

Transport in Mammals

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Transport in Mammals
Sub Topic	
Booklet	Multiple Choice
Paper Type	Question Paper 1

Time Allowed : 60 minutes

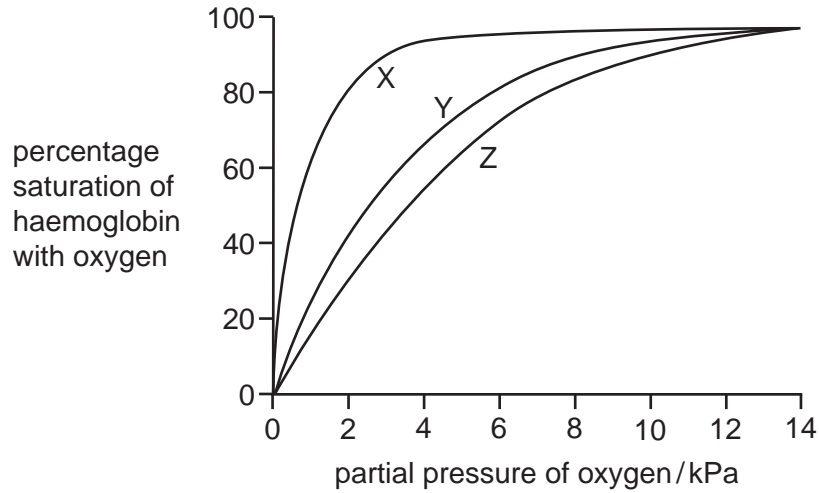
Score : / 50

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 The graph shows the oxygen dissociation curves for haemoglobin from three different animals.



Which of the haemoglobins, X, Y or Z, would be present in each of the animals 1, 2 or 3?

- 1 an adult human
- 2 a fish living in water that has a very low oxygen concentration
- 3 a very active mammal whose tissues have a much higher rate of respiration than an adult human

	1	2	3
A	X	Y	Z
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

2 What explains how the uptake of oxygen is maximised as blood passes through the capillaries of the lungs?

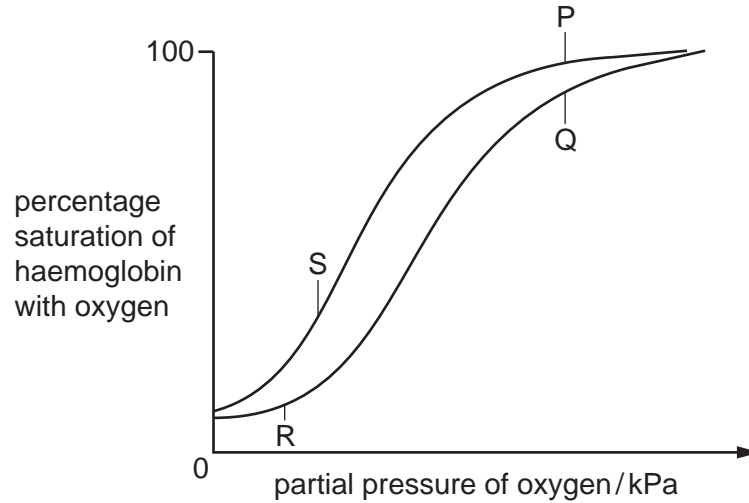
- A** Each haemoglobin molecule can temporarily bind to four oxygen atoms.
- B** Oxyhaemoglobin formation increases the capacity of red blood cells to transport oxygen.
- C** The binding of the first oxygen molecule to haemoglobin decreases the molecule's affinity for binding other oxygen molecules.
- D** The dissociation of carbon dioxide from carboxyhaemoglobin allows more haemoglobin to be available for oxygen binding.

- 3 What happens after carbonic anhydrase has catalysed a reaction involved in the transport of carbon dioxide?
- A** the dissociation of oxyhaemoglobin to haemoglobin and oxygen
 - B** the formation of carbaminohaemoglobin from carbon dioxide and haemoglobin
 - C** the formation of carbon dioxide and water from carbonic acid
 - D** the formation of oxyhaemoglobin from haemoglobin and oxygen
- 4 Which reaction takes place in a capillary in the lungs?
- A** the formation of carbaminohaemoglobin from carbon dioxide and haemoglobin
 - B** the formation of carbon dioxide and water from hydrogen carbonate ions and hydrogen ions
 - C** the formation of carbonic acid from carbon dioxide and water
 - D** the formation of haemoglobinic acid from haemoglobin and hydrogen ions

5 Resting muscle has a lower respiration rate than active muscle. The graph shows the oxygen dissociation curves for haemoglobin at carbon dioxide concentrations that are found in a resting muscle and an active muscle.

P and Q are at the partial pressures of oxygen found in the lungs.

R and S are at the partial pressures of oxygen found in **either** a resting muscle **or** an active muscle.



Which statements are correct?

- 1 The % saturation at P minus the % saturation at S represents the amount of oxygen delivered to a resting muscle.
- 2 The % saturation at Q represents the amount of oxygen carried to an active muscle.
- 3 The % saturation at R represents the amount of oxygen required by a resting muscle.
- 4 The % saturation at P minus the % saturation at Q represents the amount of oxygen delivered to an active muscle.
- 5 The % saturation at Q minus the % saturation at S represents the amount of oxygen delivered to a resting muscle.

