Transport in mammals – AS 9700 June 2022

1. June/2023/Paper_9700/11/No.11

Which statement correctly explains why blood plasma can be maintained at a stable temperature?

A It has a low specific heat capacity.

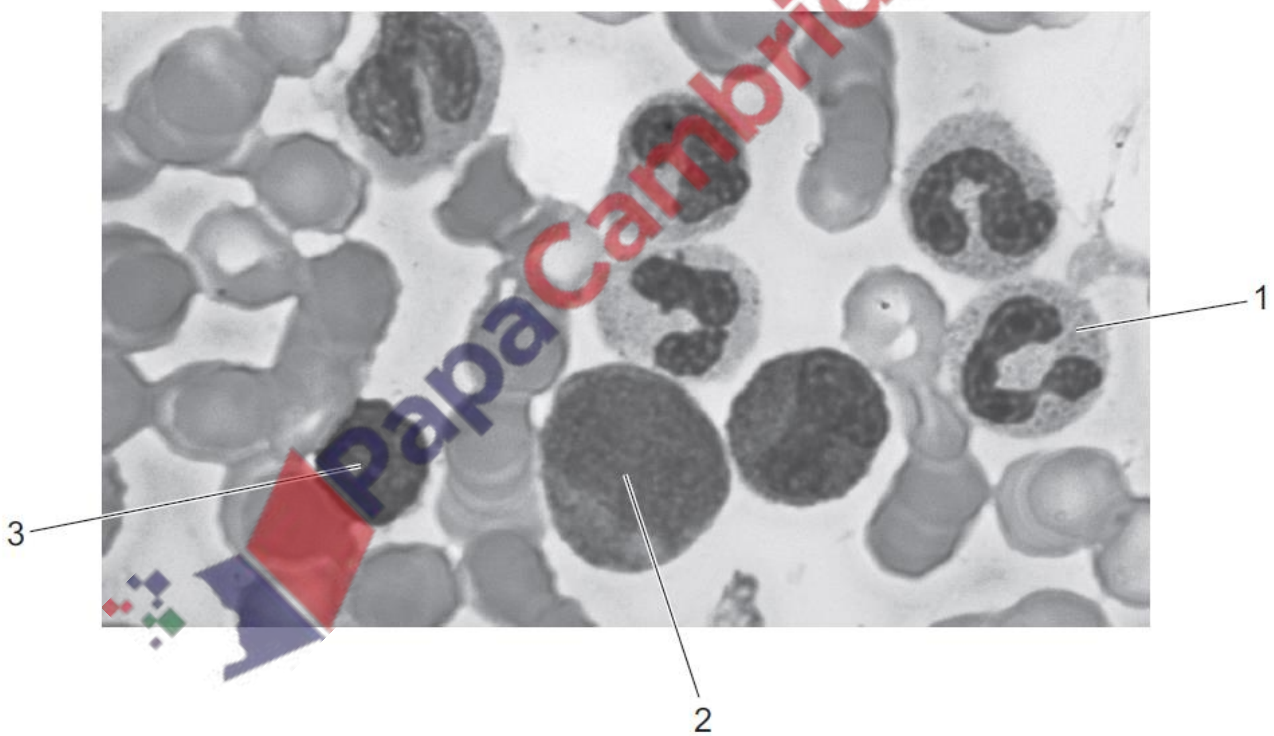
B It has a high specific heat capacity.

C It has a low latent heat of vaporisation.

D It has a high latent heat of vaporisation.

2. June/2023/Paper_9700/11/No.28

The photomicrograph shows blood cells as seen using a high-power light microscope.

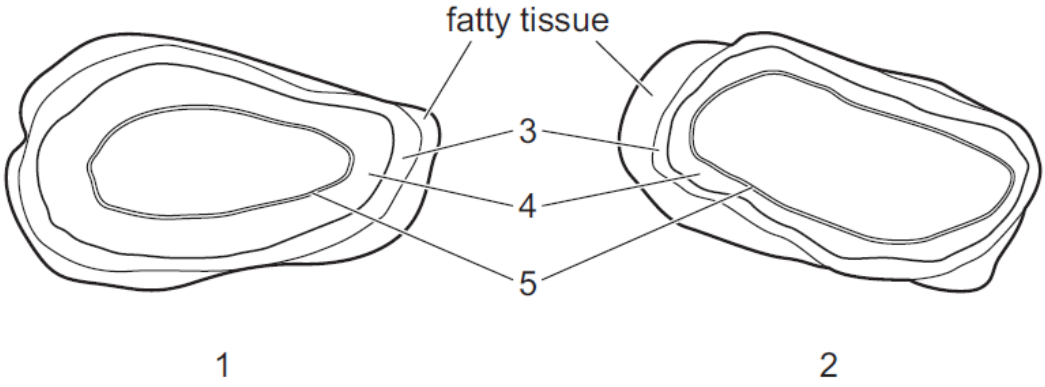


Which row correctly identifies the different types of white blood cell?

	1	2	3
A	lymphocyte	monocyte	neutrophil
B	monocyte	neutrophil	macrophage
C	neutrophil	monocyte	lymphocyte
D	phagocyte	lymphocyte	monocyte

3. June/2023/Paper_9700/11/No.29

Plan diagrams of two blood vessels are shown.



Which labels are correct?

