'model cell', as shown below.



Biochemical tests were used to identify the types of molecules present. The results are shown in the table below.

A tick (✓) represents a positive result.

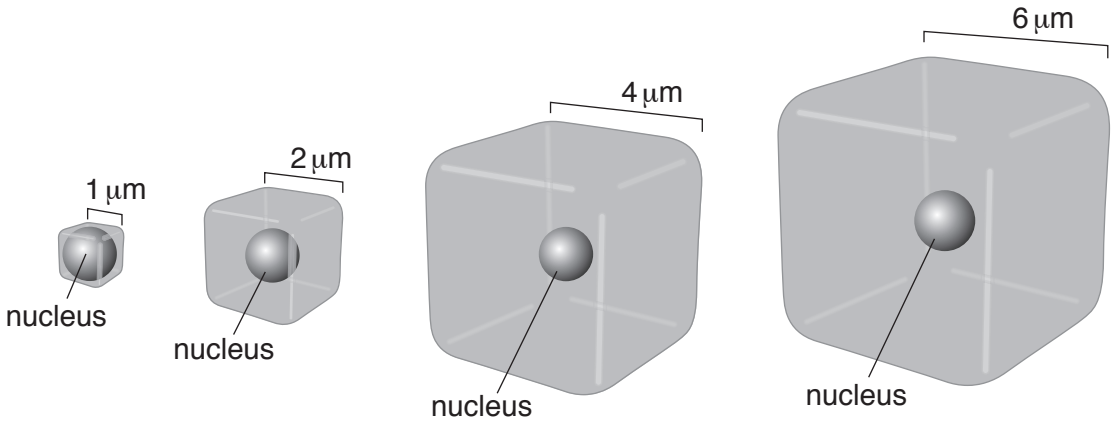
Which of the rows, **A** to **D**, shows the correct results for the 'cytoplasm' at the beginning of the experiment **and** the 'extracellular fluid' at the end of the experiment?

	Benedict's test		**Biuret test**		**Iodine test**	
	'cytoplasm'	'extracellular fluid'	'cytoplasm'	'extracellular fluid'	'cytoplasm'	'extracellular fluid'
A		✓	✓		✓	
B		✓	✓	✓	✓	
C	✓	✓			✓	✓
D	✓		✓		✓	

Your answer ☐ **[1]**

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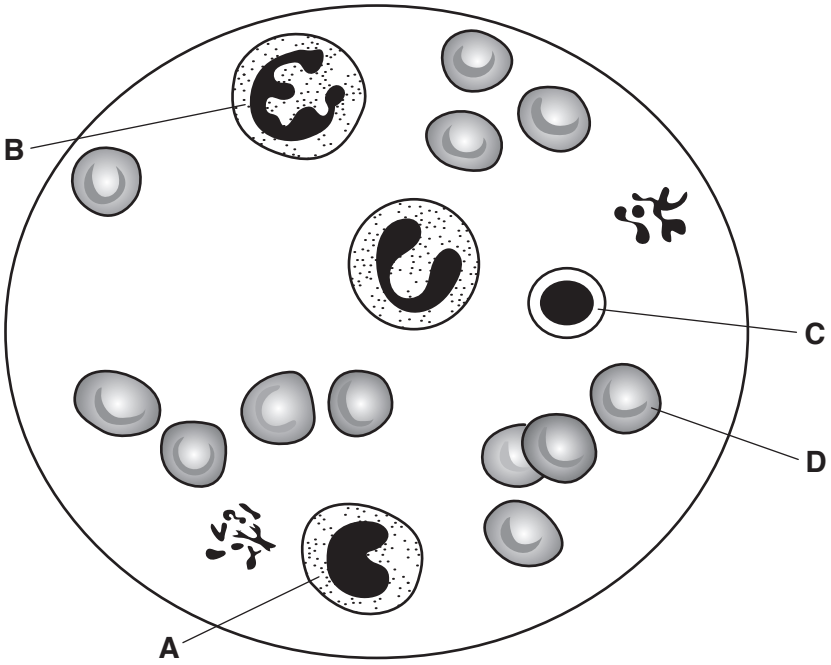
17 Which of the cells below, represented by cubes **A** to **D**, has a surface area to volume ratio of 3 : 1 ?



Your answer ☐ **[1]**

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18 A diagram of a stained blood smear observed under a light microscope is shown below.



Which of the structures labelled **A** to **D** in the diagram is a neutrophil?

Your answer ☐ **[1]**

19 Which of the following options, **A** to **D**, is a primary defence mechanism against pathogens?

A neutralisation

B agglutination

C phagocytosis

D blood clotting

Your answer ☐ **[1]**

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20 Pathogens cause disease and are transmitted from individual to individual in a variety of ways.

Which of the rows, **A** to **D**, in the table below is correct?

