CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



EXAM QUESTION PACK

8 TRANSPORT IN MAMMALS

SCORE	PERCENTAGE
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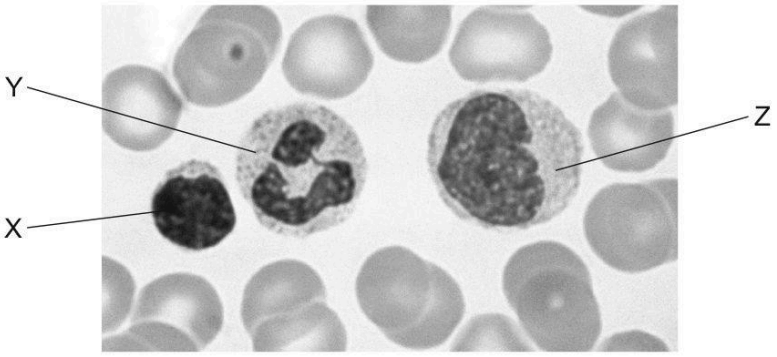
Chapter 8

Transport in mammals

8.1 The circulatory system

1114. 9700_m20_qp_12 Q: 28

The photomicrograph shows three white blood cells labelled X, Y and Z.



Which row correctly identifies these cells?

	cell X	cell Y	cell Z
A	lymphocyte	monocyte	neutrophil
B	lymphocyte	neutrophil	monocyte
C	monocyte	neutrophil	lymphocyte
D	neutrophil	monocyte	lymphocyte

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1115. 9700_m20_qp_12 Q: 29

Which row correctly identifies the locations in which a type of molecule or cell is present?

	type of molecule or cell	blood	lymph	tissue fluid
A	antibody	✓	✓	✓
B	large plasma protein	✓	✗	✓
C	lymphocyte	✓	✓	✗
D	phagocyte	✗	✓	✓

key

✓ = present

✗ = not present

1116. 9700_m20_qp_12 Q: 31

What would change the ratio of red blood cells to white blood cells in the blood of a healthy human?

1 development of leukaemia

2 infection with *Variola*

3 living for six months at high altitude

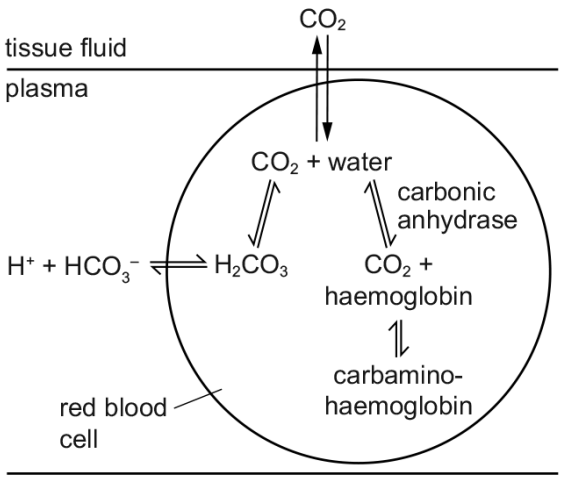
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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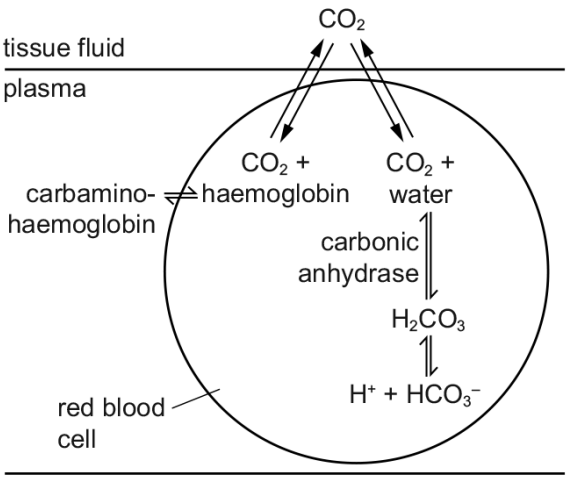
1117. 9700_s20_qp_11 Q: 32

Which diagram shows the events that occur during transport of carbon dioxide by the blood?

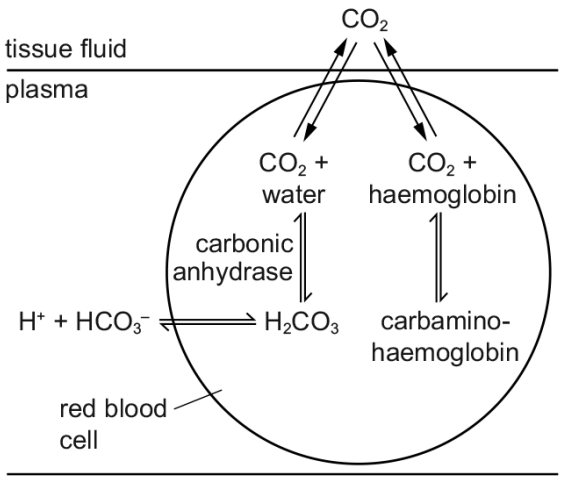
A



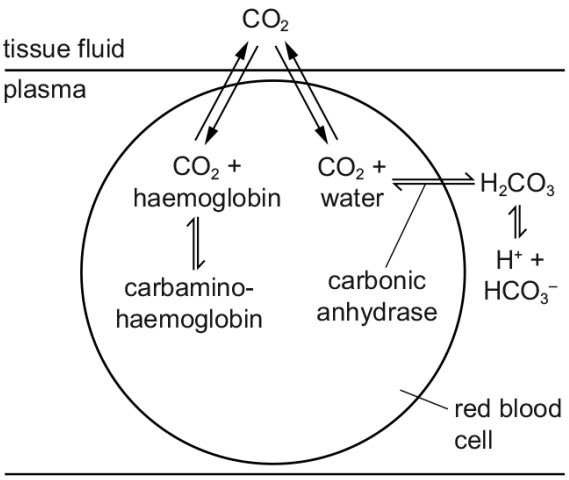
B



C

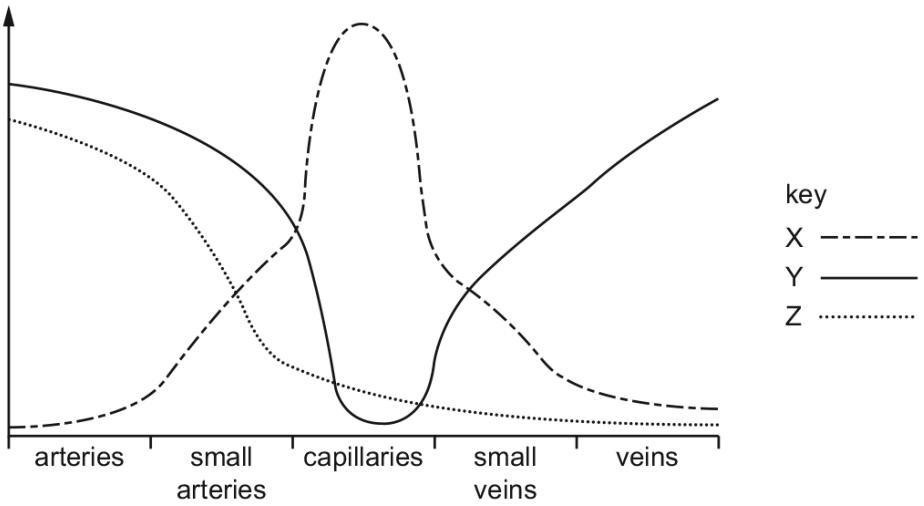


D



1118. 9700_s20_qp_12 Q: 29

The graph represents data on blood vessels and blood flow.



Which row correctly identifies the curves?

	speed of blood flow	pressure of blood	total cross-sectional area
A	X	Y	Z
B	X	Z	Y
C	Y	Z	X
D	Z	X	Y

1119. 9700_s20_qp_12 Q: 30

Which components of blood are present in lymph?

	white blood cells	proteins	sodium ions
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✓
D	✗	✓	✗

key
✓ = present
✗ = not present

1120. 9700_s20_qp_12 Q: 31

What correctly describes the significance of the increase of the red blood cell count of humans who move from living at low altitude to high altitude?

A After a few weeks at high altitude, the number of red blood cells increases to compensate for the lower availability of oxygen in the air.

B At high altitude, the bone marrow produces more red blood cells to provide binding sites for the increased number of oxygen molecules available.

C At high concentrations of oxygen in the blood, a cytokine stimulates the production of red blood cells to increase the oxygen-carrying capacity of the blood.

D After only a few days at high altitude the number of red blood cells increases considerably to compensate for the lower availability of oxygen in the air.

1121. 9700_s20_qp_13 Q: 28

Which statements about blood vessels are correct?

1 Collagen fibres in the walls of arteries and veins prevent overstretching.

2 Elastic fibres in large arteries allow stretching during ventricular systole.

3 Smooth muscle in arteries controls the distribution of blood to different parts of the body.

4 Veins have valves because their walls are thin.

A 1, 2, 3 and 4

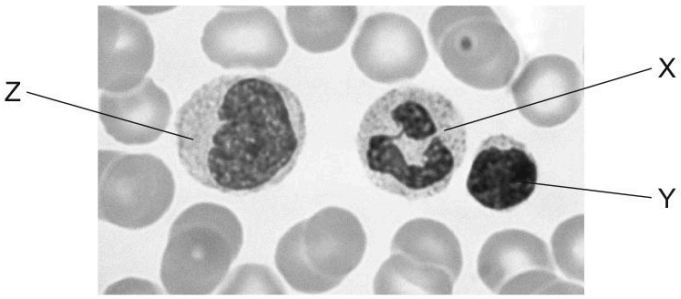
B 1, 2 and 3 only

C 2 and 4 only

D 3 and 4 only

1122. 9700_s20_qp_13 Q: 29

The photomicrograph shows three white blood cells labelled X, Y and Z.



Which row correctly identifies these cells?

	cell X	cell Y	cell Z
A	lymphocyte	neutrophil	monocyte
B	lymphocyte	monocyte	neutrophil
C	monocyte	lymphocyte	neutrophil
D	neutrophil	lymphocyte	monocyte

1123. 9700_s20_qp_13 Q: 30

The enzyme carbonic anhydrase catalyses the reaction:

$$CO_2 + H_2O \rightarrow HCO_3^- + H^+$$

Which statements describe the role of the enzyme carbonic anhydrase?