	1	2	3	4	5
A	aorta	vena cava	elastic fibres	smooth muscle	epithelium
B	artery	vein	collagen fibres	smooth muscle and elastic tissue	endothelium
C	vein	artery	collagen fibres	elastic fibres	squamous cells
D	coronary artery	coronary vein	elastic fibres	smooth muscle and elastic tissue	epithelium

4. June/2023/Paper_9700/11/No.30

What are found in blood and tissue fluid?

1 carbon dioxide

2 fatty acids

3 white blood cells

4 proteins

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

5. June/2023/Paper_9700/11/No.31

Which reactions would be slowed down by an inhibitor of carbonic anhydrase?

1 CO_2 + haemoglobin → carbaminohaemoglobin

2 $CO_2 + H_2O \rightarrow H_2CO_3$

3 $H_2CO_3 \rightarrow H^+ + HCO_3^-$

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

6. June/2023/Paper_9700/11/No.32

Which sequence of letters correctly identifies the order of events during the cardiac cycle?

T atrial walls contract

U impulse is delayed by a fraction of a second

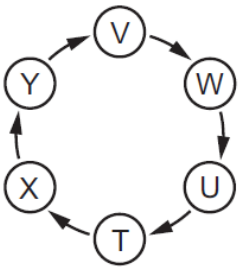
V wave of excitation enters the atrioventricular node

W wave of excitation passes down the Purkyne tissue

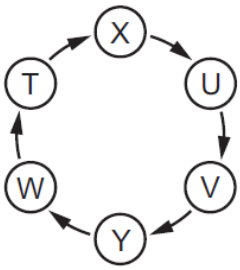
X wave of excitation spreads from the sinoatrial node

Y ventricles contract

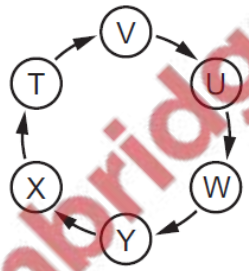
A



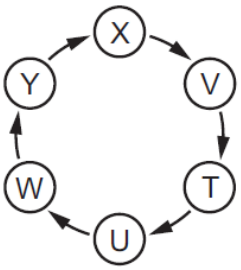
B



C

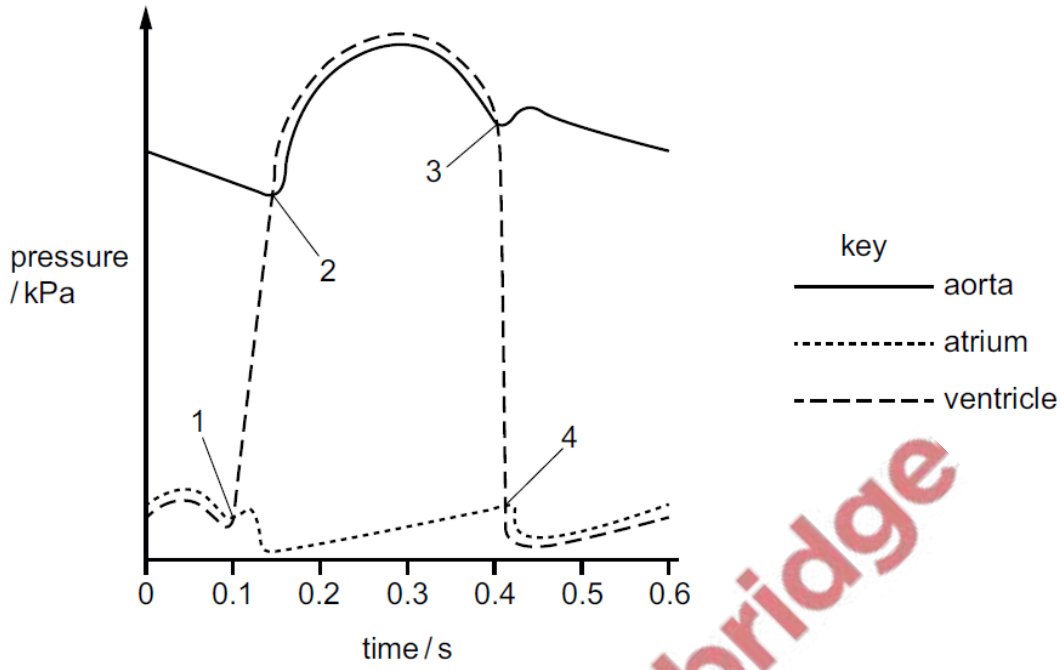


D



7. June/2023/Paper_9700/11/No.33

The diagram gives information about blood pressure in the left side of the heart during the cardiac cycle.



Valves open and close at the points numbered.

Which row identifies the valves opening or closing at the points numbered?

	atrioventricular valve opens	semilunar valve opens	atrioventricular valve closes	semilunar valve closes
A	1	3	4	2
B	2	4	3	1
C	3	1	2	4
D	4	2	1	3

8. June/2023/Paper_9700/12/No.32

Which properties of water are essential for its role in the transport of blood in mammals?

	high latent heat of vaporisation	solvent for polar substances
A	✓	✗
B	✗	✓
C	✓	✓
D	✗	✗

