Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **October/November 2022**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

DC (PQ/SG) 306205/2

[Turn over

1 **(a)** During translation, a polypeptide is synthesised when amino acids are added to a growing chain of amino acids.

Fig. 1.1 shows part of a growing chain of amino acids and the amino acid cysteine.

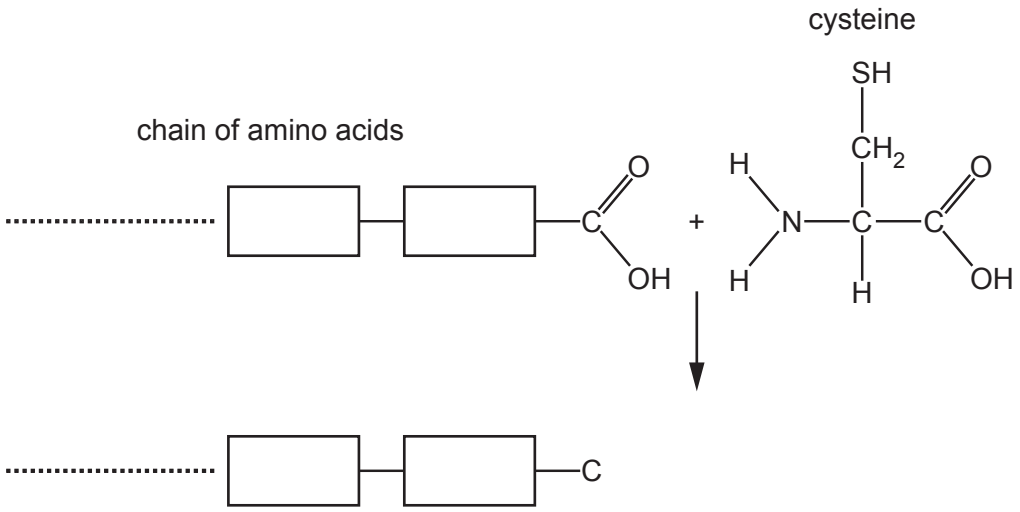

Fig. 1.1

(i) Complete Fig. 1.1 by showing the formation of the bond between cysteine and the growing chain of amino acids in the process of translation. [3]

(ii) State the name of the covalent bond that forms when cysteine is added to the growing chain of amino acids.

..... [1]

(iii) State the organelle where the reaction shown in Fig. 1.1 takes place.

..... [1]

(b) Fig. 1.2 is a ribbon diagram showing the three-dimensional structure of a protein from the bacterium *Streptococcus*.

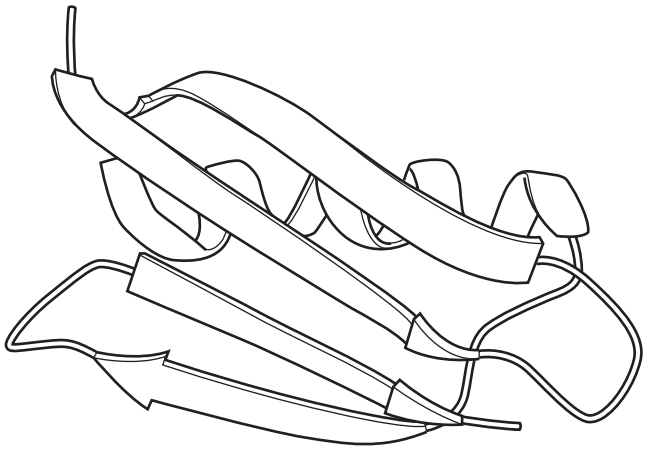

Fig. 1.2

(i) Describe the secondary structure of the protein shown in Fig. 1.2.

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..... [2]

(ii) Explain why the protein shown in Fig. 1.2 has tertiary structure, but not quaternary structure.

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..... [2]

(iii) An analysis of the amino acid composition of the protein in Fig. 1.2 showed that it does **not** contain any cysteine residues.

Explain how the three-dimensional structure of the protein shown in Fig. 1.2 is held in place.

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..... [3]

[Total: 12]

2 Fig. 2.1 is a scanning electron micrograph showing a macrophage engulfing some bacteria.

Fig. 2.1

(a) (i) Describe how macrophages engulf bacteria.