1 to speed up the decrease in pH of blood in the presence of carbon dioxide

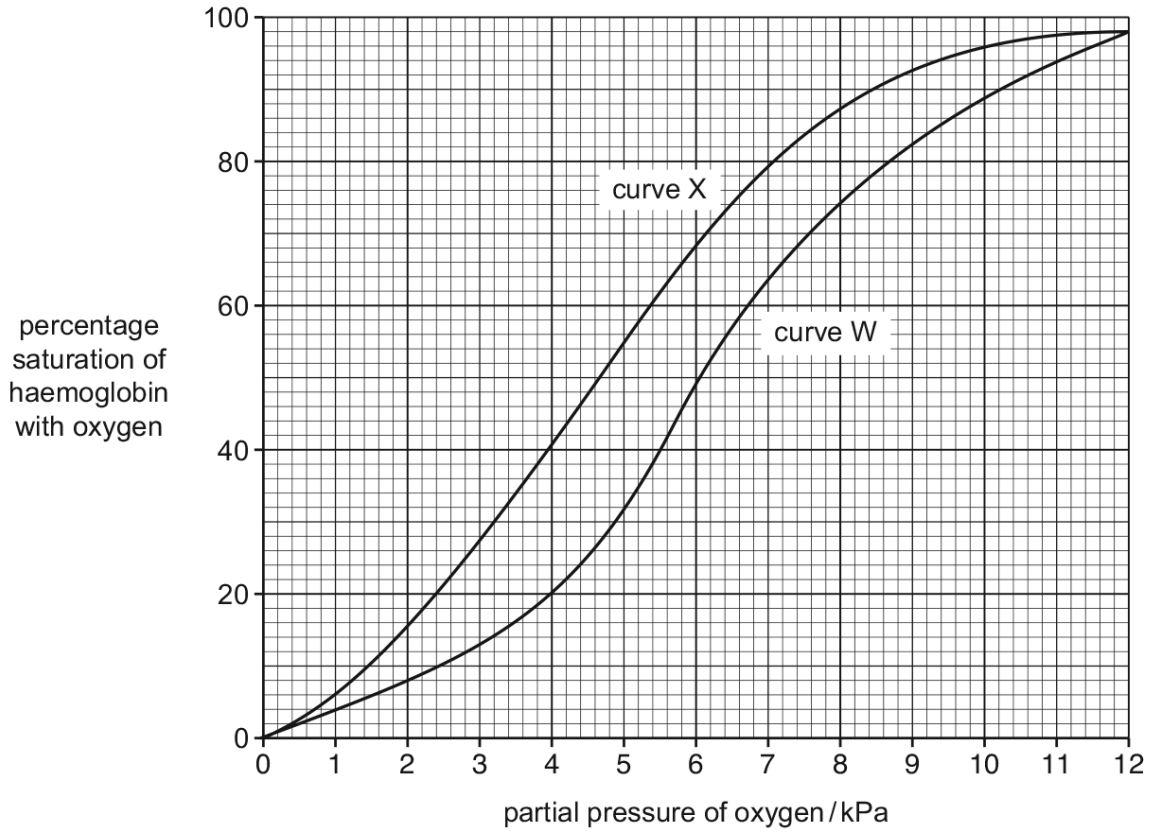
2 to facilitate the Bohr effect in haemoglobin

3 to speed up the reaction between carbon dioxide and water

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

1124. 9700_s20_qp_13 Q: 31

The graph shows the oxygen dissociation curves of adult haemoglobin at two partial pressures of carbon dioxide W and X.



Which pair of statements are correct?

1 Curve W shows the oxygen dissociation curve at a higher concentration of carbon dioxide than curve X.

2 Curve X shows the oxygen dissociation curve at a higher concentration of carbon dioxide than curve W.

3 At a partial pressure of oxygen of 7.0 kPa the haemoglobin from curve W has a higher affinity for oxygen than haemoglobin from curve X.

4 At a partial pressure of oxygen of 7.0 kPa the haemoglobin from curve X has a higher affinity for oxygen than haemoglobin from curve W.

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

1125. 9700_s20_qp_13 Q: 32

A person has two blood tests one month apart. The number of each type of cell in a fixed sample size is counted.

type of cell	first test	after one month
red blood cells	normal	higher
lymphocytes	normal	higher

What could this suggest about the person based on the results after one month?

	body temperature higher	moved to higher altitude	ATP synthesis in cells is higher
A	no	no	yes
B	no	yes	no
C	yes	no	no
D	yes	yes	yes

1126. 9700_w20_qp_11 Q: 28

Which are present in the walls of capillaries?

	endothelium	smooth muscle	elastic tissue	collagen fibres
A	✓	✗	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✗	✓
D	✗	✓	✓	✗

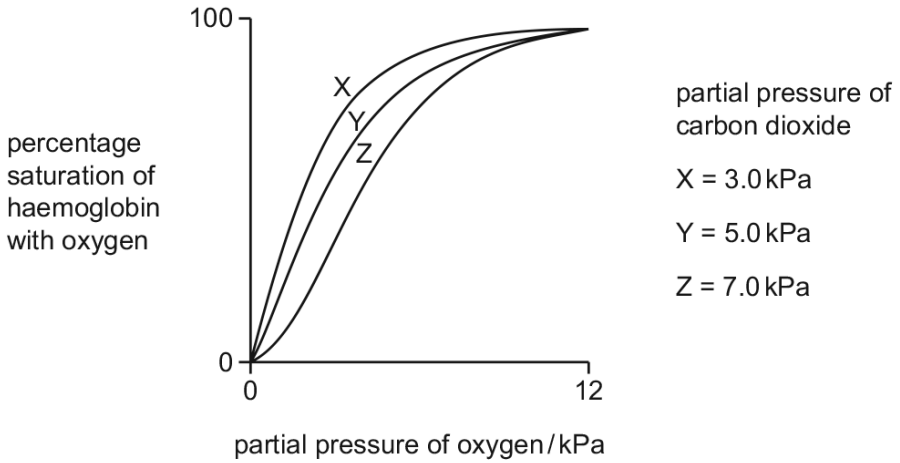
key

✓ = present

✗ = not present

1127. 9700_w20_qp_11 Q: 31

The graph shows the effect of three different partial pressures of carbon dioxide on the oxygen dissociation curve for human haemoglobin.



What effect does decreasing the partial pressure of carbon dioxide have on haemoglobin?

A It is less efficient at taking up oxygen and less efficient at releasing oxygen.

B It is less efficient at taking up oxygen and more efficient at releasing oxygen.

C It is more efficient at taking up oxygen and less efficient at releasing oxygen.

D It is more efficient at taking up oxygen and more efficient at releasing oxygen.

1128. 9700_w20_qp_12 Q: 27

Why is the mammalian circulatory system described as a double circulation?

A Blood flows twice through the heart in one complete cardiac cycle.

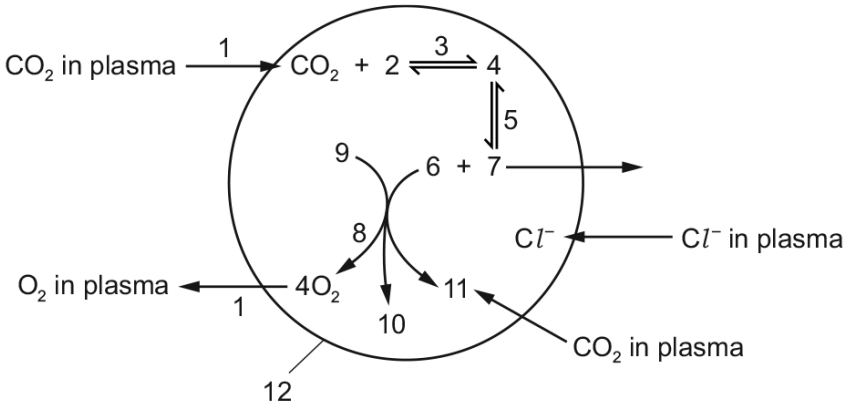
B Blood flows twice through the heart in one complete circuit of the body.

C Blood remains within arteries, capillaries and veins.

D Blood transports both oxygen and carbon dioxide.

1129. 9700_w20_qp_12 Q: 30

The diagram is a summary of the role of haemoglobin in the transport of carbon dioxide.



Which set of labels is correct?

A 1 = facilitated diffusion, 4 = carbonic acid, 7 = hydrogencarbonate ions

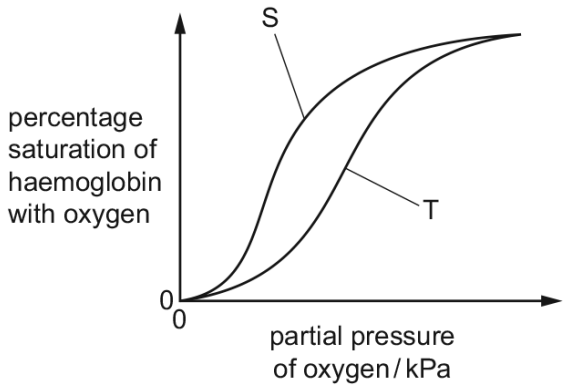
B 2 = water, 8 = dissociation, 10 = carbaminohaemoglobin

C 3 = carbonic anhydrase, 9 = oxyhaemoglobin, 11 = carbaminohaemoglobin

D 5 = carbonic anhydrase, 6 = hydrogen ions, 12 = red blood cell

1130. 9700_w20_qp_12 Q: 31

The graph shows the oxygen dissociation curves of haemoglobin from two species of mammal, S and T.



Which statements could explain the difference in the oxygen dissociation curves of species S and species T?

1 Species T has a lower haemoglobin concentration in its red blood cells than species S.

2 The haemoglobin in species T has a lower affinity for oxygen than the haemoglobin in species S.

3 Species T lives at higher altitudes than species S.

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

1131. 9700_w20_qp_13 Q: 28

Which are present in the walls of veins?

	endothelium	smooth muscle	elastic tissue	collagen fibres
A	✓	✗	✓	✓
B	✗	✓	✗	✓
C	✓	✓	✓	✗
D	✓	✓	✓	✓

key
✓ = present
✗ = not present

1132. 9700_w20_qp_13 Q: 30

What effect does decreasing carbon dioxide concentration have on haemoglobin?

A It is less efficient at taking up oxygen and less efficient at releasing oxygen.

B It is less efficient at taking up oxygen and more efficient at releasing oxygen.

C It is more efficient at taking up oxygen and less efficient at releasing oxygen.

D It is more efficient at taking up oxygen and more efficient at releasing oxygen.

1133. 9700_w20_qp_13 Q: 31

Why does the red blood cell count increase in humans as they start living at high altitude?

A to allow more carbon dioxide to be excreted by the lungs, preventing a fall in blood pH

B to allow more oxygen to be taken up by the haemoglobin as the partial pressure of oxygen is lower

C to allow more oxygen to be taken up by the lungs as there is a lower percentage of oxygen in the air

D to allow more oxygen to be transported as the affinity of haemoglobin for oxygen is lowered

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1134. 9700_m19_qp_12 Q: 29

Which row correctly identifies the locations in which a type of molecule or cell can be present?

	type of molecule or cell	blood	lymph	tissue fluid
A	antigens	✓	✗	✗
B	glucose	✓	✗	✓
C	lymphocyte	✗	✓	✓
D	neutrophil	✓	✓	✓

key

✓ = can be present

✗ = cannot be present

1135. 9700_m19_qp_12 Q: 30

Which statements about the formation of haemoglobinic acid are correct?

1 It is linked to the action of carbonic anhydrase.

2 It prevents blood from becoming too acidic by removing excess hydrogen ions.

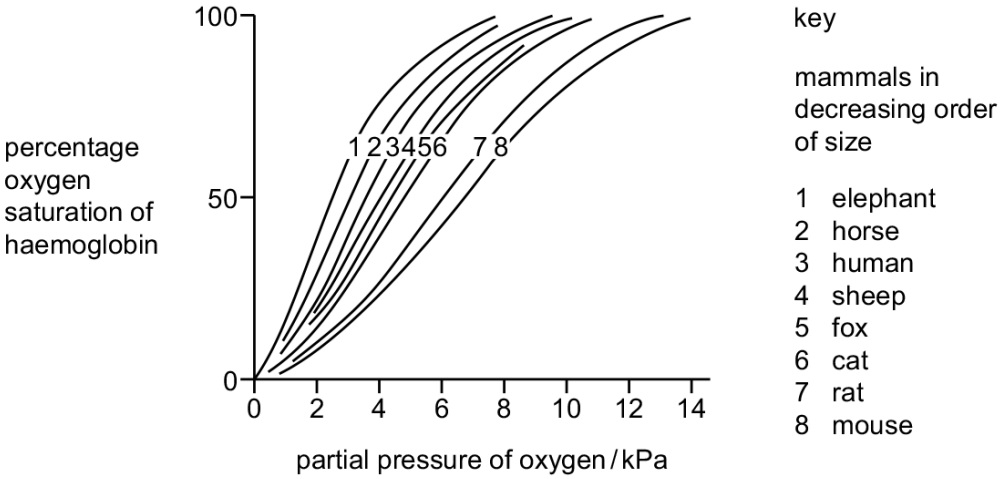
3 It can only occur when oxygen associates with haemoglobin.