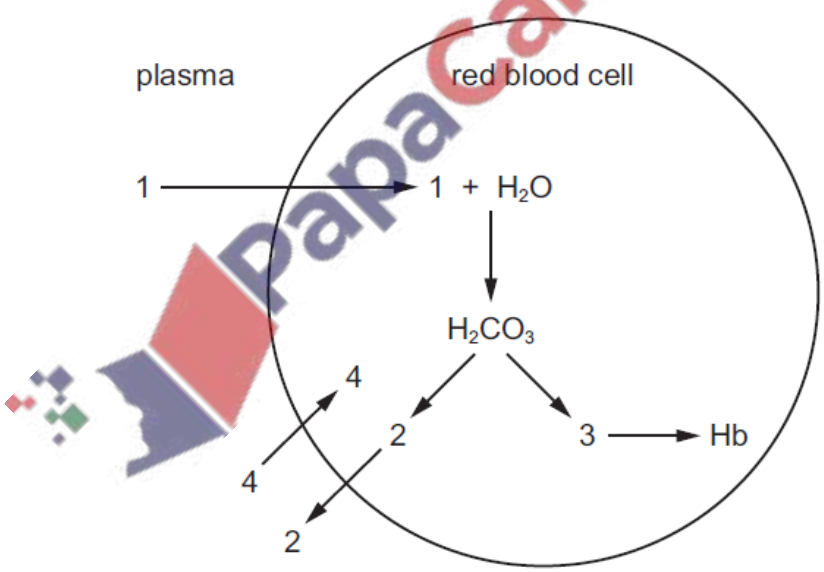
key

✓ = essential

✗ = not essential

9. June/2023/Paper_9700/12/No.33

The diagram shows some of the events that happen between the plasma and the red blood cells in the circulatory system.



What do the numbers 1, 2, 3 and 4 represent?

	1	2	3	4
A	Cl^-	HCO_3^-	H^+	CO_2
B	CO_2	HCO_3^-	H^+	Cl^-
C	HCO_3^-	Cl^-	CO_2	H^+
D	CO_2	H^+	HCO_3^-	Cl^-

10. June/2023/Paper_9700/12/No.34

The diagrams show the valves in the heart when viewed in cross-section from above at different stages in the cardiac cycle.

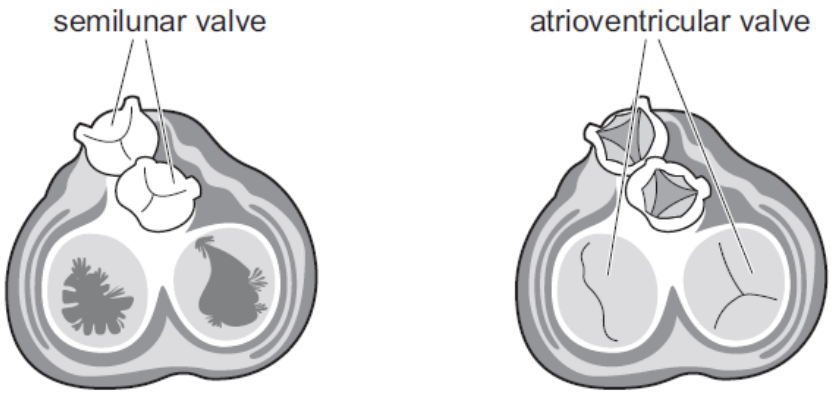


diagram 1 diagram 2

Which stages in the cardiac cycle are shown?

	diagram 1	diagram 2
A	diastole	ventricular systole
B	atrial systole	diastole
C	ventricular systole	diastole
D	diastole	atrial systole

11. June/2023/Paper_9700/13/No.33

What is present in the blood in human veins?

1 chloride ions

2 carbonic anhydrase

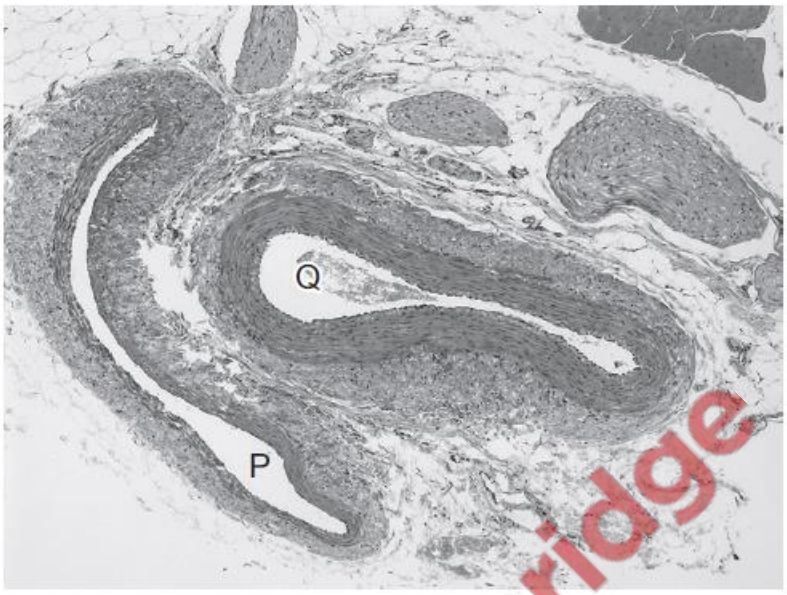
3 oxyhaemoglobin

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

12. June/2023/Paper_9700/13/No.34

The photomicrograph shows two blood vessels P and Q.

Both these blood vessels are part of a network which transports blood around the body.