A 1 and

B 3 and 4

C 1 only

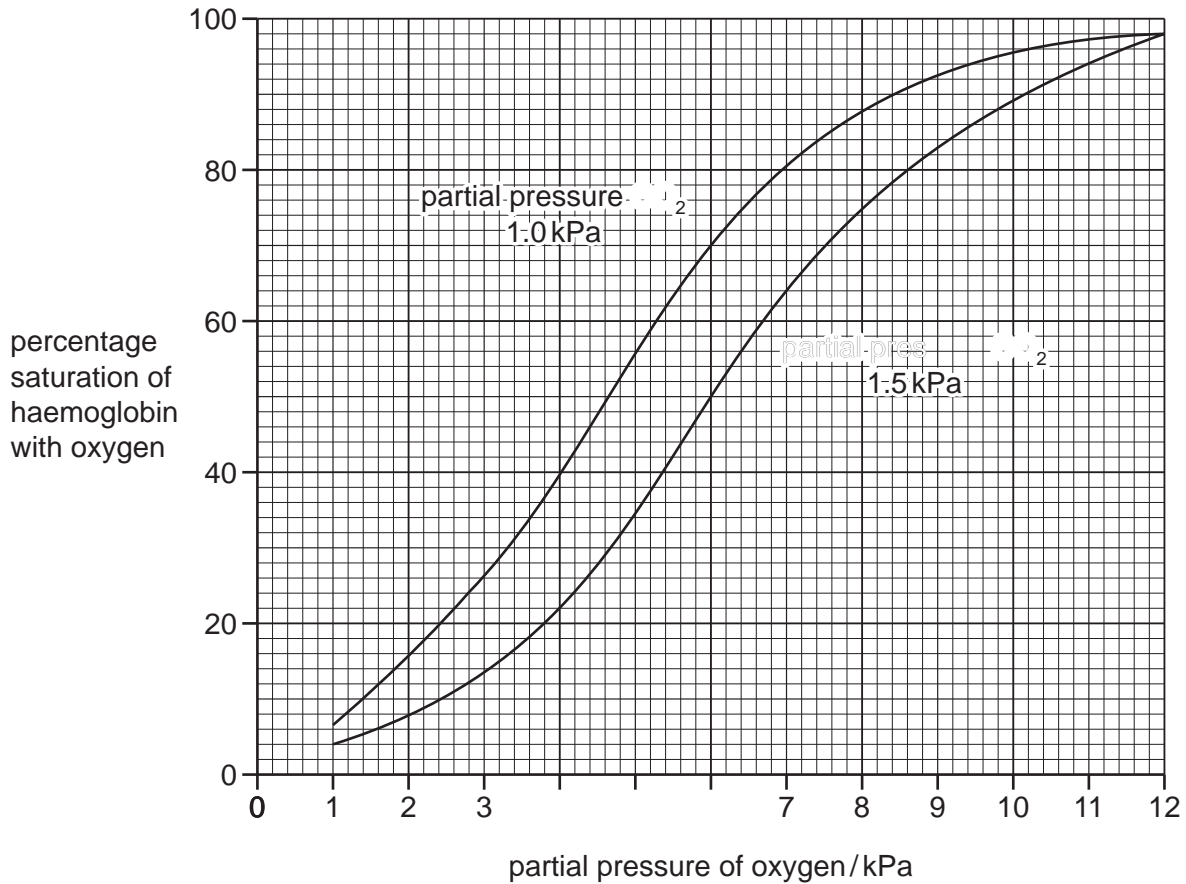
D 5

6 What is correct about the transport of carbon dioxide by blood?

- 1 The enzyme carbonic anhydrase catalyses the formation of carbonic acid in red blood cells.
- 2 Carbon dioxide diffuses from respiring cells to red blood cells and reacts with water.
- 3 Carbonic acid dissociates forming hydrogen ions that combine with haemoglobin to form carbaminoglobin.

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

7 The graph shows the effect of different partial pressures of carbon dioxide (CO_2) on the oxygen dissociation curve for haemoglobin.



What is the change in percentage oxygen saturation of haemoglobin at a partial pressure of oxygen of 6 kPa as the partial pressure of carbon dioxide changes from 1.0 kPa to 1.5 kPa?

A -26% **B** -20% **C** 20% **D** 46%

- 8 Which effect could be due to a reduced concentration of carbonic anhydrase?
- A carbaminohaemoglobin concentrations will decrease
 - B less oxygen is released from oxyhaemoglobin in respiring tissues
 - C the pH of the blood will be lowered
 - D the rate of dissociation of carbonic acid is increased
- 9 Which features allow an artery to resist changes in the pressure of blood flowing through it?
- 1 smooth endothelium
 - 2 thick elastic layer in the artery wall
 - 3 thick layer of muscle in the artery wall
- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only
- 10 Which reactions will be taking place in blood in a capillary next to an alveolus?
- 1 $\text{Hb} + 4\text{O}_2 \rightarrow \text{HbO}_8$
 - 2 $\text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{H}_2\text{CO}_3$
 - 3 $\text{HHb} + 4\text{O}_2 \rightarrow \text{HbO}_8 + \text{H}^+$
- A 1 only B 2 only C 1 and 2 D 2 and 3

- 11 The photomicrograph shows a section through two structures found in mammals viewed using a light microscope.