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

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1136. 9700_m19_qp_12 Q: 31

The graph shows the oxygen dissociation curves of haemoglobin for eight species of mammal.



Which conclusion is consistent with the data shown in the graph?

A The haemoglobin of larger mammals will combine with oxygen at a lower partial pressure of oxygen than that of smaller mammals.

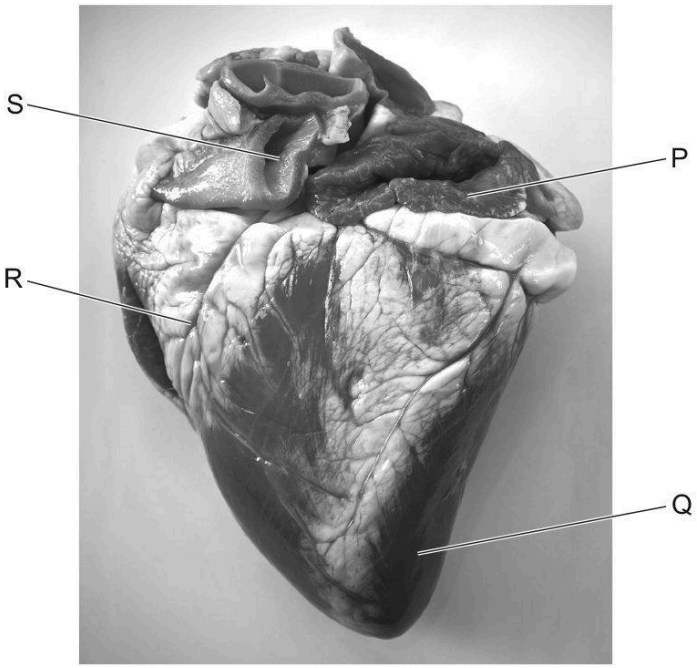
B The haemoglobin of larger mammals will release oxygen at a higher partial pressure of oxygen than that of smaller mammals.

C The metabolic activity of the mammal is directly proportional to the ability of its haemoglobin to release oxygen.

D The size of the mammal is directly proportional to the ability of its haemoglobin to release oxygen.

1137. 9700_s19_qp_11 Q: 30

The photograph shows an external view of the front of a mammalian heart.



Which row identifies the position of the structures labelled P, Q, R and S?

	P	Q	R	S
A	left atrium	cardiac muscle	Purkyne tissue	pulmonary vein
B	left atrium	left ventricle	coronary artery	vena cava
C	right atrium	cardiac muscle	Purkyne tissue	aorta
D	right atrium	right ventricle	coronary artery	pulmonary artery

---

1138. 9700_s19_qp_11 Q: 32

Athletes often move from low altitude to high altitude to train for a race.

Which statements about the effect of training at high altitude are correct?

1 Higher concentrations of carbon dioxide stimulate greater oxygen dissociation.

2 Lower concentrations of oxygen stimulate the uptake of more oxygen by red blood cells.

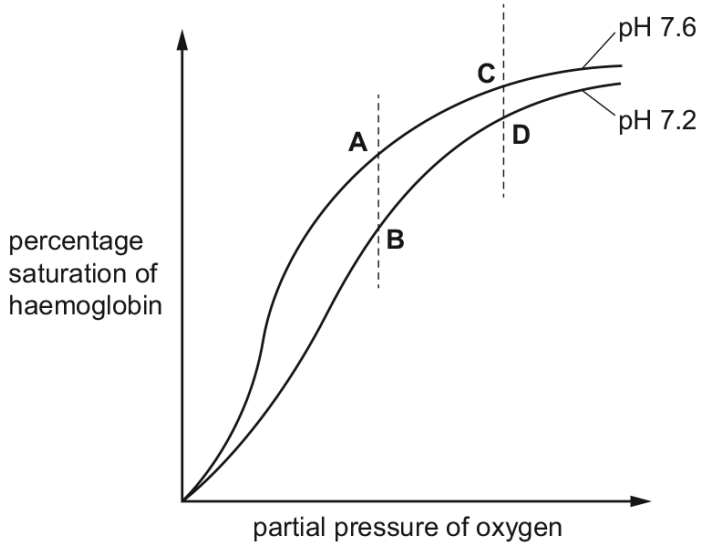
3 Lower partial pressures of oxygen stimulate higher production of red blood cells.

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

1139. 9700_s19_qp_11 Q: 33

The graph shows the oxygen haemoglobin dissociation curves at pH 7.6 and at pH 7.2.

Which point on the graph shows the percentage saturation of haemoglobin in the blood leaving an active muscle?



1140. 9700_s19_qp_12 Q: 28

At a certain point in a cardiac cycle, the pressure in the right ventricle is lower than that in the right atrium and lower than that in the pulmonary artery.

Which row is correct?

	atrioventricular valve	semilunar valve
A	closed	closed
B	closed	open
C	open	closed
D	open	open

1141. 9700_s19_qp_13 Q: 32

The table shows some information about three blood vessels, P, Q and R, from a mammal.

	diameter / mm	wall thickness / mm	percentage composition of wall		
			muscle	collagen	elastin
P	25	2	22	33	40
Q	20	1	25	40	25
R	4	1	35	25	30

Which row identifies blood vessels P, Q and R?

	P	Q	R
A	artery	vein	artery
B	artery	vein	capillary
C	vein	artery	capillary
D	vein	artery	vein

1142. 9700_s19_qp_13 Q: 33

Which row correctly identifies the locations in which a type of molecule or cell is present?

	type of molecule or cell	blood	lymph	tissue fluid
A	antigen	✓	✓	✓
B	glucose	✓	✗	✓
C	lymphocyte	✗	✓	✗
D	neutrophil	✗	✓	✓

key

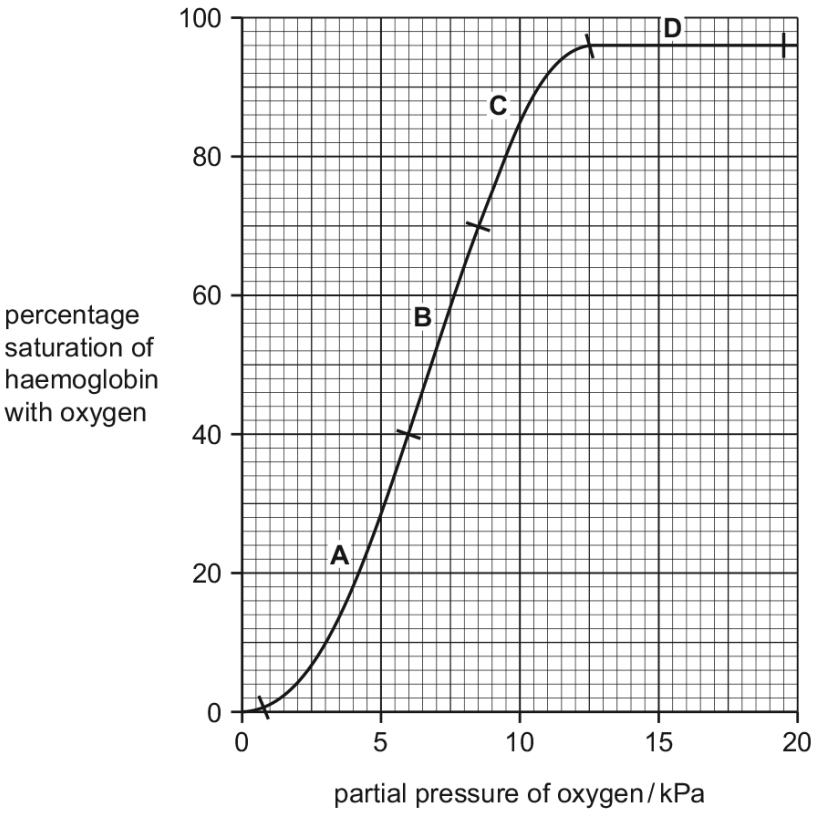
✓ = is present

✗ = is not present

1143. 9700_s19_qp_13 Q: 34

The graph shows the percentage saturation of haemoglobin with oxygen at different partial pressures of oxygen.

Which range of partial pressures of oxygen results in the greatest change of percentage saturation of haemoglobin per kPa?



1144. 9700_s19_qp_13 Q: 35

How many layers of cell surface membrane separate an oxygen molecule in the air space of an alveolus from the nearest haemoglobin molecule?

A 3 **B** 4 **C** 5 **D** 6

1145. 9700_s19_qp_13 Q: 36

Which biochemical is formed and what happens to the oxygen dissociation curve of adult haemoglobin when carbon dioxide combines with haemoglobin?

	biochemical formed	oxygen dissociation curve
A	carbaminohaemoglobin	shifts to the left
B	carbaminohaemoglobin	shifts to the right
C	carboxyhaemoglobin	shifts to the left
D	carboxyhaemoglobin	shifts to the right

1146. 9700_w19_qp_11 Q: 29

Which statement about oxygen combining with haemoglobin is correct?

A All oxygen molecules which combine stop the haemoglobin molecule changing shape.

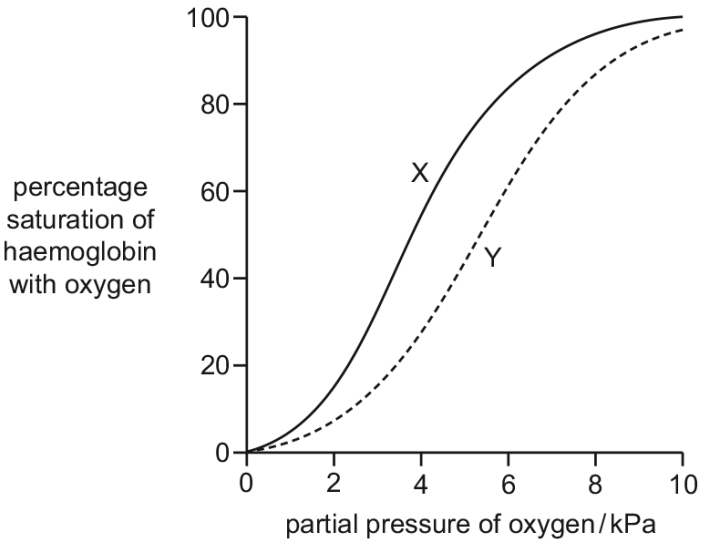
B Four oxygen molecules can combine with each haem group.

C The first oxygen molecule to combine does not affect the shape of haemoglobin.

D The second oxygen molecule to combine makes it easier for the third to combine.

1147. 9700_w19_qp_11 Q: 30

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

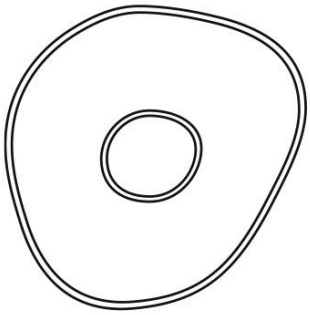
C increased concentration of carbon dioxide and high pH

D increased concentration of carbon dioxide and low pH

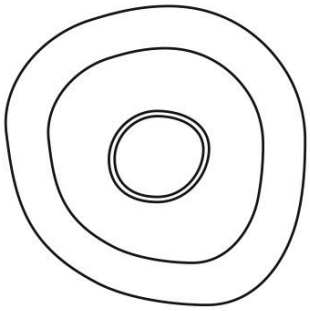
1148. 9700_w19_qp_11 Q: 31

Which plan diagram represents the tissues in a major vein?