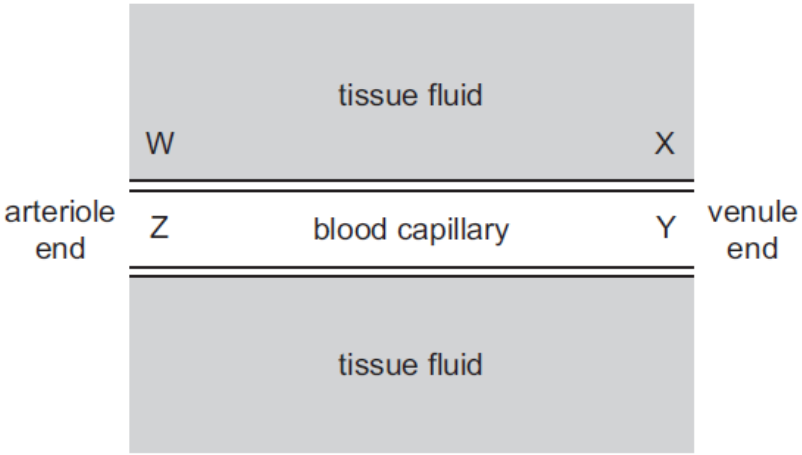


Which row is correct for blood vessel P and blood vessel Q?

	blood vessel P	blood vessel Q
A	carries blood into arterioles	carries blood into arterioles
B	carries blood into arterioles	carries blood from venules
C	carries blood from venules	carries blood into arterioles
D	carries blood from venules	carries blood from venules

13. June/2023/Paper_9700/13/No.35

The diagram shows a blood capillary and the tissue fluid which surrounds it.



Tissue fluid is formed when fluid and solutes from blood plasma pass through tiny gaps in the capillary wall. Most tissue fluid is then returned to the blood in the capillary.

Which pressures will be needed at points W, X, Y and Z so that this system can function?

	pressure at W / mm Hg	pressure at X / mm Hg	pressure at Y / mm Hg	pressure at Z / mm Hg
A	18	26	36	26
B	26	26	18	36
C	26	36	26	18
D	36	18	26	26

14. June/2023/Paper_9700/13/No.36

What happens during ventricular systole in a mammalian heart?

A Aortic pressure increases.

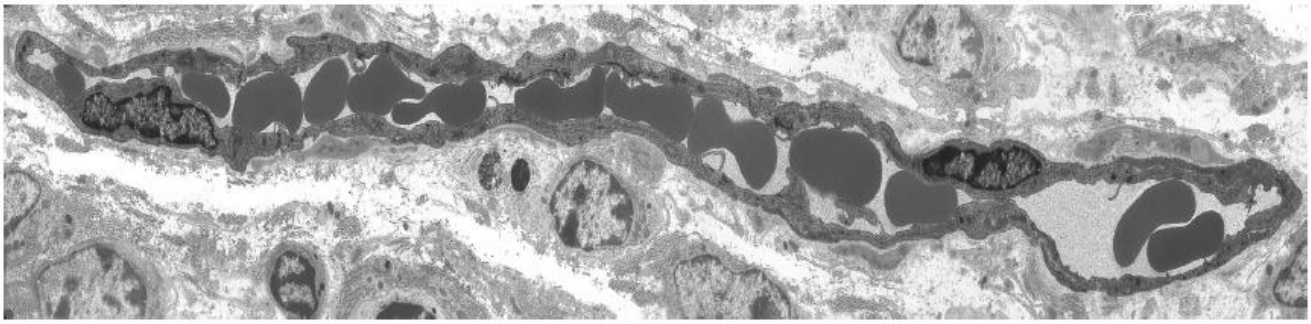
B Atrioventricular valves open.

C Semilunar valves close.

D Ventricular pressure decreases.

15. June/2023/Paper_9700/21/No.5

Fig. 5.1 is a longitudinal section of a capillary in muscle tissue as viewed with a transmission electron microscope.



magnification ×2000

Fig. 5.1

(a) State the evidence, **visible in Fig. 5.1**, that identifies the cells inside the capillary as red blood cells.

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(b) Explain how the structure of the capillary wall is related to its functions.

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(c) Fig. 5.2 is a diagram showing some of the events that occur as blood flows through a capillary in a respiring tissue.