×40

Which row is correct?

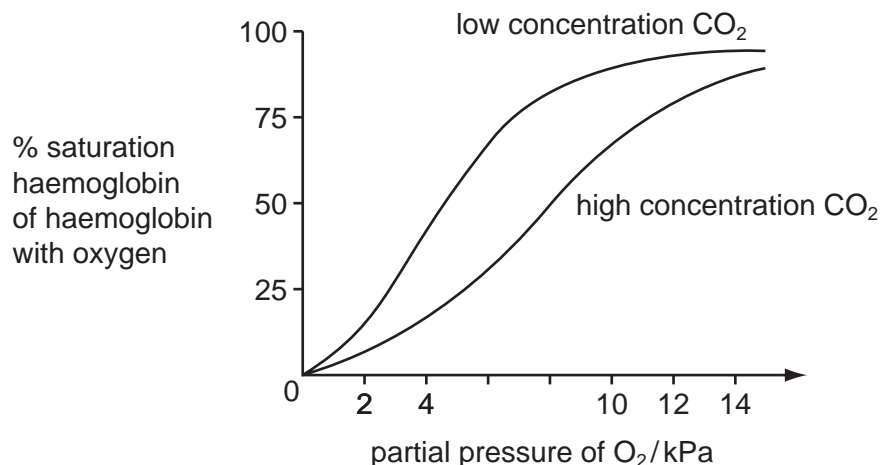
	W	X	feature
A	artery	vein	X contains cells with haemoglobin
B	bronchiole	vein	X contains cells with oxyhaemoglobin
C	trachea	artery	the lumen of W allows air to pass through
D	vein	atrium	W contains deoxygenated blood

- 12 What is **not** a factor influencing blood pressure?
- A the diameter of the blood vessels
 - B the number of red blood cells in circulation
 - C the systolic pressure of the heart ventricles
 - D the volume of blood returning to the heart each heart beat
- 13 Which of the following are found in blood and lymph and tissue fluid?

- 1 carbon dioxide
- 2 fatty acids
- 3 white blood cells
- 4 proteins

- A 1, 2
- B 1, 2 and 3
- C 1, 2 and 4
- D 3 and 4 only

- 14 The graph shows the percentage saturation of haemoglobin with oxygen at different partial pressures of oxygen and two different concentrations of carbon dioxide.



What is the effect of increasing the concentration of carbon dioxide?

- A It increases the affinity of haemoglobin for oxygen at respiring tissues.
- B It increases the dissociation of haemoglobin inside red blood cells.
- C It increases the dissociation of oxygen from haemoglobin at respiring tissues.
- D It increases the inhibition of carbonic anhydrase enzyme in red blood cells.

- 15 Some babies are born with a hole between the right and left atria. These babies are found to have an increased number of red blood cells.

What is the reason for this increase?

- A** More blood is needed because it is pumped faster.
- B** More blood is needed because the pressure is lower.
- C** Their haemoglobin has a higher affinity for oxygen.
- D** There is less oxygen available to the newly born baby.

- 16 Which process can be carried out by a mature red blood cell?

- A** active transport
- B** cell division
- C** phagocytosis
- D** protein synthesis

- 17 Which of the following are found in blood and lymph and tissue fluid?

- 1 carbon dioxide
- 2 glucose
- 3 white blood cells
- 4 fatty acids

- A** 1, 2, 3 and 4 **B** 1, 2 and 3 only **C** 1, 3 and 4 only **D** 2 and 4 only

18 Haemoglobin can bind to carbon dioxide, carbon monoxide and oxygen.

Which statement about the binding sites of haemoglobin is correct?

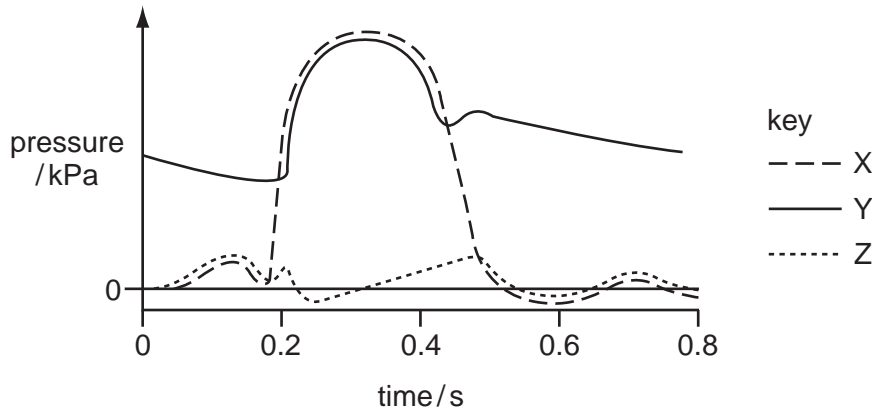
- A** Carbon dioxide and carbon monoxide bind to one site, oxygen binds to a different site.
- B** Carbon dioxide and oxygen bind to one site, carbon monoxide binds to a different site.
- C** Carbon monoxide and oxygen bind to one site, carbon dioxide binds to a different site.
- D** Carbon monoxide, oxygen and carbon dioxide all bind to different sites.