	Disease	**Type of pathogen**	**Means of transmission**
A	Athlete's foot	Fungus	Direct and indirect contact
B	HIV/AIDs	Virus	Indirect contact
C	Malaria	Bacterium	Vector
D	Tuberculosis	Protoctist	Direct contact

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

21 Fig. 21.1 shows some of the apparatus used in an experiment investigating water potential in potato tuber tissue.

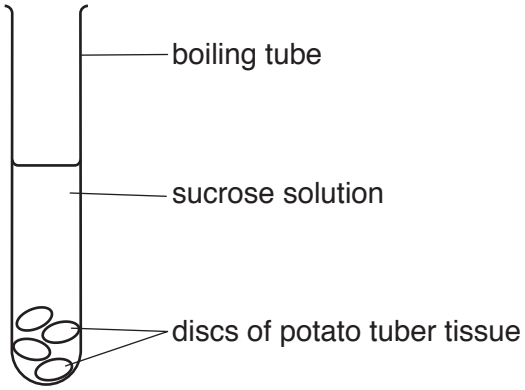


Fig. 21.1

The discs were placed in boiling tubes containing sucrose solutions of different concentrations for four hours. The percentage change of mass was then calculated.

The results are shown in Table 21.2.

Concentration of sucrose solution (mol dm^{-3})	Change in mass of potato discs (%)
0.00	+18.00
0.10	+12.50
0.20	+ 2.50
0.30	– 3.00
0.40	– 8.00
0.45	–11.50

Table 21.2

(a) (i) State **two** details of the procedure that must be followed to obtain valid results.

1 .....

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2 .....

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[2]

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(ii) Explain how a student could use the data in Table 21.2 to determine the water potential of the potato tuber tissue.

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

(b) Fig. 21.3 shows a diagram of a cell from a potato tuber disc that was placed in 0.45 mol dm^{-3} sucrose solution.

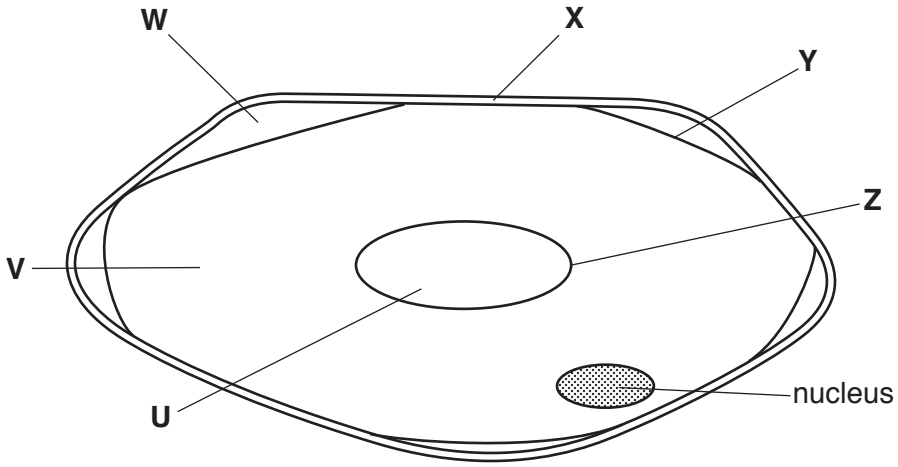


Fig. 21.3

(i) Identify the parts of the cell labelled **X**, **Y** and **Z**.

X .....

Y .....

Z .....

[3]

(ii) What will be found at **W** in the immersed cell?

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

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(c) Halophytes are plants that have the ability to live in soils with a very low water potential. In the UK these plants form part of salt marsh communities.

Suggest **and** explain how the root hairs of halophytes are able to absorb water by osmosis from the soil of the salt marsh.

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

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22 Even the smallest DNA molecules are very long.

- A kilobase (Kb) is a unit equivalent to 1000 base pairs of a DNA molecule.
- One Kb of double stranded DNA has a length of 0.34 μm.

(a) The DNA in the nucleus of a cell from a fruit fly (*Drosophila*) is 5.6 cm long.

(i) Calculate the number of Kb in the DNA of the fruit fly.
Show your working. Give your answer to the nearest whole number.

Answer = ... Kb **[2]**

(ii) The DNA of the fruit fly was analysed and 22% of the bases were adenine.

What % of the bases were guanine? Show your working.

Answer = ... % **[2]**

(b) A DNA molecule contains polynucleotide strands.

(i) Individual nucleotides are joined together to make a polynucleotide strand.

What type of chemical reaction takes place when two nucleotides in a single polynucleotide strand are joined together?

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

(ii) Name the chemical released when the bond is formed between the two nucleotides.

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

(iii) A DNA molecule contains two polynucleotide chains.

Describe how these two chains are held together.

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

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23 The Sumatran rhinoceros, *Dicerorhinus sumatrensis*, is a rare member of the family Rhinocerotidae. These rhinoceros are now critically endangered, with only six substantial populations in the wild: four in Sumatra, one in Borneo, and one in the Malay Peninsula.

D. sumatrensis lives in rainforests. Their numbers are difficult to determine but they are estimated to number fewer than 100.

(a) Complete the table below, showing the classification of the Sumatran rhinoceros.