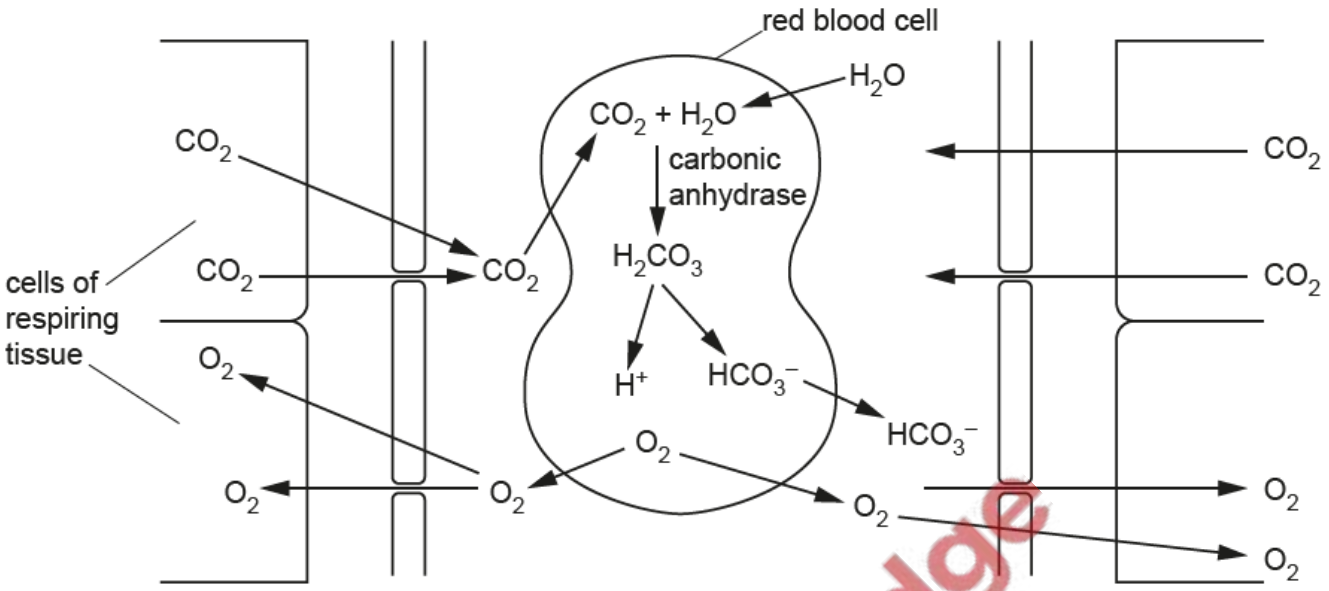

Fig. 5.2

(i) An increase in respiration results in an increase in the carbon dioxide concentration in the blood and the release of more oxygen from red blood cells to tissues.

Explain how an increase in carbon dioxide in the blood leads to the release of more oxygen from red blood cells.

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(ii) Chloride ions are a constituent of blood plasma. The concentration of chloride ions in the plasma of deoxygenated blood is between 2–4 mmol dm^{-3} lower than in the plasma of oxygenated blood.

Explain why the concentration of chloride ions in the blood plasma of deoxygenated blood is lower than in the plasma of oxygenated blood.

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..... [2]

[Total: 11]

16. June/2023/Paper_9700/22/No.1

The sinoatrial node (SAN) and the atrioventricular node (AVN) have an important role in the control of the cardiac cycle. The timing of atrial and ventricular systole and diastole must be controlled so that blood passes through the heart efficiently.

(a) Fig. 1.1 is a summary of blood flow through the **right** side of the heart during one cardiac cycle. Three boxes in Fig. 1.1 are **not** complete.

Complete boxes **3**, **5** and **7** in Fig. 1.1 using **only** the terms **systole** and **diastole**.

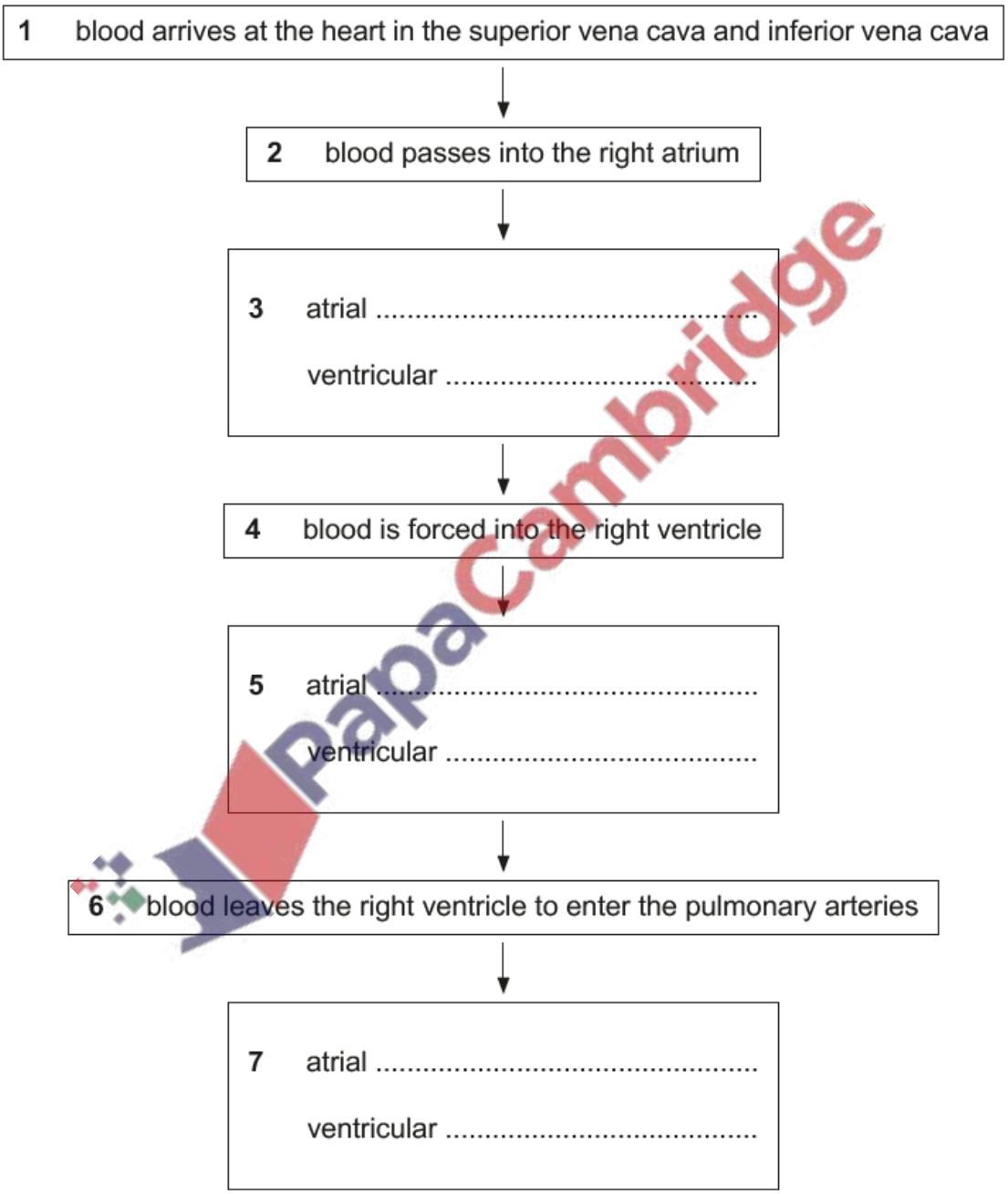

Fig. 1.1

[2]

(b) Impulses sent out by the SAN pass to the AVN, where there is a short delay.