19 Which substances will displace oxygen from oxyhaemoglobin?

- 1 carbon dioxide
- 2 carbon monoxide
- 3 hydrogen carbonate ions
- 4 hydrogen ions

- A** 1 and 2 only **B** 1 and 4 only **C** 2 and 3 only **D** 2 and 4 only

- 20 The diagram shows the pressure changes in various structures of the **right side** of the heart during the cardiac cycle.



Which structures are represented by the letters X, Y and Z?

	X	Y	Z
A	pulmonary artery	right atrium	right ventricle
B	right atrium	pulmonary artery	right ventricle
C	right ventricle	pulmonary artery	right atrium
D	right ventricle	right atrium	pulmonary artery

- 21 Aortic stenosis is a heart valve disorder in which the aortic semi-lunar valve opening is narrow.

Which effect could aortic stenosis have on heart structure and function?

- A** The cardiac muscle of the left ventricle wall is thinned by blood leaking out of the left ventricle during ventricular diastole.
- B** There is less cardiac muscle in the left ventricle and reduced diastolic blood pressure, caused by the smaller blood volume entering the left atrium.
- C** The tendons of the heart valves are weakened by blood being forced back through the left atrio-ventricular (bicuspid) valve into the left atrium.
- D** The wall of the left ventricle thickens, leading to an enlarged heart and inability to relax and fill completely during diastole.

22 Which row describes the changes in the properties of haemoglobin as a result of the Bohr effect?

	affinity for oxygen by haemoglobin	oxygen dissociates from haemoglobin
A	higher	less readily
B	higher	more readily
C	lower	less readily
D	lower	more readily

23 Humans have a double circulation system.

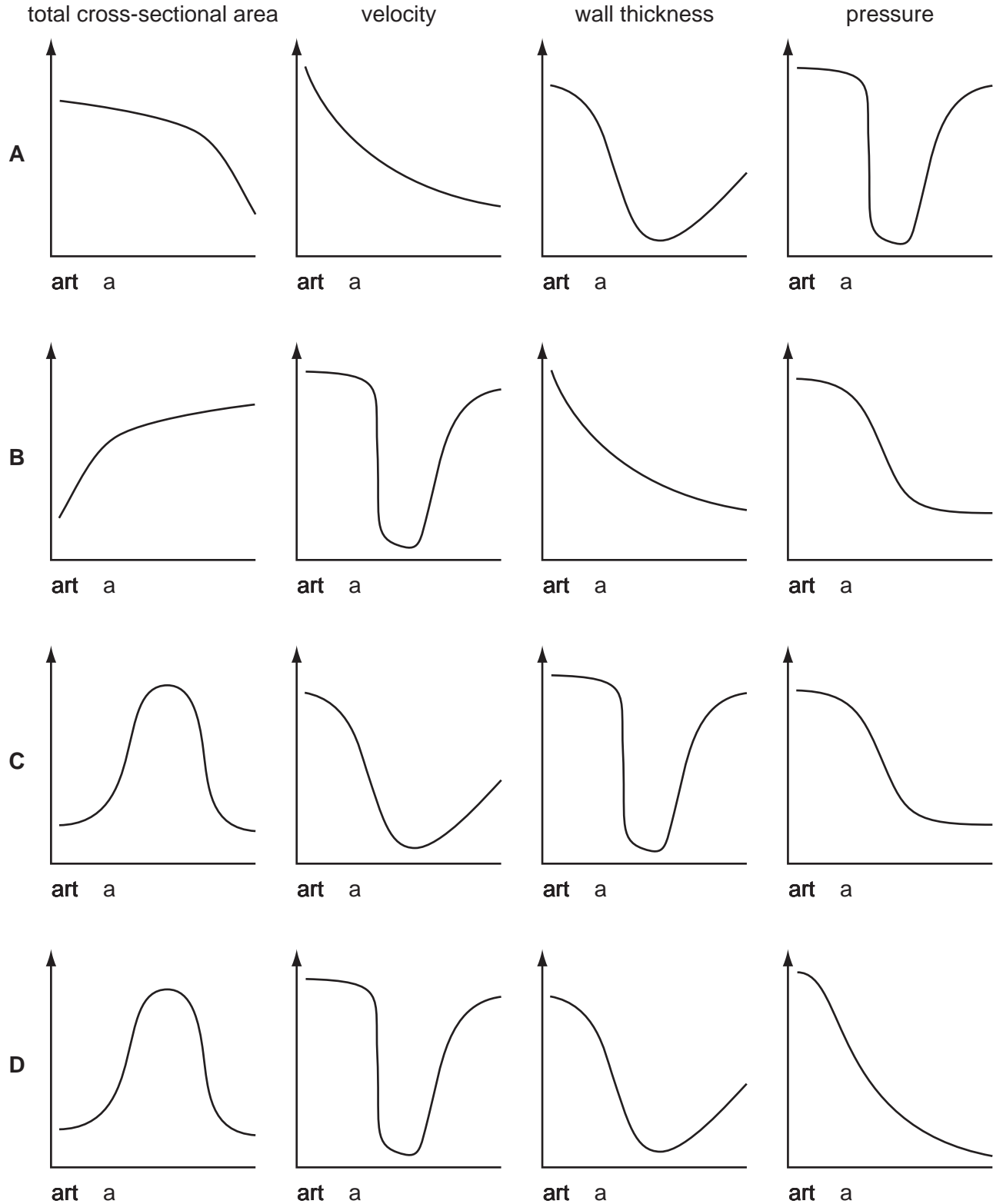
What does the term 'double circulation' mean?