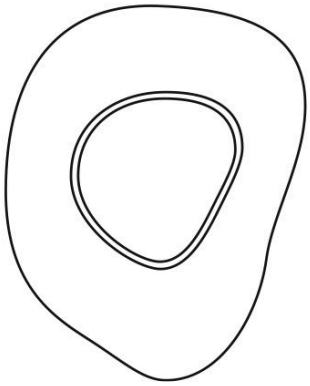
A



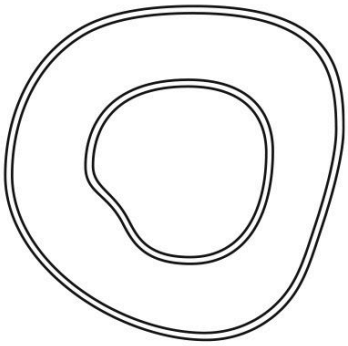
B



C



D



1149. 9700_w19_qp_11 Q: 32

Ventricular septal defect (VSD) is a heart defect that people can have from birth. People with VSD have a hole in the wall (septum) that separates the left and right ventricles.

What could happen in a person with VSD?

1 Blood will leak through the hole, mostly from right to left.

2 The volume of blood circulating through the lungs will be higher than in a person without VSD.

3 Less oxygen will be delivered to the body tissues.

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

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1150. 9700_w19_qp_12 Q: 27

Which are present in the walls of arteries?

	endothelium	smooth muscle	elastic tissue	collagen fibres
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✓	✗	✓	✓
D	✗	✓	✗	✓

key
✓ = present
✗ = not present

1151. 9700_w19_qp_12 Q: 29

Which row correctly identifies the molecules or cells that are present in the different locations?

	type of molecule or cell	blood	lymph	tissue fluid
A	antibodies	✗	✓	✓
B	large plasma proteins	✓	✗	✓
C	lymphocytes	✓	✓	✗
D	phagocytes	✓	✓	✓

key
✓ = present
✗ = not present

1152. 9700_w19_qp_12 Q: 30

When active tissues have high carbon dioxide concentrations, oxyhaemoglobin releases oxygen to these tissues.

What encourages this release in the presence of high concentrations of carbon dioxide?

1 carboxyhaemoglobin forms more readily

2 oxyhaemoglobin dissociates more readily

3 haemoglobin needs higher concentrations of oxygen to become saturated

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

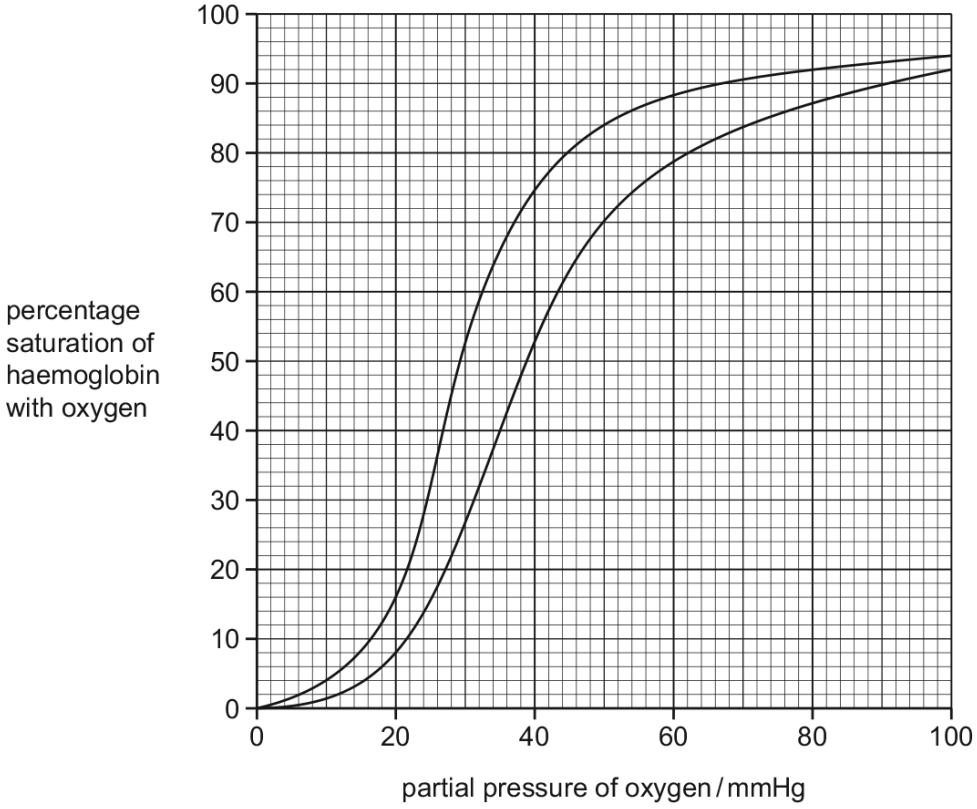
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1153. 9700_w19_qp_12 Q: 31

The graph shows oxygen dissociation curves of haemoglobin at two different carbon dioxide concentrations.

The partial pressure of oxygen in the lungs is 100 mmHg.

The partial pressure of oxygen in metabolically active tissues is 35 mmHg.



What is the percentage saturation of haemoglobin with oxygen at the lungs and in metabolically active tissues?

	percentage saturation of haemoglobin with oxygen	
	lungs	metabolically active tissue
A	92	40
B	92	66
C	94	40
D	94	66

1154. 9700_w19_qp_13 Q: 31

Red blood cells may contain a molecule known as 2,3-bisphosphoglycerate (2,3-BPG).

When 2,3-BPG binds to haemoglobin a higher partial pressure of oxygen is needed to bring about 50% saturation of haemoglobin with oxygen.

Which statements about the effect of 2,3-BPG are correct?

1 2,3-BPG in red blood cells causes the oxygen dissociation curve to shift to the right.

2 The binding of 2,3-BPG to haemoglobin reduces the Bohr effect.

3 The binding of 2,3-BPG to haemoglobin lowers the affinity of the haemoglobin for oxygen.

4 When 2,3-BPG is absent, oxyhaemoglobin is less likely to unload oxygen.

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

1155. 9700_w19_qp_13 Q: 33

What explains why the red blood cell count of humans increases when they remain at high altitudes?

A Haemoglobin is not saturated with oxygen in the lungs.

B The partial pressure of oxygen in the air is higher.

C The percentage of oxygen in the air has decreased.

D There is more carbon dioxide, increasing the Bohr effect.

1156. 9700_m18_qp_12 Q: 31

Which of these statements about the formation of haemoglobinic acid are correct?

1 It depends on the formation of carbaminohaemoglobin.

2 It removes excess hydrogen ions preventing the blood becoming too acidic.

3 It is linked to the action of carbonic anhydrase.

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

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1157. 9700_m18_qp_12 Q: 32

What can combine with the haem group of a haemoglobin molecule?

1 oxygen

2 carbon dioxide

3 carbon monoxide

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

---

1158. 9700_m18_qp_12 Q: 33

Which factors would help a person to adjust from living at a low altitude to living at a high altitude?

1 formation of fewer red blood cells

2 an increase in the oxygen-carrying capacity of the blood

3 an increase in the output of blood by the heart

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

---

1159. 9700_s18_qp_11 Q: 29

Which effect could be due to a reduced concentration of carbonic anhydrase?

A Carbaminohaemoglobin concentrations will decrease.

B Less oxygen is released from oxyhaemoglobin for active tissues.

C The pH of the blood will be lowered.

D The rate of dissociation of carbonic acid is increased.

1160. 9700_s18_qp_11 Q: 30

Which statement correctly compares blood plasma and tissue fluid in a healthy person?

A Blood plasma contains more protein than tissue fluid.

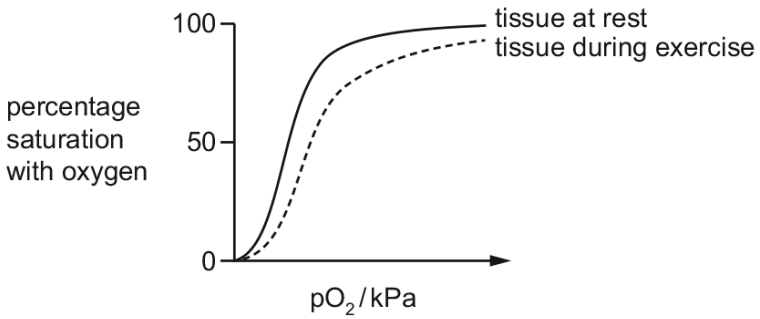
B Both blood plasma and tissue fluid contain red blood cells.

C Tissue fluid contains white blood cells whereas blood plasma does not.

D Tissue fluid is formed from blood plasma and is not returned to blood plasma.

1161. 9700_s18_qp_12 Q: 32

The graph shows two oxygen dissociation curves, one for a tissue at rest and one for the same tissue during exercise.



What factors have caused the difference in the position of the dissociation curve during exercise compared with the dissociation curve for the tissue at rest?

1 increase in pH

2 decrease in pH

3 increase in haemoglobin affinity for O_2

4 decrease in haemoglobin affinity for O_2

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

1162. 9700_s18_qp_12 Q: 33

Which of these statements about the formation of haemoglobinic acid are correct?

1 It can only occur with the dissociation of oxygen from haemoglobin.

2 It removes excess hydrogen ions preventing blood becoming too acidic.

3 It is linked to the action of carbonic anhydrase.

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

---

1163. 9700_s18_qp_13 Q: 31

Which statement about the role in the mammalian circulatory system of the heart, blood vessels and blood is correct?

A The contraction of heart muscle causes blood to enter arteries that pump the blood to organs, causing the formation of tissue fluid between cells before returning to the heart in veins.

B The heart connects two sets of blood vessels so that oxygen from the lungs can be distributed by red blood cells and wastes can be collected from tissues by blood plasma for removal.

C The heart muscle contracts and relaxes causing blood, carrying materials from one part of the body to another, to move through blood vessels that connect the different parts of the body.

D The heart provides enough pressure to push blood through arteries to capillaries between cells causing filtration of blood and the formation of tissue fluid which diffuses back into veins.

1164. 9700_s18_qp_13 Q: 32

What explains how the maximum uptake of oxygen occurs 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.

1165. 9700_s18_qp_13 Q: 33

At high altitudes, the oxygen content of the air may be a third of that at sea level.

As a person climbs a mountain, their body gradually adjusts to the high altitude.

What is increased during this period of adjustment?

A the concentration of haemoglobin in the red blood cells

B the oxygen-carrying capacity of the haemoglobin

C the number of red blood cells per mm^3 of blood

D the rate at which haemoglobin releases oxygen to the tissues

---

1166. 9700_w18_qp_11 Q: 30

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

Which row shows the composition of lymph?

	water	antibodies	lipid
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = present
✗ = absent

1167. 9700_w18_qp_11 Q: 31

Which row shows the change in concentration of some substances in red blood cells when carbon dioxide diffuses from active cells?

	carbonic anhydrase	hydrogencarbonate ions	hydrogen ions
A	decreases	no change	no change
B	increases	increases	increases
C	no change	decreases	increases
D	no change	increases	increases

1168. 9700_w18_qp_12 Q: 31

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

A active transport

B cell division

C phagocytosis

D protein synthesis

1169. 9700_w18_qp_12 Q: 32

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.

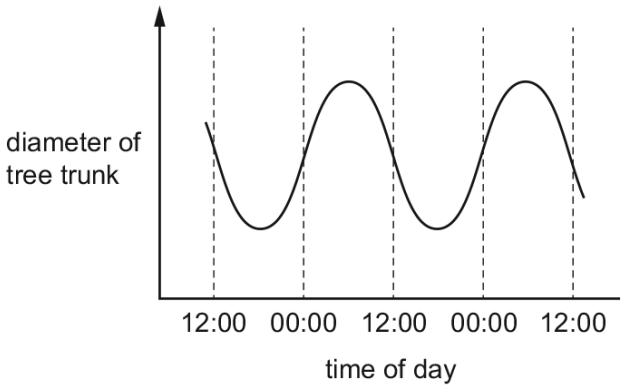
B Carbon dioxide and oxygen bind to one site, carbon monoxide binds to a different site.

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.

1170. 9700_w18_qp_13 Q: 28

The graph shows the diameter of a tree trunk over time.



Which statement explains these changes?

A Cohesive tension forces increased during the day.