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..... [3]

(ii) Explain the functions of lysosomes in cells such as macrophages.

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..... [3]

Question 2 continues on page 6.

(b) Fig. 2.2 shows the reported number of new cases of tuberculosis (TB) in the USA and the number of new cases per 100 000 of the population of the USA between 1993 and 2018.

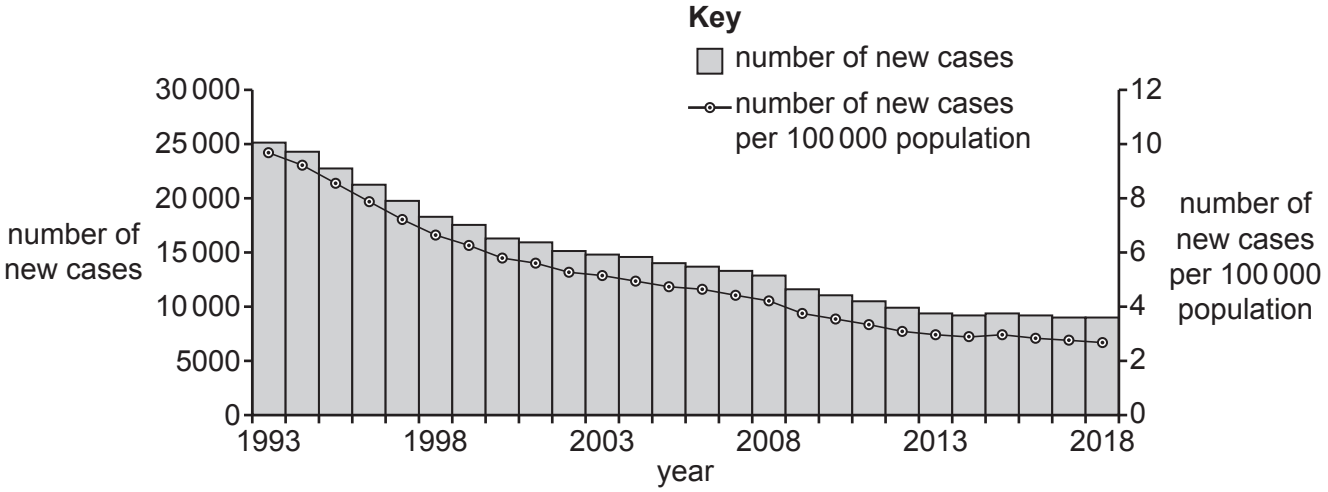

Fig. 2.2

(i) Calculate the percentage change in the number of new cases of TB in the USA between 1993 and 2018.

Show all your working.

answer ..... % [3]

(ii) Use Fig. 2.2 to describe the trend in the number of new cases of TB in the USA between 1993 and 2018.

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..... [2]

(c) Suggest an advantage of calculating the number of new cases per 100 000 each year in the prevention and control of TB across the world.

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..... [1]

(d) TB is endemic (always present) in many populations across the world and many countries have high numbers of cases.

State **two** reasons why it is difficult to reduce the number of cases of TB across the world.

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..... [2]

[Total: 14]

3 **(a)** Explain how water moves up xylem vessels in the trunks of trees.

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..... [4]

(b) Cavitation is the formation of air-filled spaces inside the columns of water in xylem vessels in trees. These air-filled spaces form more often when there are high rates of movement of water in xylem vessels.

When an air-filled space forms in a xylem vessel, a noise is made that can be detected as a 'click' by a sensor placed close to the xylem vessels in the trunk of a tree.

Students investigated the relationship between two environmental factors and the rate of cavitation in a Scots pine tree, *Pinus sylvestris*, over a 50-hour period. The two factors they investigated were:

- photosynthetically active radiation (PAR), which is the light energy available to plants that they absorb and use in photosynthesis
- wind speed.

The cavitation rate was estimated by recording the number of clicks detected by the sensor. The results are shown in Fig. 3.1.

Suggest the conclusions that can be made with reference to the data in Fig. 3.1.