With reference to Fig. 1.1, explain why it is important for the control of the cardiac cycle that there is a short delay at the AVN after impulses have been sent out by the SAN.

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(c) Changes in blood pressure occur in the heart during the cardiac cycle. These changes cause the opening and closing of the bicuspid and tricuspid (atrioventricular) valves and the aortic and pulmonary (semilunar) valves.

Explain how blood pressure changes:

- cause the **opening** of the **tricuspid** valve
- cause the **opening** of the **pulmonary** valve
- help the flow of blood through the heart.

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..... [3]

[Total: 7]

17. June/2023/Paper_9700/23/No.3

Blood contains white blood cells and red blood cells.

(a) Fig. 3.1 is a photomicrograph showing different types of blood cell.

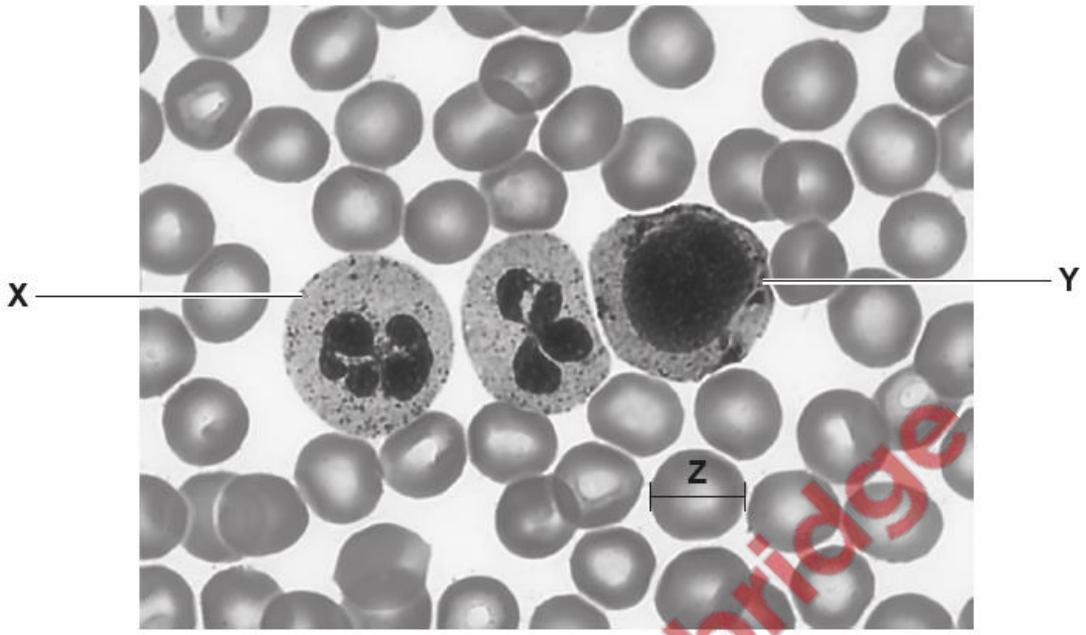

Fig. 3.1

(i) Identify cell **X** and cell **Y** in Fig. 3.1.

X .....

Y .....

[2]

(ii) The width of one of the cells in Fig. 3.1 is represented by the line **Z**.

The actual width of cell **Z** is 8 μm.

Calculate the magnification used to produce the image shown in Fig. 3.1.

Write down the formula you will use to make your calculation.

formula

magnification = x ..... [2]

(b) Carbonic anhydrase is an enzyme found in red blood cells.

(i) Describe how carbonic anhydrase is involved in the release of oxygen from red blood cells at respiring tissues.

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(ii) Sulfonamide is a competitive inhibitor of carbonic anhydrase.

Fig. 3.2 shows the effect of increasing substrate concentration on the rate of the reaction catalysed by carbonic anhydrase.

Sketch a curve **on Fig. 3.2** to show the effect of sulfonamide on the rate of reaction catalysed by carbonic anhydrase.