B Columns of water break up during the day.

C Mass flow of sucrose decreased during the day.

D Root pressure increased during the day.

1171. 9700_w18_qp_13 Q: 29

What is found in **all** blood vessels, lymph and tissue fluid?

1 carbon dioxide

2 glucose

3 white blood cells

4 antibodies

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 3 and 4 only

D 2 and 4 only

1172. 9700_w18_qp_13 Q: 30

Which reactions will be taking place in blood that is passing through active tissues?

1 $HbO_8 \rightarrow Hb + 4O_2$

2 $HbO_8 + H^+ \rightarrow HHb + 4O_2$

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

4 $H_2O + CO_2 \rightarrow H_2CO_3$

A 1, 2, 3 and 4

B 1, 2 and 4 only

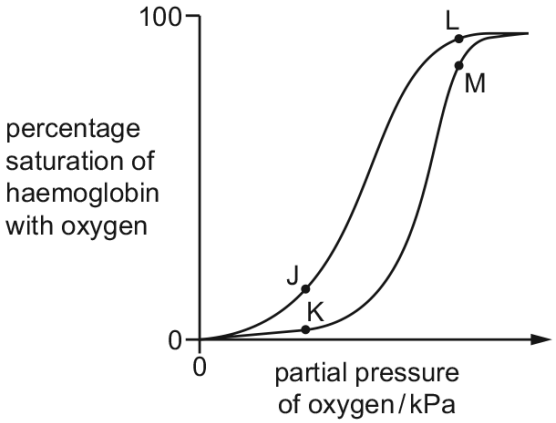
C 1, 3 and 4 only

D 2 and 3 only

1173. 9700_w18_qp_13 Q: 31

The graph shows the percentage saturation of haemoglobin with oxygen at a range of partial pressures of oxygen and at two partial pressures of carbon dioxide.

One curve is at the partial pressure of carbon dioxide in the lungs and the other curve at the partial pressure of carbon dioxide in the liver.



Which points on the curves correspond to the percentage saturation of haemoglobin at the lungs and at the liver?

A L and J **B** L and K **C** M and J **D** M and K

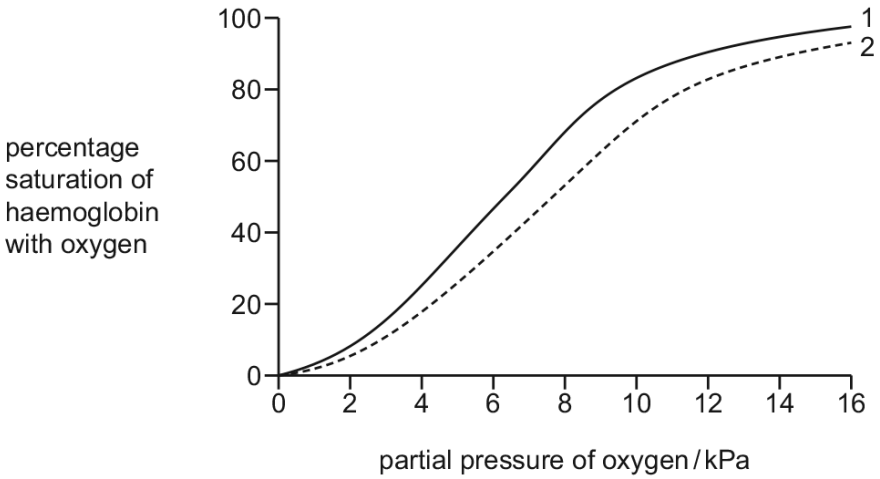
1174. 9700_s17_qp_11 Q: 35

Which row is correct for the pulmonary artery?

	blood carried	muscle in walls	lumen size
A	deoxygenated	thick	small
B	deoxygenated	thin	large
C	oxygenated	thick	small
D	oxygenated	thin	large

1175. 9700_s17_qp_11 Q: 36

The graph shows oxygen dissociation curves of adult oxyhaemoglobin in different carbon dioxide concentrations, 1 and 2.



Which conditions could change the shape of curve 1 to the shape of curve 2?

A high carbon dioxide concentration causing a decrease in pH

B high carbon dioxide concentration causing an increase in pH

C low carbon dioxide concentration causing a decrease in pH

D low carbon dioxide concentration causing an increase in pH

1176. 9700_s17_qp_12 Q: 27

What is systolic blood pressure?

A the blood pressure in the arteries when the heart is relaxing

B the blood pressure in the left ventricle at the end of a contraction

C the maximum blood pressure in the arteries

D the maximum blood pressure in the right ventricle

1177. 9700_s17_qp_12 Q: 28

When they remain at high altitudes the red blood cell count of humans increases.

Why does this occur?

1 to increase the Bohr effect

2 to increase the diffusion gradient for oxygen in the lungs

3 to maintain transport of oxygen

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

---

1178. 9700_s17_qp_12 Q: 29

Which comparisons of blood, tissue fluid and lymph are correct?

1 Blood has a higher concentration of proteins than tissue fluid because the larger proteins are too big to pass through the endothelial pores into tissue fluid.

2 Lymph has a higher concentration of lymphocytes than tissue fluid as a high number of lymphocytes are located in lymph nodes.

3 Macrophages are too large to leave the blood to enter tissue fluid whereas neutrophils, which are much smaller, can enter tissue fluid and pass into lymph.

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

---

1179. 9700_s17_qp_12 Q: 30

A number of different tissues occur in the walls of major blood vessels.

Which row correctly identifies the main tissues found in the three layers of the wall of an artery?

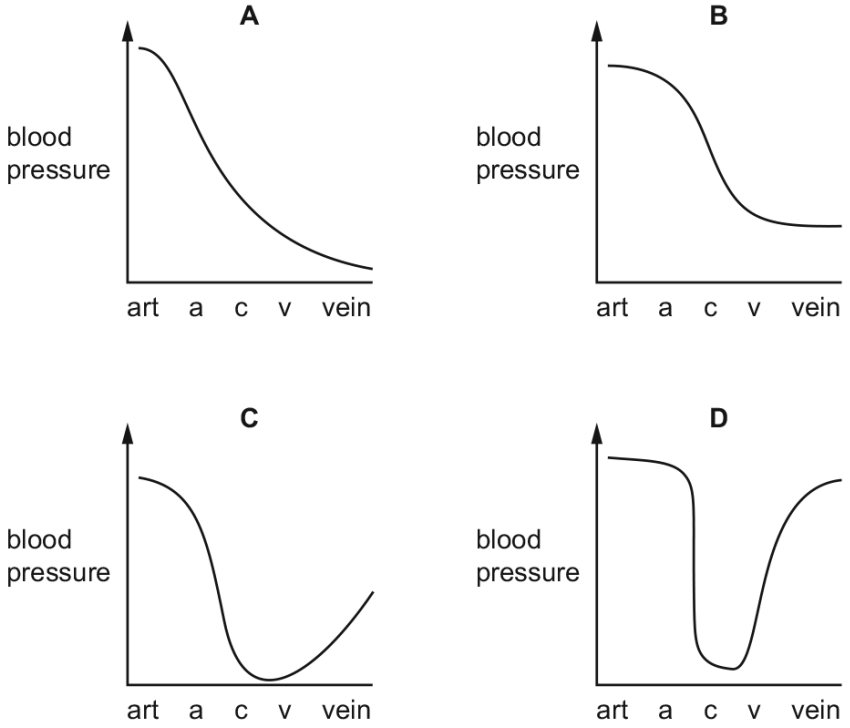
	outer layer (tunica externa)	middle layer (tunica media)	inner layer (tunica intima)
A	collagen	elastic	endothelium
B	collagen	muscle	elastic
C	elastic	collagen	endothelium
D	muscle	collagen	elastic

1180. 9700_s17_qp_13 Q: 27

As blood flows from an artery to a vein, the blood pressure in the vessels changes. The four graphs represent data for blood vessels in the sequence shown.

key	artery	arteriole (small artery)	capillaries	venule (small vein)	veins
	art	a	c	v	vein

Which graph shows these changes correctly?



1181. 9700_s17_qp_13 Q: 28

How is most carbon dioxide transported in the blood?

A as carbaminohaemoglobin

B as carbonic acid

C as hydrogencarbonate ions

D in solution in cytoplasm

1182. 9700_s17_qp_13 Q: 29

When a doctor or nurse takes a blood sample from a person they use a needle to penetrate a vein, not an artery.

Which reasons explain why veins are used?

1 Arteries carry blood under more pressure than veins.

2 Arteries have a thicker middle layer than veins.

3 Veins carry deoxygenated blood.

4 Veins have a larger lumen than arteries.

A 1, 2, 3 and 4

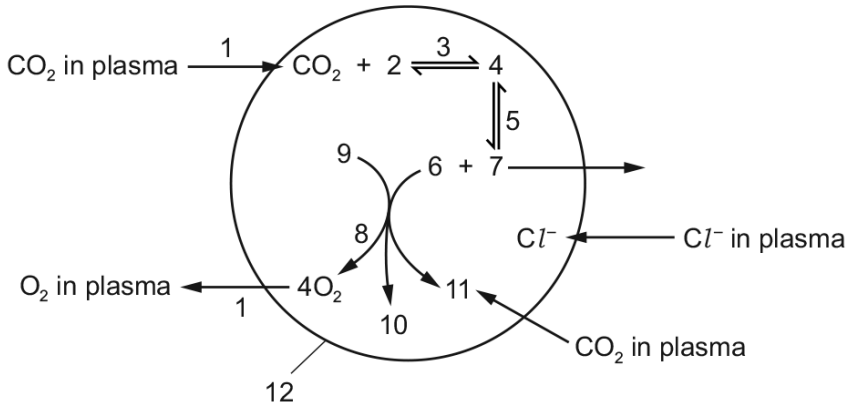
B 1, 2 and 3 only

C 1, 2 and 4 only

D 3 and 4 only

1183. 9700_s17_qp_13 Q: 30

The diagram is an incomplete summary explaining the role of haemoglobin in the carriage of carbon dioxide.



Which set of labels is correct?

A 1 = facilitated diffusion, 4 = carbonic acid, 7 = hydrogencarbonate ions

B 2 = water, 8 = dissociation, 10 = carbaminohaemoglobin

C 3 = carbonic anhydrase, 9 = oxyhaemoglobin, 11 = carbaminohaemoglobin

D 5 = carbonic anhydrase, 6 = hydrogen ions, 12 = red blood cell

---

1184. 9700_w17_qp_11 Q: 28

Which substances could displace oxygen from oxyhaemoglobin?

1 carbon dioxide

2 carbon monoxide

3 hydrogencarbonate ions

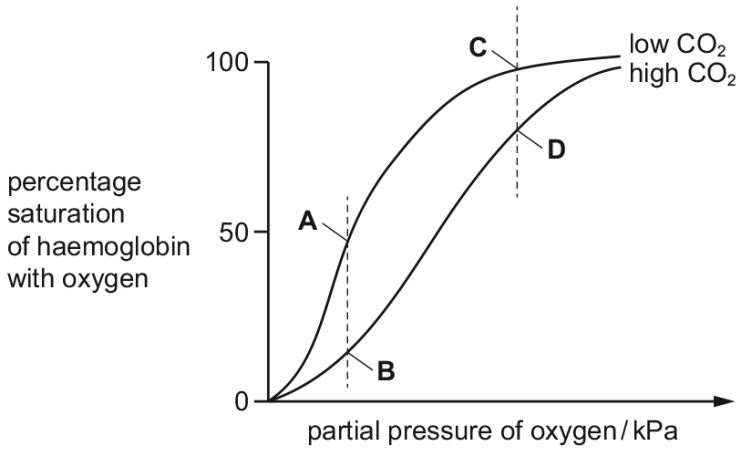
4 hydrogen ions

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

1185. 9700_w17_qp_11 Q: 29

The graph shows the affinity of haemoglobin for oxygen at two different concentrations of carbon dioxide.