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..... [3]

[Total: 7]

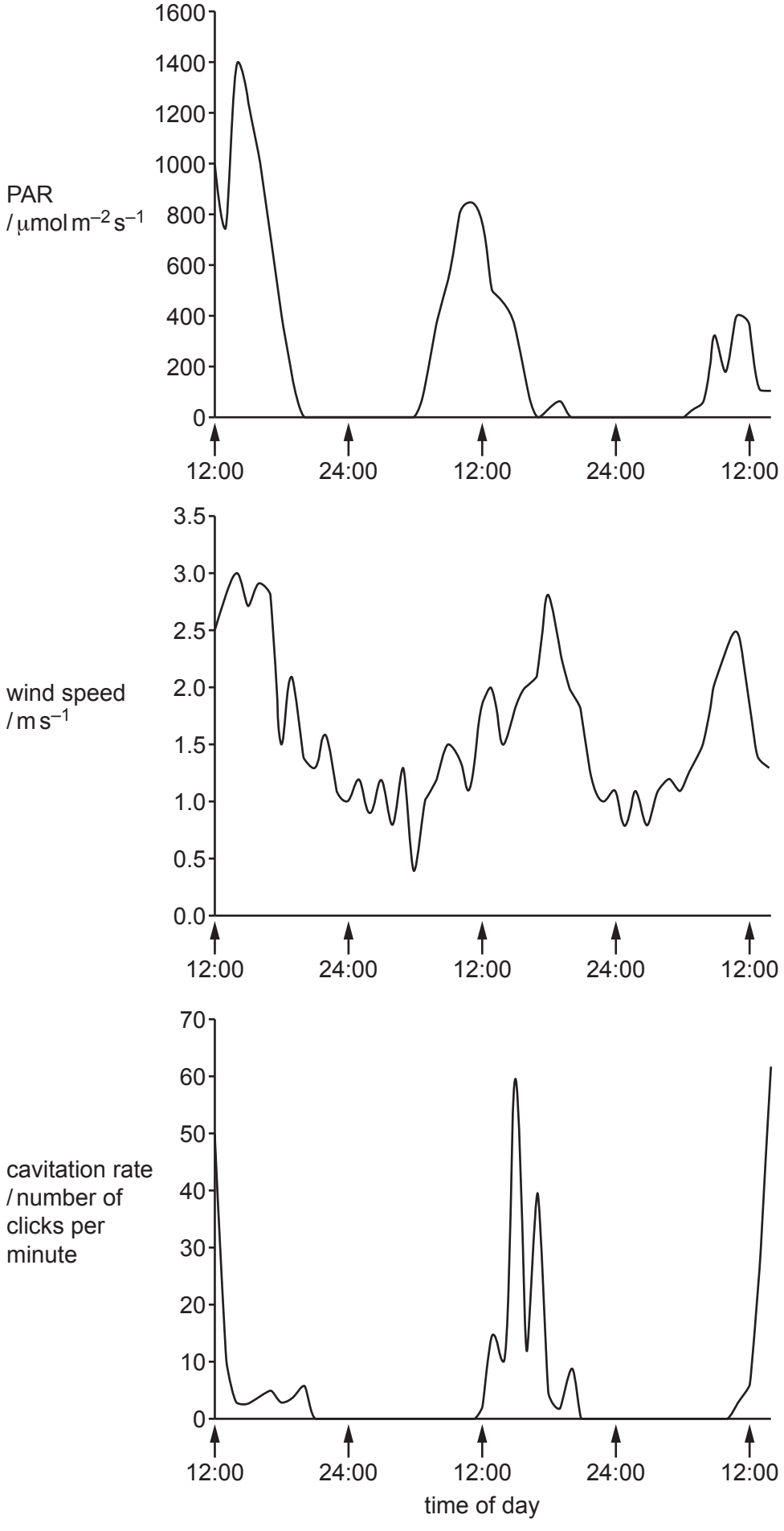
PAR / μmol m−2 s−1
1600
1400
1200
1000
800
600
400
200
0
12:00
24:00
12:00
24:00
12:00
wind speed / m s−1
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
12:00
24:00
12:00
24:00
12:00
cavitation rate / number of clicks per minute
70
60
50
40
30
20
10
0
12:00
24:00
12:00
24:00
12:00
time of day

Fig. 3.1

4 The early development of an animal involves divisions of the zygote and daughter cells by mitosis to form an embryo consisting of genetically identical cells.