- A** The blood circulates separately in the two sides of the heart.
- B** The blood passes twice through the heart during one complete circulation.
- C** The heart has two of each chamber; atria and ventricles.
- D** The heart beat has a double sound caused by the two sets of valves closing.

24 Each set of graphs represents data for blood vessels in the sequence:

art a c v vein
artery arterioles capillaries venules veins

Which set is correct?



25 An increase in carbon dioxide in human blood shifts the oxyhaemoglobin dissociation curve to the right.

What is the explanation for this effect?

- A** An increase in carbon dioxide concentration increases the ventilation rate.
- B** Carbon dioxide is more soluble than oxygen and displaces it.
- C** Diffusion of carbon dioxide between the alveoli and the blood is more rapid.
- D** Increasing the H^+ concentration decreases haemoglobin affinity for oxygen.

26 Which statements describe why a large animal has had to evolve a transport system?

- 1 diffusion occurs slowly over long distances
- 2 it has a high rate of gas exchange
- 3 it has a large surface area to volume ratio

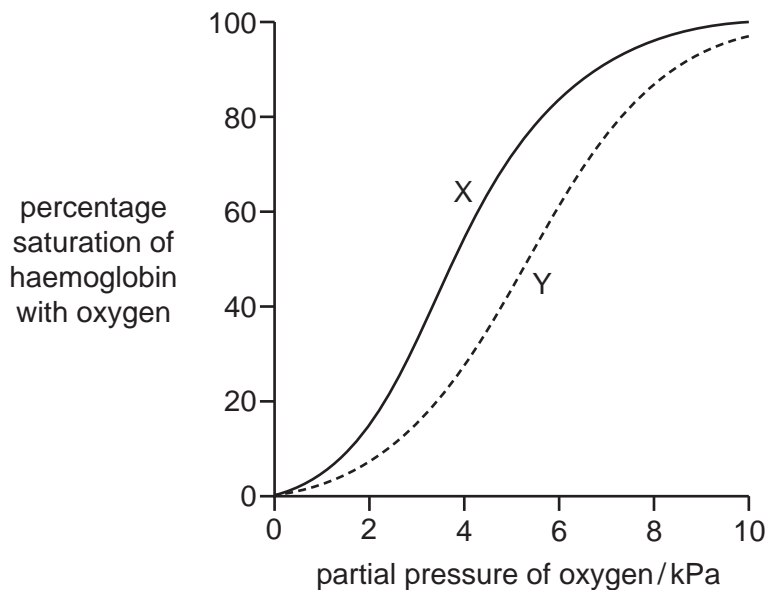
- A** 1 only
- B** 3 only
- C** 1 and 2 only
- D** 1, 2 and 3

27 Which of the following are found in **all** blood vessels, lymph and tissue fluid?

- 1 carbon dioxide
- 2 glucose
- 3 white blood cells
- 4 antibodies

- A** 2 and 4 only
- B** 1, 2 and 3
- C** 1, 3 and 4
- D** 1, 2, 3 and 4

28 The diagram shows the Bohr effect.



What causes the shift from X to Y?

- A** decreased concentration of carbon dioxide and high pH
- B** decreased concentration of carbon dioxide and low pH
- C** increased concentration of carbon dioxide and high pH
- D** increased concentration of carbon dioxide and low pH

29 What is correct for tissue fluid?

	phagocytes	platelets	protein concentration compared to blood plasma	
A	✓	✓	higher	key ✓ = present x = absent
B	x	x	higher	
C	✓	x	lower	
D	x	✓	lower	

30 Which row correctly identifies the structure of an artery compared with a vein seen in transverse section under a light microscope?

	outer wall of artery	layer of muscles and elastic fibres	diameter of the lumen (hollow space)
A	thicker	thicker	narrower
B	thicker	thinner	wider
C	thinner	thicker	narrower
D	thinner	thinner	wider

31 In the lungs, oxygen and carbon dioxide pass through cell membranes by diffusion.

Which row is correct?

	number of cell membranes diffused through by	
	oxygen from air	carbon dioxide to air
A	3	2
B	3	2 or 3
C	5	4
D	5	4 or 5

32 There is a decreased partial pressure of oxygen at high altitude compared to sea level.

Which row is a correct description and reason for the response of the body to high altitude?