Which point on the graph shows the percentage saturation of haemoglobin entering the pulmonary artery?



1186. 9700_w17_qp_12 Q: 31

Which statement about the human circulatory system is correct?

A Blood passes twice through the heart in one complete circulation.

B Blood, tissue fluid and lymph are all parts of the circulatory system.

C Capillaries have the lowest blood pressure.

D Veins in the circulatory system all carry deoxygenated blood.

1187. 9700_w17_qp_12 Q: 33

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

1 carbon dioxide

2 carbon monoxide

3 oxygen

Which gases share a binding site?

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

---

1188. 9700_w17_qp_13 Q: 34

Which of these processes are responsible for the Bohr shift?

1 Carbon dioxide reacts with haemoglobin to form carbaminohaemoglobin.

2 Carbon dioxide reacts with water to form carbonic acid.

3 Haemoglobinic acid is formed from the dissociation of carbonic acid.

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

1189. 9700_m16_qp_12 Q: 28

Cardiac muscle is made up of many fibres that form the walls of the chambers of the heart.

When the heart contracts, these fibres shorten in length so the muscle creates a force that exerts a pressure on the blood, causing it to move.

Which statement explains the difference in thickness of the walls of ventricles of the heart?

A There is more muscle in the wall of the right ventricle than that of the left ventricle because more pressure is needed to push blood into the aorta than into the pulmonary artery.

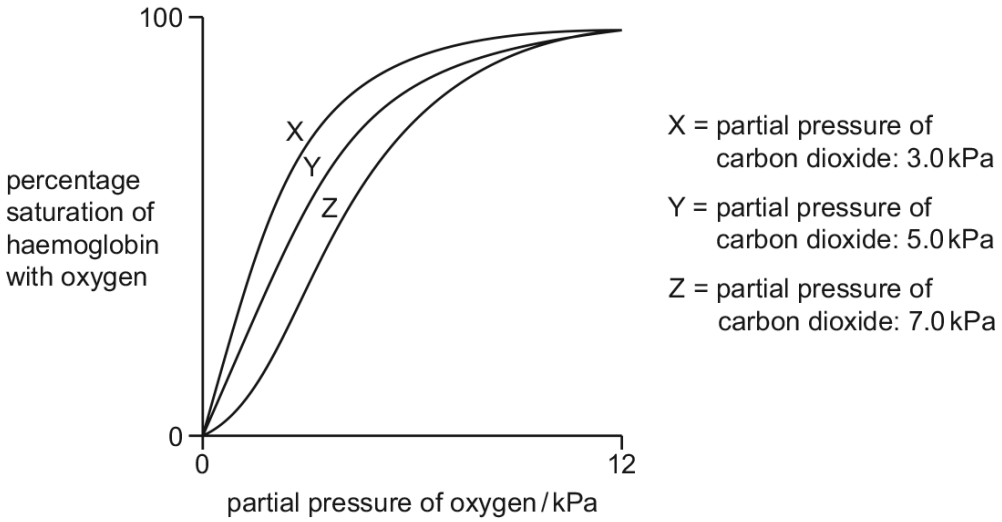
B The number of muscle fibres in the left ventricle is greater than the number in the right ventricle so their contraction has more force, exerting more pressure on blood.

C The space available to fill with blood inside the left ventricle is smaller than that of the right ventricle so more pressure is needed to force blood out.

D The wall of the right ventricle is thicker than that of the left ventricle because it has to resist more pressure when the muscle of the right ventricle contracts.

1190. 9700_m16_qp_12 Q: 30

The diagram shows the effect of three different concentrations of carbon dioxide on the oxygen dissociation curve for human haemoglobin.



What effect does increasing carbon dioxide concentration have on haemoglobin?

A It makes it less efficient at taking up oxygen and less efficient at releasing it.

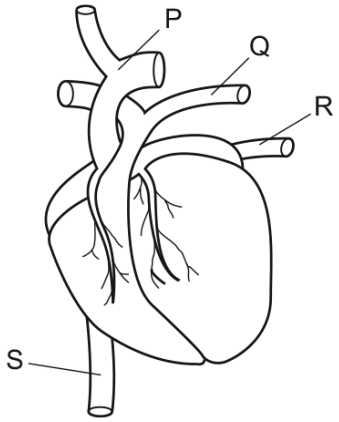
B It makes it less efficient at taking up oxygen and more efficient at releasing it.

C It makes it more efficient at taking up oxygen and less efficient at releasing it.

D It makes it more efficient at taking up oxygen and more efficient at releasing it.

1191. 9700_s16_qp_11 Q: 28

The diagram is an external view of the mammalian heart and the associated blood vessels.



Which statement about the blood vessels associated with a normal, healthy heart is correct?

A P and Q carry blood with more oxyhaemoglobin than haemoglobin.

B P and R carry blood that is saturated with oxygen.

C S and P carry blood with a low oxygen concentration.

D S and R carry blood with more haemoglobin than oxyhaemoglobin.

1192. 9700_s16_qp_11 Q: 30

Which does **not** occur when a red blood cell arrives at the alveolus?

A Carbaminohaemoglobin releases carbon dioxide from the α-globin and β-globin polypeptide chains.

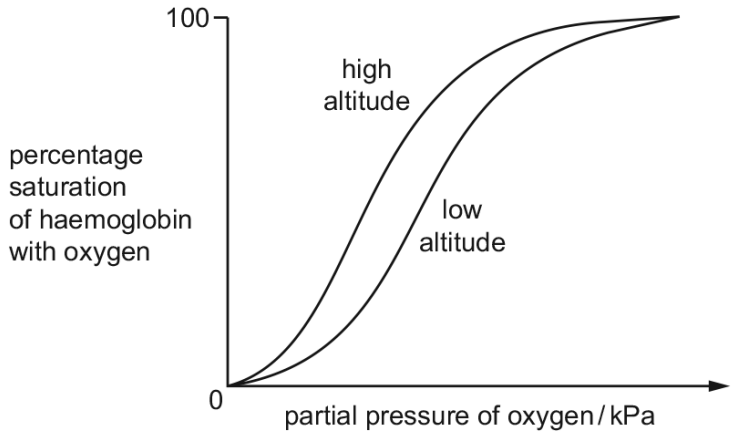
B Carbonic acid in the red blood cell forms carbon dioxide and water.

C Hydrogencarbonate ions diffuse from the plasma into the red blood cell.

D Hydrogen ions are released from haemoglobinic acid and diffuse out of the red blood cell.

1193. 9700_s16_qp_11 Q: 31

The graph shows the oxygen dissociation curves for haemoglobin of animals that live at high altitude and animals that live at low altitude.



What explains the oxygen dissociation curve at **high** altitude?

A Haemoglobin has a higher affinity for oxygen.

B Haemoglobin releases oxygen more readily.

C The change in partial pressure of carbon dioxide causes a Bohr effect.

D The decrease in percentage of carbon dioxide causes the curve to shift to the left.

1194. 9700_s16_qp_12 Q: 27

Which of the tissue types below are present in the walls of **all** blood vessels?

1 collagen

2 elastic

3 endothelial

4 smooth muscle

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 2 and 3 only

D 3 only

1195. 9700_s16_qp_12 Q: 28

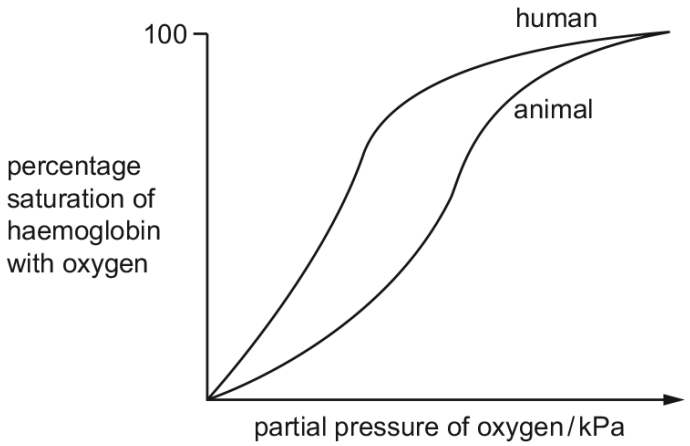
Which components of blood are present in tissue fluid?

	phagocytes	proteins	sodium ions
A	✓	✓	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

key
✓ = present
✗ = absent

1196. 9700_s16_qp_12 Q: 29

The graph shows changes in percentage saturation of haemoglobin with oxygen in the blood of a human and of another animal. The partial pressure of carbon dioxide remains constant at 1.0 kPa and the temperature is constant at 25 °C.



Which conclusion is supported by the graph?

A At 25 °C the affinity of haemoglobin for oxygen increases more in humans than in the animal.

B Haemoglobin in the animal carries less oxygen than haemoglobin in the human.

C Oxygen is more easily released from haemoglobin in animal muscle than in human muscle.

D The Bohr effect in the haemoglobin of the animal is greater than in human haemoglobin.

1197. 9700_s16_qp_12 Q: 30

Which statements about the formation of haemoglobinic acid are correct?

1 It can only occur with the dissociation of oxygen from haemoglobin.

2 It acts to prevent excess hydrogen ions causing acidity in blood.

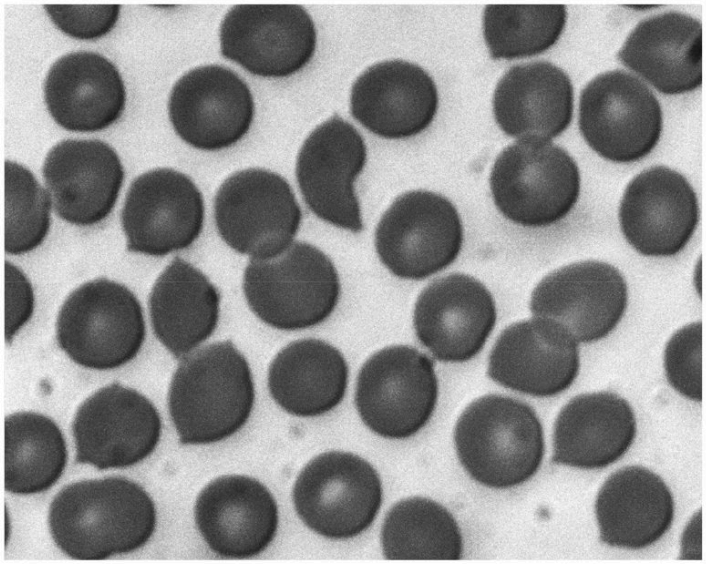
3 It depends on the release of hydrogen ions by the action of carbonic anhydrase.

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

---

1198. 9700_s16_qp_12 Q: 31

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

---

1199. 9700_s16_qp_13 Q: 29

Which components of blood are present in lymph?

	white blood cells	proteins	sodium ions
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✓
D	✗	✓	✗

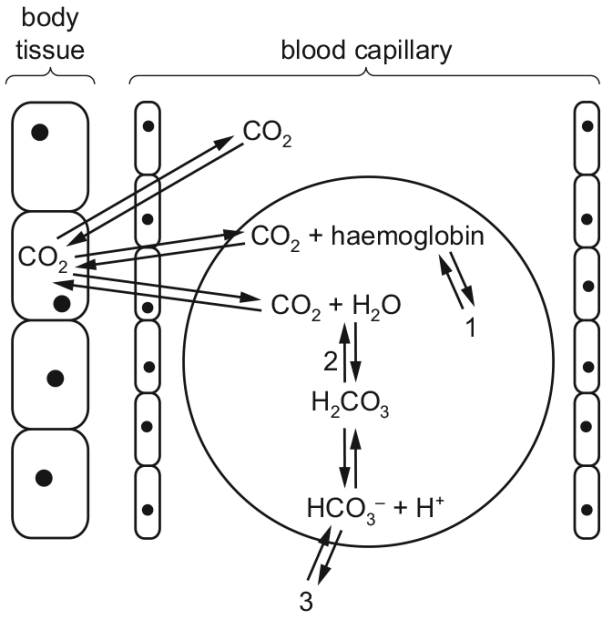
key

✓ = present

✗ = absent

1200. 9700_s16_qp_13 Q: 30

Which row gives the correct labels for the diagram shown?