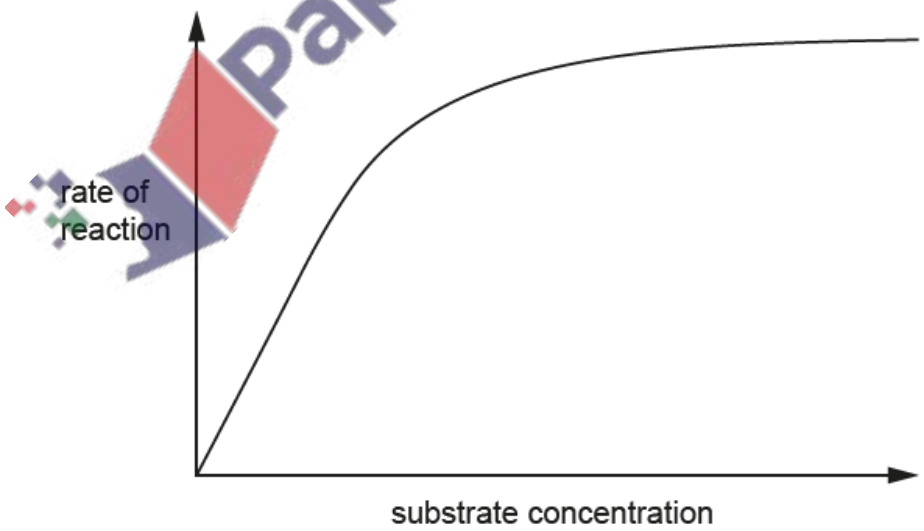


Fig. 3.2

[2]

[Total: 10]

18. March/2023/Paper_9700/12/No.20

The estimated total number of red blood cells in the human body is 2.5×10^{13}.

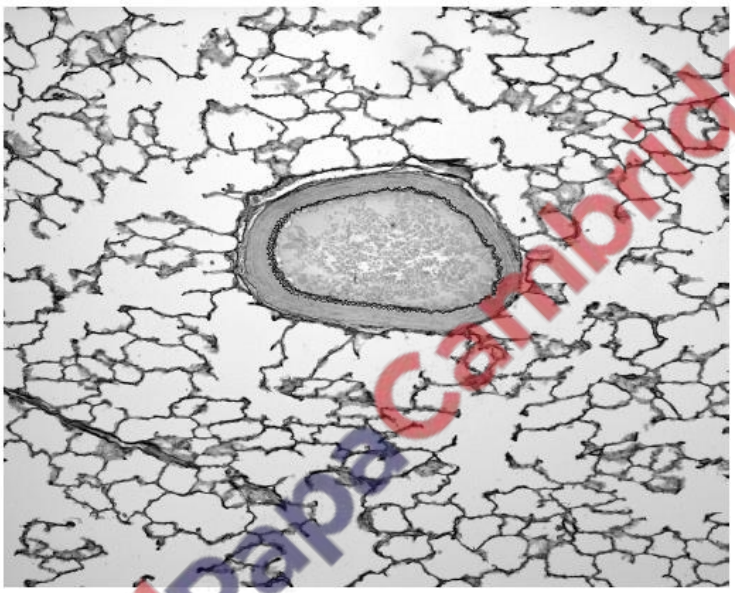
It is estimated that, each day, 2.5×10^{11} red blood cells are removed from the circulation and are replaced by stem cells in the bone marrow.

Which percentage of the total number of red blood cells is replaced each day?

A 0.01% **B** 0.1% **C** 1% **D** 10%

19. March/2023/Paper_9700/12/No.31

The photomicrograph shows a section through a tissue with an artery.



Which row correctly shows the type of artery and whether the blood inside the artery is oxygenated or deoxygenated?

	type of artery	blood
A	muscular	deoxygenated
B	muscular	oxygenated
C	elastic	deoxygenated
D	elastic	oxygenated

20. March/2023/Paper_9700/12/No.32

Heart surgery may cause a decrease in the transmission of impulses in the Purkyne tissue to the right side of the heart.

What is a possible effect of this decrease?

A Impulses would be delayed by the atrioventricular node.

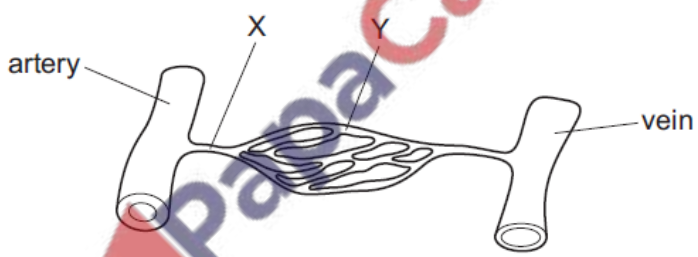
B The muscle of the right ventricle would contract slightly more slowly than the muscle of the left ventricle.

C The muscle of the right atrium would not contract as fully as the muscle of the left atrium.

D The sinoatrial node would transmit fewer impulses.

21. March/2023/Paper_9700/12/No.33

The diagram shows a network of blood vessels that supply blood to muscle tissue in the human body.



What is a correct comparison between the blood at X and the blood at Y when the muscle tissue is at rest?

	blood pressure at X compared with blood pressure at Y	water potential of blood at X compared with water potential of blood at Y
A	equal	higher
B	equal	lower
C	higher	higher
D	higher	lower

22. March/2023/Paper_9700/22/No.5

Pneumonia is a severe lung disease that can interfere with gas exchange. A person with pneumonia can be connected to an ECMO machine. This machine performs the gas exchange functions of the lungs.

A cannula (tube) is inserted into the right atrium and this takes blood to the ECMO machine. In the ECMO machine, blood is passed firstly to an artificial pump and then to an oxygenator, where gas exchange occurs. The blood is then warmed and returns by another cannula to the vena cava.

(a) Complete Fig. 5.1 to show how the ECMO machine is connected to the right atrium and to the vena cava. Use a single line to represent each cannula.