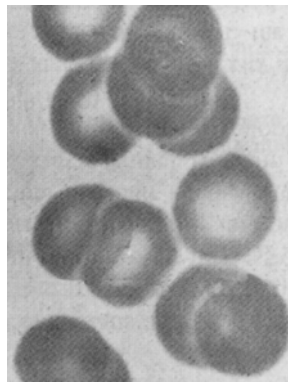
	description	reason
A	more red blood cells	because haemoglobin breaks down more rapidly
B	red blood cells have genes switched on	so red blood cells produce more haemoglobin
C	oxygen dissociation curve shifts to the right	to compensate for an increase in oxygen unloading in tissues
D	percentage saturation of haemoglobin with oxygen in lungs decreases	so more red blood cells are produced to carry more haemoglobin

33 Blood, tissue fluid and lymph each have a different composition.

Which row shows the composition of lymph?

	contains water	contains antibodies	contains lipid	
A	✓	✓	✓	key ✓ = present x = absent
B	✓	✓	x	
C	✓	x	✓	
D	x	✓	✓	

34 The photograph shows a type of blood cell.

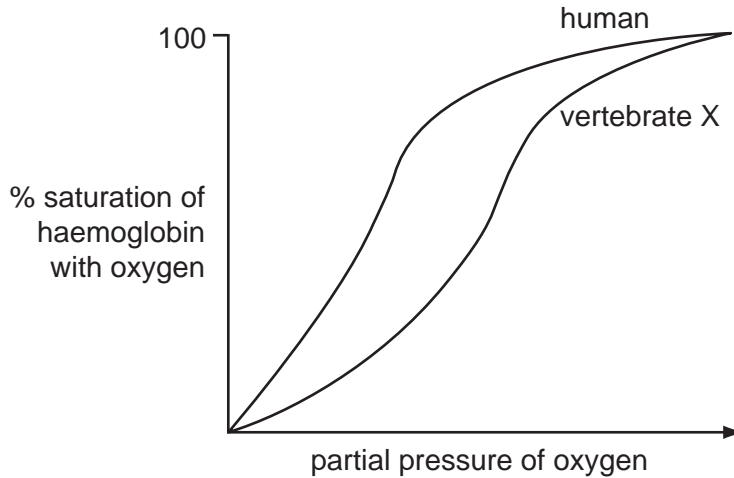


Which statements about these cells are correct?

- 1 Oxygen diffuses through the phospholipid bilayer.
- 2 Sodium ions diffuse through the phospholipid bilayer.
- 3 Water passes in and out of these cells by osmosis.

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

- 35 The graphs show changes in the percentage saturation of haemoglobin in the blood of humans and of another vertebrate animal. The partial pressure of CO₂ remains constant at 1.0 kPa and the temperature is constant at 25 °C.



Which conclusion is justified from the graph?

- A At the temperature of 25 °C the affinity of haemoglobin for oxygen increases more in humans than in vertebrate X.
 - B Haemoglobin does not become fully saturated in the lungs of vertebrate X.
 - C Oxygen is more easily released from haemoglobin in the muscle of vertebrate X than in human muscle.
 - D The Bohr effect in the haemoglobin of vertebrate X is greater than in human haemoglobin.
- 36 In mammals, some carbon dioxide is transported by red blood cells in combination with haemoglobin.

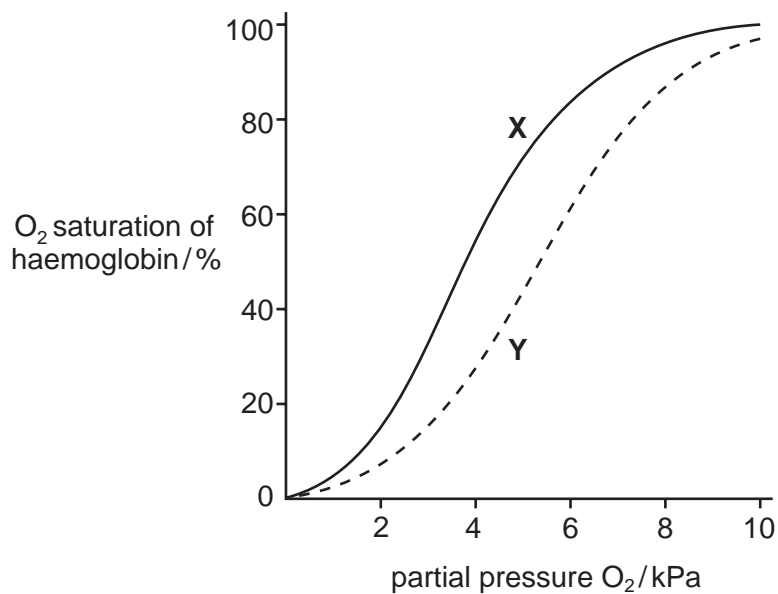
What is the product of this combination?

- A carbamino-haemoglobin
- B carbonic acid
- C carboxyhaemoglobin
- D haemoglobinic acid

37 What does tissue fluid contain?

	phagocytes	platelets	protein concentration compared to blood plasma
A	✓	✓	higher
B	x	x	higher
C	✓	x	lower
D	x	✓	lower

38 The diagram shows the Bohr Effect.



What causes the shift from X to Y?