Kingdom	.....
Phylum	Chordata
.....	Mammalia
.....	Perissodactyla
Family	Rhinocerotidae
.....	Dicerorhinus
Species	.....

[2]

(b) The name *Dicerorhinus sumatrensis* is part of the binomial naming system.

State an advantage of using this system rather than using the common name, Sumatran rhinoceros.

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

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(c) (i) Suggest **two** reasons why this species is critically endangered in the wild.

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

(ii) The remaining populations of *D. sumatrensis* are all small and are scattered in isolated areas. These are factors that might speed up the extinction of the species.

Suggest why.

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

(iii) Captive breeding programmes with *D. sumatrensis* have been unsuccessful.

Suggest **one** other way in which zoos can contribute to the conservation of the Sumatran rhinoceros.

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

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24 In mammalian blood, oxygen is mainly transported combined with haemoglobin. The presence of haemoglobin greatly increases the oxygen carrying capacity of blood.

- 100 cm^3 of plasma contains 0.3 cm^3 of oxygen when fully saturated.
- 100 cm^3 of blood contains 20.1 cm^3 of oxygen when fully saturated.

(a) Calculate the percentage increase in oxygen carried in fully saturated **blood** compared with oxygen carried in fully saturated **plasma**.

Show your working.

Answer = ... % **[2]**

(b) Haemoglobin is found in erythrocytes. Unlike other vertebrates, the mature erythrocytes of mammals lack nuclei and other membrane-bound organelles.

(i) Explain **one** advantage and **one** disadvantage of the lack of nuclei and other membrane-bound organelles to mammalian erythrocytes.

Advantage .....

.....

Disadvantage .....

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

(ii) Viruses do not use erythrocytes as host cells, whereas the malarial pathogen *Plasmodium* spends part of its life cycle inside erythrocytes.

Suggest why.

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

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(iii) Explain why erythrocytes do **not** make use of any of the oxygen that they are transporting.

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

(c) Oxygenated blood returns from the lungs to the heart before being pumped around the body.

(i)
- Normal cardiac output is $5\,dm^3\,min^{-1}$.
- $100\,cm^3$ of blood contains $20.1\,cm^3$ of oxygen when fully saturated.

Calculate the volume (cm^3) of oxygen being transported to the tissues per minute.

Show your working and give your answer to **four significant figures**.

Answer = ... cm^3 **[2]**

(ii) With reference to the structure of blood vessels, explain why oxygen is **not** released until the blood reaches the capillaries.

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

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(d) Fig. 24 shows the oxygen dissociation curves at different carbon dioxide concentrations.

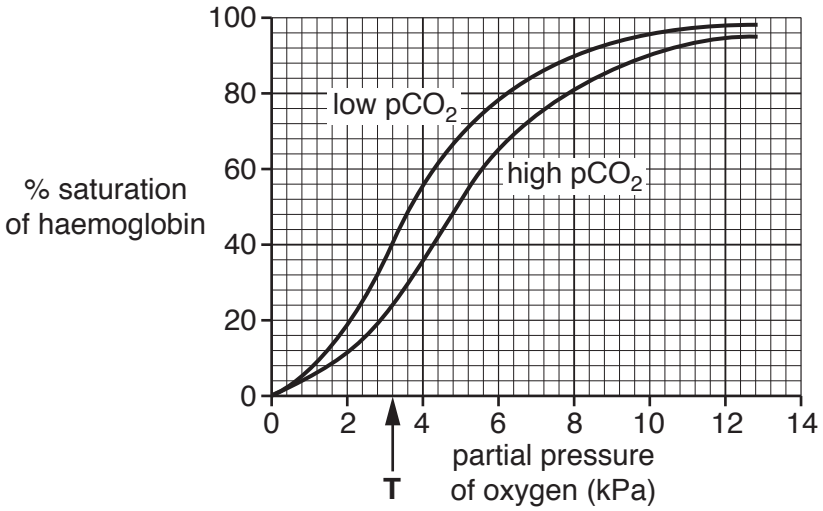


Fig. 24

(i) What name is given to a change in the oxygen dissociation curve due to increasing carbon dioxide concentration?

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

(ii) Letter **T** in Fig. 24 indicates the partial pressure of oxygen in actively respiring tissues.

Explain why the blood off-loads more oxygen to actively respiring tissues than to resting tissues.

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

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25 The following statements summarise the results from experiments designed to discover more about the translocation of organic materials in the phloem.

A	Any increase in the sugar content of leaves is followed by a similar change in the sieve tube contents in the stem.
B	The rate of transport increases with increasing temperature, reaching a maximum at 25 °C before decreasing at higher temperatures.
C	Translocation stops when stems are treated with a substance that inhibits respiration.
D	Sugars can be transported both up and down the plant.
E	Aphids can be used to sample phloem sap.
F	Roots, young leaves and growing fruits will import sugars.

(a) State all the letters that provide evidence for the following conclusions:

Translocation is an active process.

.....

Sugars are translocated from source to sink.

.....

[4]

(b) Explain how mass flow of the phloem sap occurs in plants with a vascular system.

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

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin.

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