Fig. 4.1 shows several cells at various stages of the cell cycle in an embryo of whitefish, *Coregonus artedi*.

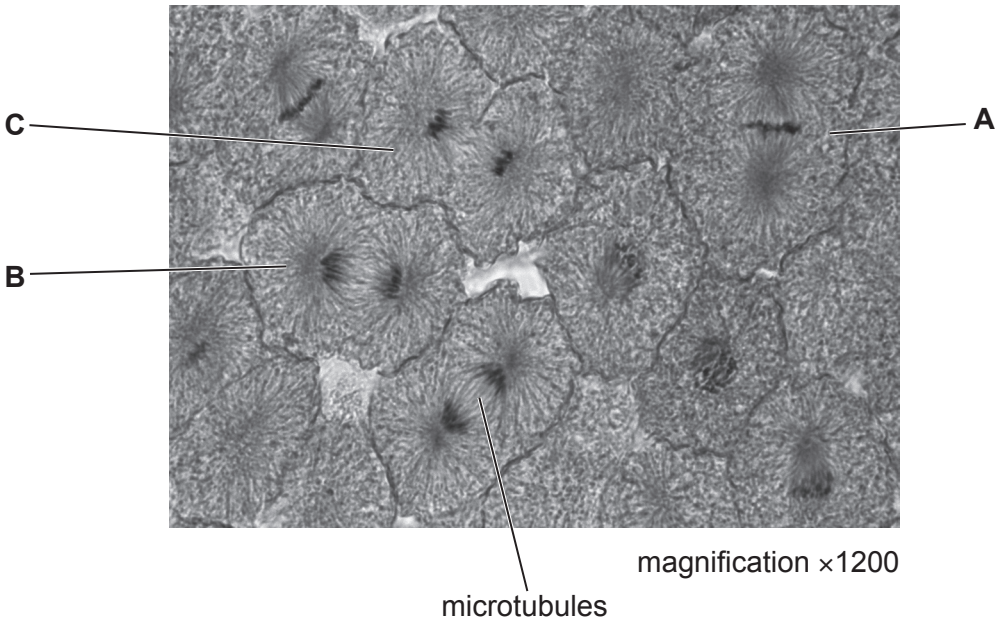

Fig. 4.1

(a) (i) Name the stage of mitosis in cell **A** and in cell **B**, shown in Fig. 4.1.

A .....

B .....

[2]

(ii) Fig. 4.1 shows microtubules in the cells that are dividing.

Describe the role of microtubules in mitosis.

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..... [3]

(iii) State what happens in cell **C**, shown in Fig. 4.1, until two new cells are formed.

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..... [3]

(b) The cells produced in the developing whitefish are genetically identical.

Identify **and** explain **two** events that occur during the cell cycle that lead to daughter cells being genetically identical.

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..... [3]

[Total: 11]

5 Cathelicidin LL-37 is a cell signalling compound that stimulates many different cells in humans. One role of cathelicidin LL-37 is stimulating the production of endothelial cells in the formation of capillaries during wound healing.

(a) (i) Explain how it is possible for many different cell types to respond to the same cell signalling compound.

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..... [2]

(ii) Describe the appearance of the endothelial cells of a capillary.

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..... [2]

Cathelicidin LL-37 is a protein composed of 37 amino acids.

Table 5.1 shows:

- the sequence of the first 10 amino acids in the primary structure of cathelicidin LL-37
- DNA triplets in the non-transcribed strand in the gene that codes for the first 10 amino acids in the primary structure of cathelicidin LL-37.

Table 5.1

amino acid position	1	2	3	4	5	6	7	8	9	10
amino acid	leu	leu	gly	asp	phe	phe	arg	lys	ser	lys
DNA triplet	CTG	CTG	GGT	GAT	TTC	TTC	CGG	AAA	TCT	AAA

Table 5.2 shows the triplets of bases in **DNA** and the amino acids for which they code.