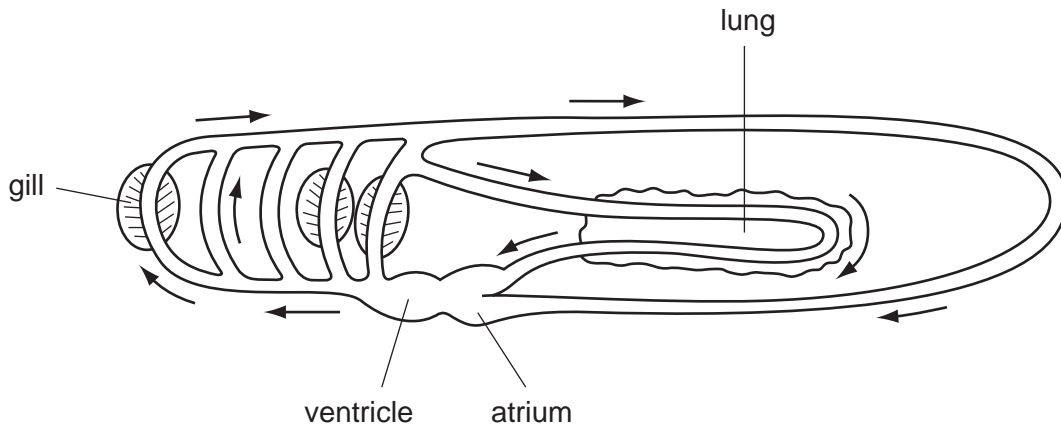
- A** decreased levels of carbon dioxide and high pH
- B** decreased levels of carbon dioxide and low pH
- C** increased levels of carbon dioxide and high pH
- D** increased levels of carbon dioxide and low pH

39 Which type of tissue is present in the walls of all blood vessels?

- A elastic
- B endothelial
- C fibrous
- D smooth muscle

40 The mammalian circulatory system is described as a closed double circulation.

The diagram shows the circulatory system in a different organism. The arrows show the direction of blood flow in the vessels.



How is the circulatory system in this organism described?

- A closed double
- B closed single
- C open double
- D open single

41 Normal venous pressure in the feet is 3.3 kPa. When a person stands very still venous blood pressure in the feet rises to 5.0 kPa.

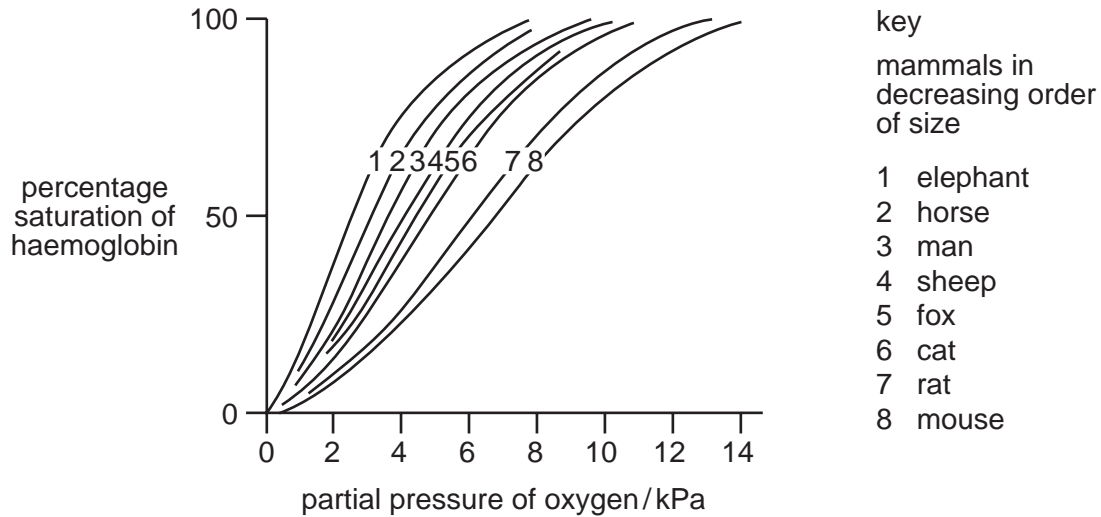
What causes the high pressure?

- A** Muscles in the walls of the veins contract, reducing the diameter of the veins.
- B** Skeletal muscles in the legs are not squeezing blood upward in the veins.
- C** Systolic blood pressure increases.
- D** The semilunar valves in the veins of the leg cease to function.

42 What is systolic blood pressure?

- A** the maximum blood pressure in the arteries
- B** the blood pressure in the left ventricle at the end of a contraction
- C** the maximum blood pressure in the right ventricle
- D** the blood pressure in the arteries when the heart is relaxing

43 The graph shows the oxygen dissociation curves of haemoglobin for eight mammals.



Which conclusion can be drawn from the graph?

- A** The activity of the mammal is directly proportional to the ability of its haemoglobin to release oxygen.
- B** The haemoglobin of larger mammals will release oxygen at a higher pO_2 than that of smaller mammals.
- C** The haemoglobin of smaller mammals will release oxygen at a higher pO_2 than that of larger mammals.
- D** The size of the mammal is directly proportional to the ability of its haemoglobin to release oxygen.

44 The table describes the walls of three blood vessels.

vessel 1	vessel 2	vessel 3
thick layer of elastic fibres and smooth muscle	no elastic fibres or smooth muscle	thin layer of smooth muscle with few elastic fibres

What are vessels 1, 2 and 3?