	1	2	3
A	carbaminohaemoglobin	carbonic anhydrase	hydrogencarbonate
B	carbonic anhydrase	carbaminohaemoglobin	carbon dioxide
C	carbonic anhydrase	carbaminohaemoglobin	hydrogencarbonate
D	hydrogencarbonate	carbon dioxide	carbonic anhydrase

1201. 9700_s16_qp_13 Q: 31

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 breathing 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.

1202. 9700_s16_qp_13 Q: 32

A person has two blood tests one month apart. The number of each type of cell in a fixed sample size is counted.

type of cell	first test	after one month
red blood cells	normal	higher
lymphocytes	normal	higher

What could this suggest about the person based on the results after one month?

	body temperature higher	moved to higher altitude	ATP synthesis in cells is higher
A	no	no	yes
B	no	yes	no
C	yes	no	no
D	yes	yes	yes

1203. 9700_w16_qp_11 Q: 28

Which statement about haemoglobin is correct?

A Carbon dioxide increases its affinity for oxygen.

B Its affinity for oxygen changes with altitude.

C It can combine reversibly with carbon monoxide.

D It can combine with carbon dioxide.

1204. 9700_w16_qp_11 Q: 30

What is the reason for the increase in red blood cells in humans at high altitudes?

A to compensate for the low percentage saturation of haemoglobin

B to enable haemoglobin to unload more oxygen in the tissues by the Bohr effect

C to ensure that haemoglobin is almost 90% saturated when it reaches the tissues

D to increase the number of mitochondria in the blood for ATP production

---

1205. 9700_w16_qp_11 Q: 31

Which statement explains why the oxygen dissociation curve for haemoglobin is S-shaped?

A At high oxygen concentrations, oxygen dissociates from the haemoglobin molecule.

B Haemoglobin becomes saturated at low partial pressures of oxygen.

C Oxygenated haemoglobin accepts hydrogen ions from carbonic acid.

D The shape of the haemoglobin molecule changes when oxygen binds to it.

1206. 9700_w16_qp_11 Q: 32

Which reactions take place in a capillary in an alveolus?

1 carbon dioxide + water → carbonic acid

2 carbon dioxide + haemoglobin → carbaminohaemoglobin

3 haemoglobinic acid → haemoglobin + hydrogen ions

4 hydrogencarbonate ions + hydrogen ions → carbon dioxide + water

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

1207. 9700_w16_qp_12 Q: 29

Which blood vessels carry blood into the atria of the heart?

A coronary artery and pulmonary artery

B pulmonary artery and vena cava

C pulmonary vein and vena cava

D vena cava and coronary artery

1208. 9700_w16_qp_12 Q: 30

Which statement describes the effect of increased carbon dioxide concentration on the oxygen dissociation curve of human haemoglobin and its significance?

A The curve shifts to the left allowing haemoglobin to bind more oxygen in active tissues.

B The curve shifts to the left allowing haemoglobin to offload more oxygen in active tissues.

C The curve shifts to the right allowing haemoglobin to bind more oxygen in active tissues.

D The curve shifts to the right allowing haemoglobin to offload more oxygen in active tissues.

1209. 9700_w16_qp_12 Q: 31

What combines with haemoglobin to form carbaminohaemoglobin?

A carbon dioxide

B carbon monoxide

C carbonic acid

D hydrogencarbonate ions

1210. 9700_w16_qp_13 Q: 27

The following are all structural components of blood vessels.

1 collagen fibres

2 elastic fibres

3 endothelial cells

4 smooth muscle cells

Which row shows the components in an artery and a vein?

	artery	vein
A	1, 2 and 4	1, 3 and 4
B	2, 3 and 4	1, 3 and 4
C	1, 2, 3 and 4	1, 2, 3 and 4
D	1, 2, 3 and 4	2, 3 and 4

1211. 9700_w16_qp_13 Q: 28

Scientists have shown that the oxygen dissociation curves for haemoglobin of smaller mammals are to the right of those of larger mammals.

What does this suggest about the haemoglobin of smaller mammals?

A It carries more oxygen when the partial pressure of oxygen is higher.

B It releases oxygen less easily at lower partial pressures of oxygen.

C It saturates with oxygen more easily.

D It unloads oxygen more easily.

1212. 9700_w16_qp_13 Q: 29

Which row could be correct for the average blood pressure in different parts of the human circulatory system?

	blood pressure			
	right atrium	artery in arm	vein in arm	capillary in arm
A	+	++++	++	+++
B	++	++++	+++	+
C	+++	++	++++	+
D	++++	+++	+	++

key

++++ highest average blood pressure



+ lowest average blood pressure

1213. 9700_w16_qp_13 Q: 30

Which statements are correct?

1 The activity of carbonic anhydrase increases the hydrogen ion concentration in blood passing through active tissue.

2 Carbon dioxide can react with haemoglobin in red blood cells to form carboxyhaemoglobin.

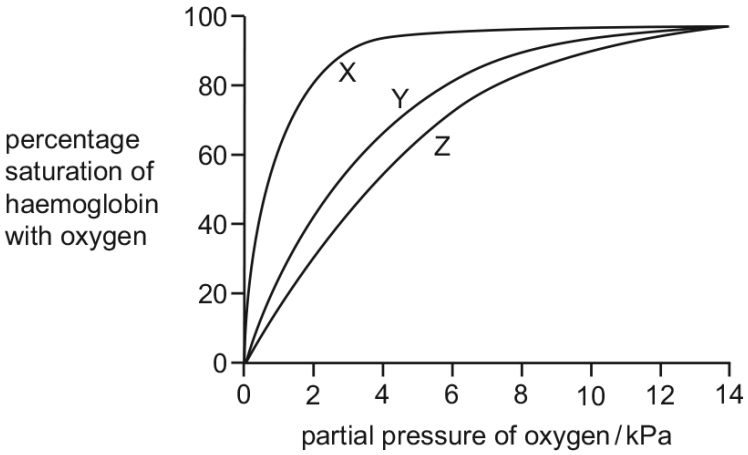
3 When haemoglobin binds with the hydrogen ion its affinity for oxygen decreases.

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

---

1214. 9700_s15_qp_11 Q: 27

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

1215. 9700_s15_qp_11 Q: 28

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.

1216. 9700_s15_qp_11 Q: 29

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

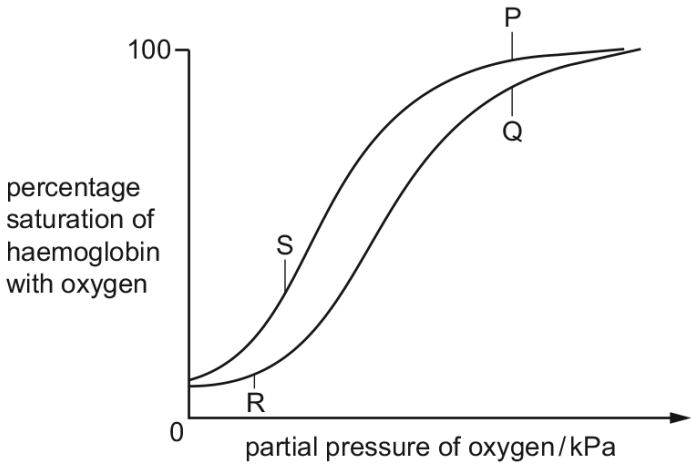
C the formation of carbon dioxide and water from carbonic acid

D the formation of oxyhaemoglobin from haemoglobin and oxygen

---

1217. 9700_s15_qp_12 Q: 29

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 2 **B** 3 and 4 **C** 1 only **D** 5

1218. 9700_s15_qp_12 Q: 30

What does **not** help to maximise uptake of oxygen as blood flows through capillaries in the lungs?

A Dissociation of carbon dioxide from carboxyhaemoglobin allows more haemoglobin to be available for oxygen binding.

B Each haemoglobin molecule can temporarily bind to eight oxygen atoms.

C Oxyhaemoglobin formation increases the capacity of red blood cells to transport oxygen.

D The binding of the first oxygen molecule to haemoglobin increases the molecule's affinity for binding other oxygen molecules.

1219. 9700_s15_qp_13 Q: 27

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.

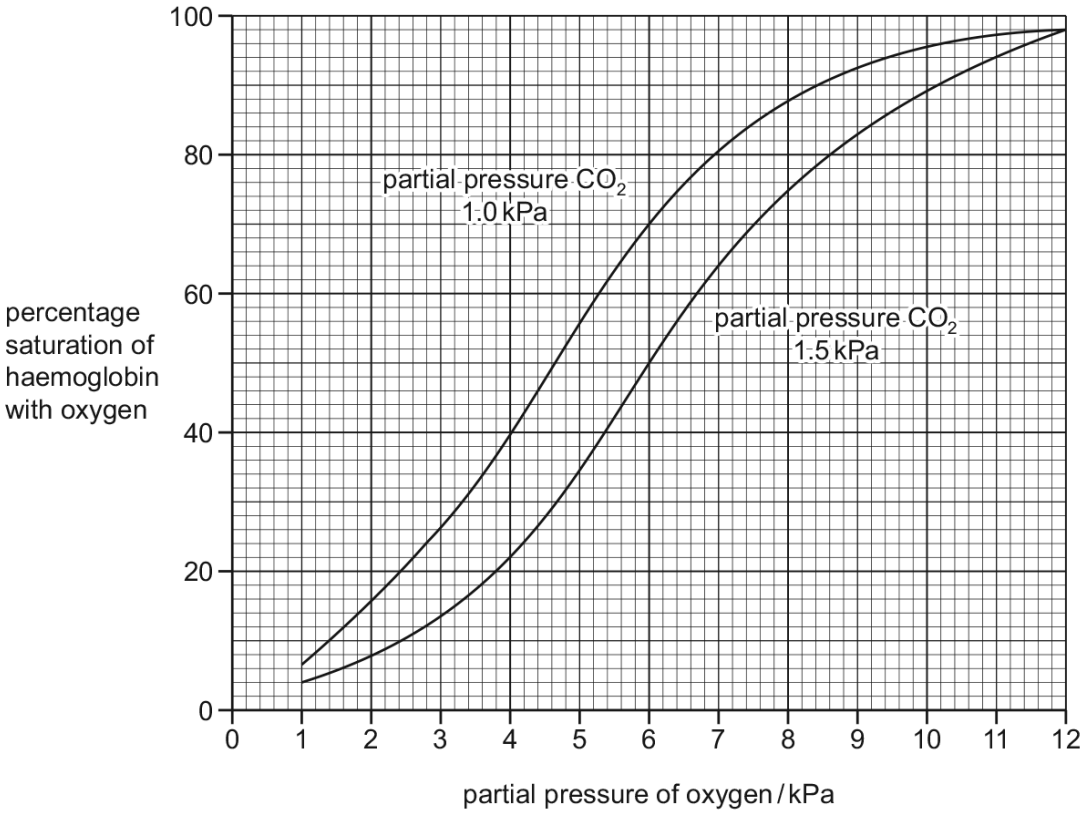
3 Carbonic acid dissociates forming hydrogen ions that combine with haemoglobin to form carbaminoglobin.

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

---

1220. 9700_s15_qp_13 Q: 28

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%

1221. 9700_s15_qp_13 Q: 30

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

1222. 9700_w15_qp_11 Q: 27

Which reactions take place in a capillary in the lungs?