Table 5.2

first base	second base: T		C		A		G		third base
T	TTT	phe	TCT	ser	TAT	tyr	TGT	cys	**T**
	TTC		TCC		TAC		TGC		**C**
	TTA	leu	TCA		TAA	stop	TGA	stop	**A**
	TTG		TCG		TAG		TGG	try	**G**
C	CTT	leu	CCT	pro	CAT	his	CGT	arg	**T**
	CTC		CCC		CAC		CGC		**C**
	CTA		CCA		CAA	gln	CGA		**A**
	CTG		CCG		CAG		CGG		**G**
A	ATT	ile	ACT	thr	AAT	asp	AGT	ser	**T**
	ATC		ACC		AAC		AGC		**C**
	ATA	ile	ACA		AAA	lys	AGA	arg	**A**
	ATG	met	ACG		AAG		AGG		**G**
G	GTT	val	GCT	ala	GAT	asp	GGT	gly	**T**
	GTC		GCC		GAC		GGC		**C**
	GTA		GCA		GAA	glu	GGA		**A**
	GTG		GCG		GAG		GGG		**G**

(b) Mutations of DNA base sequences in a gene can affect the primary structure of proteins.

Use the information in Table 5.1 and Table 5.2 to suggest the effect on the primary structure of cathelicidin LL-37 of:

(i) the substitution of the base T with the base A in the middle of the triplet at position 5

..... [1]

(ii) the deletion of base T in the triplet at position 2

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..... [2]

(iii) the insertion of base G between bases G and T in the triplet at position 3.

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..... [2]

(c) The genetic code is described as universal.

Explain why the genetic code is described as universal.

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..... [1]

(d) Use Table 5.2 to explain why some mutations have no effect on the primary structure of a protein.

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..... [2]

[Total: 12]

6 Fig. 6.1 shows some of the events that occur when a red blood cell flows through a capillary in the lungs.

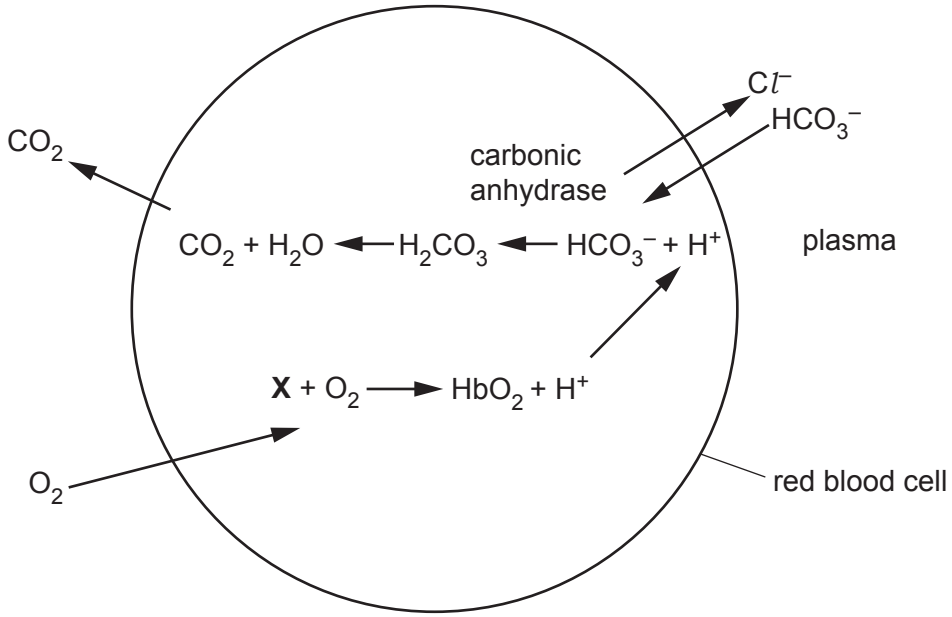

Fig. 6.1

(a) State why there are transport proteins in the membranes of red blood cells to allow the movement of hydrogencarbonate ions (HCO_3^-) and chloride ions (Cl^-).

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..... [1]

(b) Fig. 6.1 shows that chloride ions move out of the red blood cells.

Explain why this movement is necessary when red blood cells flow through capillaries in the lungs.

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..... [1]

(c) State why carbon dioxide molecules diffuse from the red blood cells into the plasma.

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..... [1]

(d) State the name of the compound indicated by **X**.

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..... [1]

[Total: 4]

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