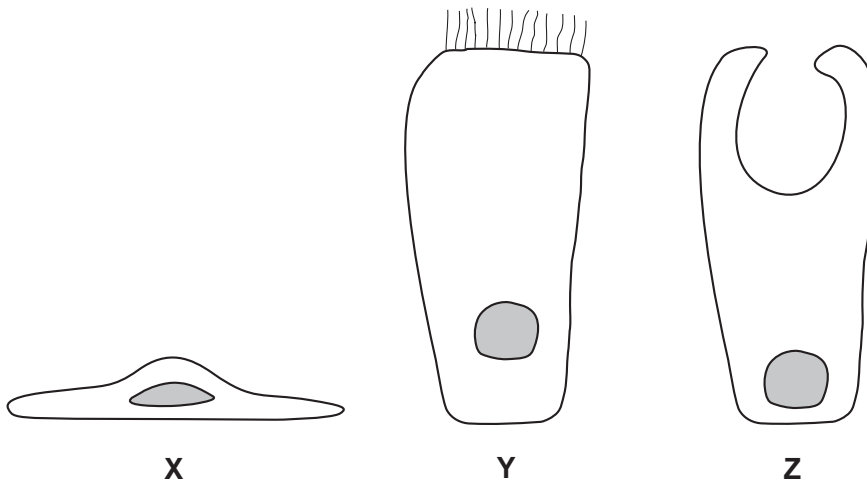
	artery	capillary	vein
A	1	2	3
B	2	3	1
C	3	1	2
D	3	2	1

45 An oxygen molecule diffuses directly from the air in an alveolus to haemoglobin in a red blood cell.

What is the minimum number of cell surface membranes through which this molecule must pass?

- A 2
- B 3
- C 4
- D 5

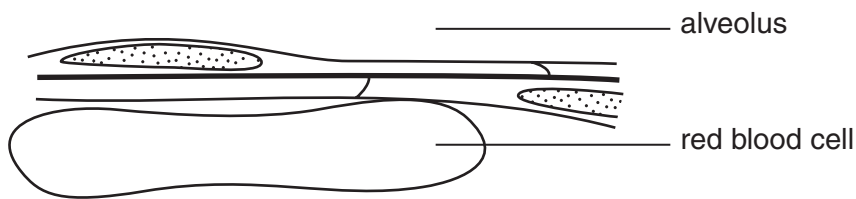
46 The diagram shows three types of cells.



Which cells are found in alveoli and in bronchi?

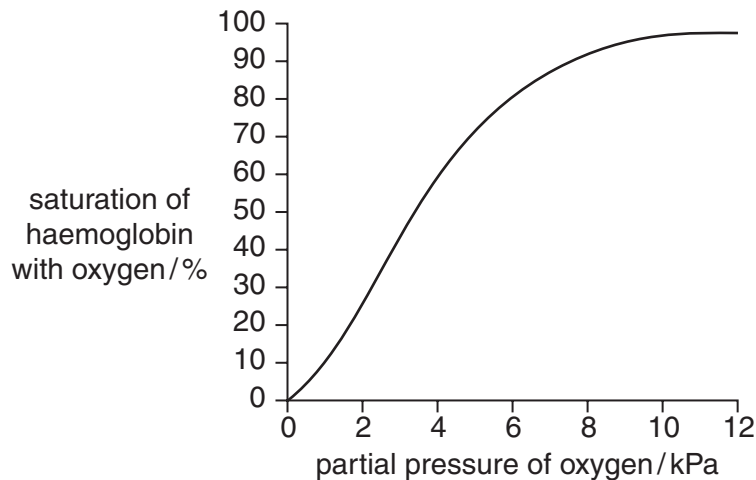
	alveoli	bronchi
A	X	Y and Z
B	X and Y	Z
C	Y and Z	X
D	Z	X and Y

- 47 The drawing has been made from a section showing part of an alveolus and a red blood cell in a capillary. The magnification of the drawing is $\times 5000$



What is the minimum distance that oxygen must diffuse from air in an alveolus into a red blood cell?

- A 0.1 nm
 - B 1.0 nm
 - C 0.1 μm
 - D 1.0 μm
- 48 The graph shows the human haemoglobin dissociation curve.



Which range of partial pressures of oxygen would be found in pulmonary arteries?

- A between 0 and 2 kPa
- B between 2 and 6 kPa
- C between 6 and 8 kPa
- D between 8 and 12 kPa

49 Which statement describes the Bohr effect?

- A** In high partial pressure of oxygen and high partial pressure of carbon dioxide, the affinity of haemoglobin for oxygen increases.
- B** In high partial pressure of oxygen and low partial pressure of carbon dioxide, the affinity of haemoglobin for oxygen decreases.
- C** In low partial pressure of oxygen and high partial pressure of carbon dioxide, the affinity of haemoglobin for oxygen decreases.
- D** In low partial pressure of oxygen and low partial pressure of carbon dioxide, the affinity of haemoglobin for oxygen is unchanged.

50 What is produced by the action of carbonic anhydrase?

- A** carbaminohaemoglobin
- B** haemoglobinic acid
- C** hydrogencarbonate ions
- D** oxyhaemoglobin