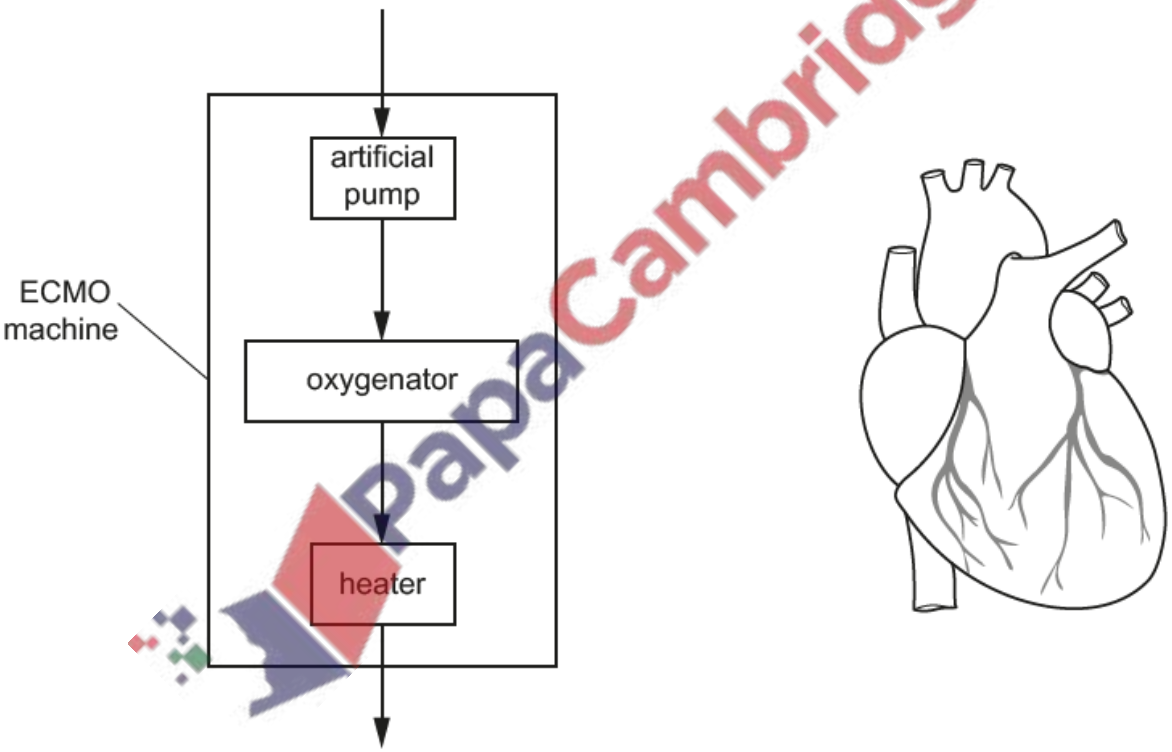


Fig. 5.1

[1]

(b) In the oxygenator, a partially permeable membrane separates the blood from air that has been enriched with extra oxygen.

(i) State the name of a structure in the gas exchange system that has the same function as the partially permeable membrane of the oxygenator.

..... [1]

(ii) In the oxygenator, blood and oxygen-enriched air flow in opposite directions.

Suggest **and** explain how the oxygenator carries out the functions of gas exchange that normally occur in the lungs.

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(c) Fig. 5.2 is a photomicrograph showing a transverse section of part of the human aorta.

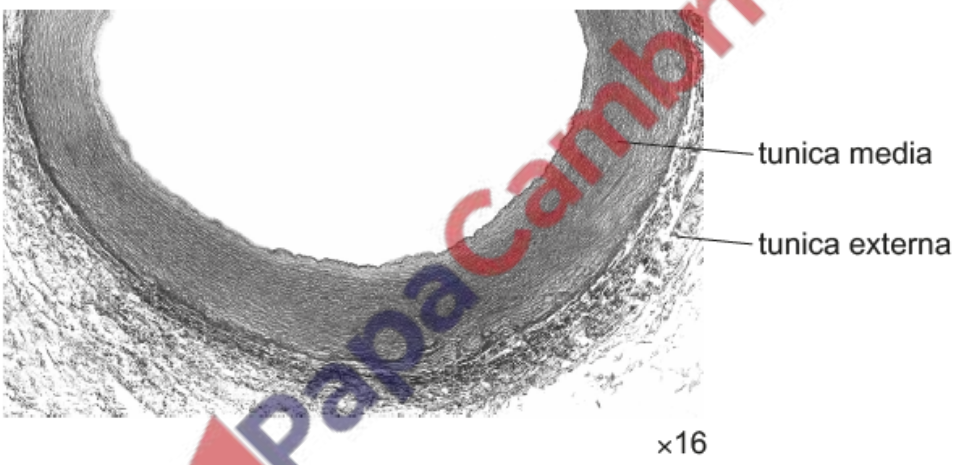

Fig. 5.2

Explain how the structure of the tunica media in Fig. 5.2 is different from the structure of the tunica media in a muscular artery **and** relate the difference to the function of the aorta.

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(d) Some biologists investigated the transport of carbon dioxide in the blood of *Caiman latirostris*, a type of reptile.

The biologists found that when *C. latirostris* respires:

- most of the carbon dioxide is converted into hydrogencarbonate ions in red blood cells
- the hydrogencarbonate ions combine with haemoglobin inside the red blood cells
- the hydrogencarbonate ions remain combined with haemoglobin until the blood reaches the lungs.

(i) Explain why the physiology of *C. latirostris* requires carbonic anhydrase.

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(ii) Explain why the physiology of *C. latirostris* does **not** require the chloride shift.

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[Total: 10]