1 carbonic acid is formed from carbon dioxide and water

2 carbaminohaemoglobin is formed from carbon dioxide and haemoglobin

3 haemoglobinic acid is formed from haemoglobin and hydrogen ions

4 carbon dioxide and water are formed from hydrogen carbonate ions and hydrogen ions

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

1223. 9700_w15_qp_11 Q: 28

Red blood cells may contain a molecule known as 2,3-bisphophoglycerate (2,3BPG). When 2,3BPG binds to haemoglobin a higher partial pressure of oxygen is needed to bring about 50% saturation of haemoglobin with oxygen.

Which statements about the effect of 2,3BPG are correct?

1 2,3BPG in red blood cells causes the oxygen dissociation curve to shift to the left.

2 The binding of 2,3BPG to haemoglobin lowers the affinity of the haemoglobin for oxygen.

3 Binding of 2,3BPG to haemoglobin reduces the Bohr effect.

4 When 2,3BPG is absent, oxyhaemoglobin is less likely to unload oxygen.

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

1224. 9700_w15_qp_11 Q: 29

Which statements about arteries are correct?

1 Artery walls can resist high pressure.

2 Arteries pump blood out of the heart.

3 Blood in arteries has the same flow rate as in veins.

4 The pulse in arteries is the result of a surge in blood that causes expansion of the artery wall.

5 There are semilunar valves at the junction of arteries with the heart.

A 1, 2, and 4 **B** 1, 3 and 5 **C** 1, 4 and 5 **D** 2, 3 and 4

1225. 9700_w15_qp_11 Q: 31

Which statements are correct?

1 Tissue fluid has less protein and no red blood cells compared to plasma.

2 Lymph may contain lipids, carbon dioxide and phagocytes.

3 Tissue fluid contains glucose, amino acids, urea and carbon dioxide.

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

---

1226. 9700_w15_qp_11 Q: 33

Which process leads to atherosclerosis?

A a blood clot forming in a coronary artery

B contraction of muscles in arteries caused by nicotine

C formation of plaques in an artery wall

D loss of elasticity in an artery wall causing it to burst

1227. 9700_w15_qp_12 Q: 27

Which components of blood are found in tissue fluid?

	glucose	proteins	white blood cells
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = present

✗ = absent

1228. 9700_w15_qp_12 Q: 28

Which reactions take place in a capillary in an active tissue?

1 carbon dioxide and water are formed from hydrogencarbonate ions and hydrogen ions

2 carbonic acid is formed from carbon dioxide and water

3 carbaminohaemoglobin is formed from carbon dioxide and haemoglobin

4 haemoglobin and hydrogen ions are formed from haemoglobinic acid

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

1229. 9700_w15_qp_12 Q: 30

Red blood cells may contain a molecule known as 2,3-bisphophoglycerate (2,3BPG). When 2,3BPG binds to haemoglobin a higher partial pressure of oxygen is needed to bring about 50% saturation of haemoglobin with oxygen.

Which statements about the effect of 2,3BPG are correct?

1 2,3BPG in red blood cells causes the oxygen dissociation curve to shift to the right.

2 The binding of 2,3BPG to haemoglobin reduces the Bohr effect.

3 The binding of 2,3BPG to haemoglobin lowers the affinity of the haemoglobin for oxygen.

4 When 2,3BPG is absent, oxyhaemoglobin is less likely to unload oxygen.

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

1230. 9700_w15_qp_13 Q: 27

Which reactions take place in a capillary in an active tissue?

1 the formation of carbonic acid from carbon dioxide and water

2 the formation of carbaminohaemoglobin from carbon dioxide and haemoglobin

3 the formation of haemoglobinic acid from haemoglobin and hydrogen ions

4 the formation of carbon dioxide and water from hydrogen carbonate ions and hydrogen ions

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2 and 4 only

D 3 and 4 only

1231. 9700_w15_qp_13 Q: 28

What is present in the blood in human veins?

1 collagen

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

---

1232. 9700_w15_qp_13 Q: 30

Which statement about the pulmonary artery is correct?

A it contains a series of valves

B it contains blood at high pressure

C it contains blood moving towards the heart

D it contains oxygenated blood

1233. 9700_w15_qp_13 Q: 31

Red blood cells may contain a molecule known as 2,3-bisphophoglycerate (2,3BPG). When 2,3BPG binds to haemoglobin a higher partial pressure of oxygen is needed to bring about 50% saturation of haemoglobin with oxygen.

Which statement about the effect of 2,3BPG is correct?

A 2,3BPG in red blood cells causes the oxygen dissociation curve to shift to the left.

B Binding of 2,3BPG to haemoglobin reduces the Bohr effect.

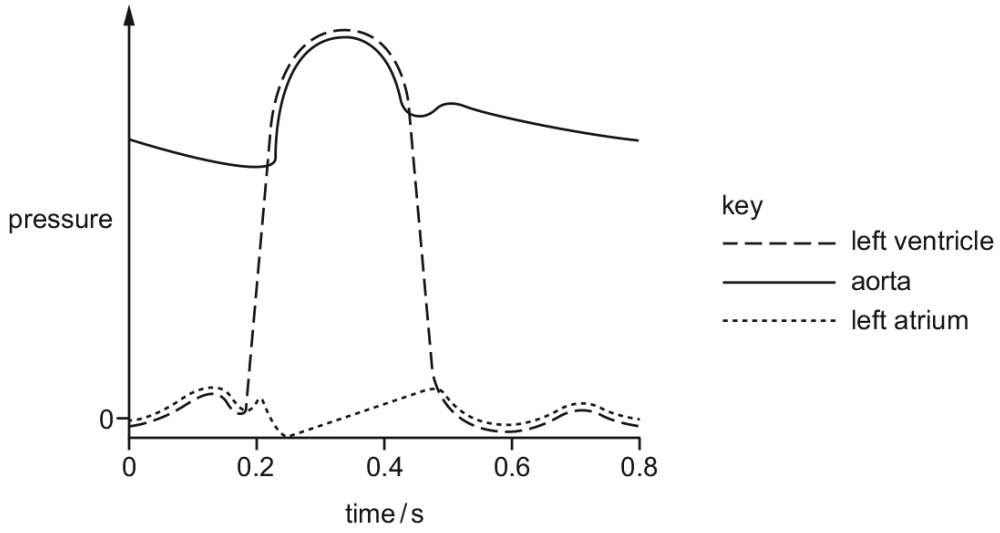
C The binding of 2,3BPG to haemoglobin lowers the affinity of the haemoglobin for oxygen.

D When 2,3BPG is absent, oxyhaemoglobin is less likely to unload oxygen.

8.2 The heart

1234. 9700_m20_qp_12 Q: 30

The graph shows the changes in pressure that occur in the left side of the heart during one cardiac cycle.



At which time are the semi-lunar valves in the heart open?

A 0.1 s **B** 0.3 s **C** 0.5 s **D** 0.7 s

1235. 9700_s20_qp_11 Q: 29

What explains why the left and right sides of the heart contract simultaneously?

A Both atria have a sinoatrial node.

B Both sides of the heart are supplied by the same coronary artery.

C Purkyne tissue links the two sides of the heart.

D There is no barrier to electrical excitation between two sides of the heart.

1236. 9700_s20_qp_11 Q: 30

The statements list some of the events in the cardiac cycle. They are not in the correct order.

1 The impulse travels through Purkyne tissue.

2 A wave of excitation sweeps across the atria.

3 The atrioventricular node delays the impulse for a fraction of a second.

4 The sinoatrial node contracts.

5 The wave of excitation sweeps upwards from the base of the ventricles.

6 The ventricles contract.

7 The atria contract.

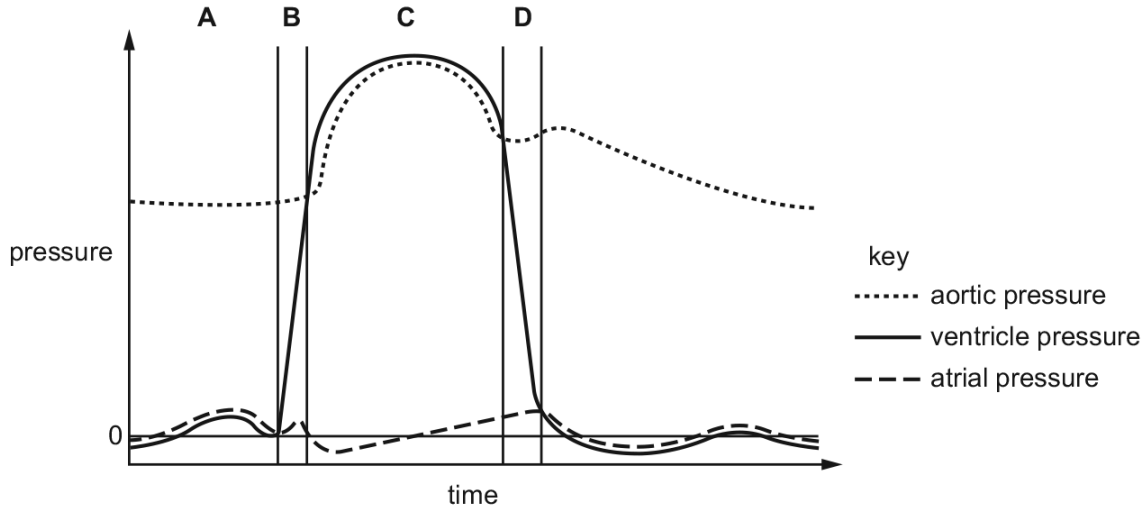
Which statement describes the third of these events to occur in the cardiac cycle?

A 1 **B** 3 **C** 4 **D** 7

1237. 9700_s20_qp_11 Q: 31

The diagram shows pressure changes in different parts of the heart during one cardiac cycle.

During which period are the semilunar valves open and the atrioventricular valves closed?



1238. 9700_w20_qp_11 Q: 30

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

T atrial walls contract

U impulse is delayed a fraction of a second

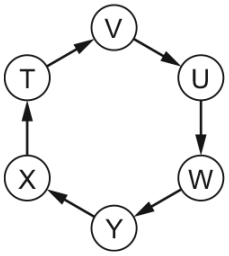
V wave of excitation enters the atrioventricular node

W wave of excitation passes down the Purkyne tissue

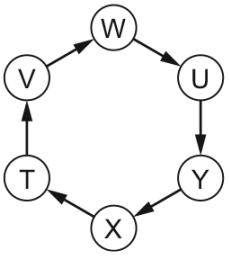
X wave of excitation spreads from the sinoatrial node

Y ventricles contract

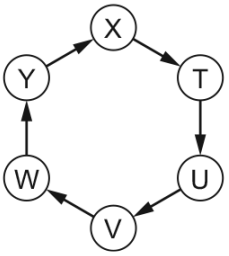
A



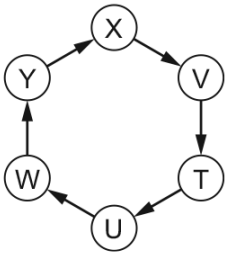
B



C



D



1239. 9700_w20_qp_12 Q: 28

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

T atrial walls contract

U impulse is delayed a fraction of a second

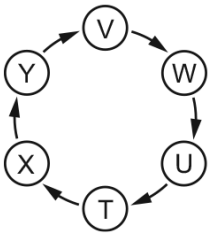
V wave of excitation enters the atrioventricular node

W wave of excitation passes down the Purkyne tissue

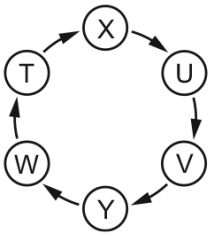
X wave of excitation spreads from the sinoatrial node

Y ventricles contract

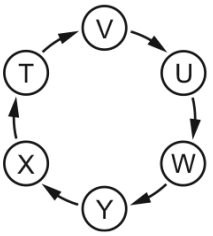
A



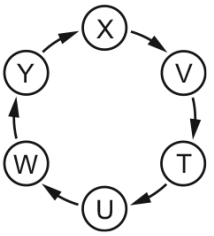
B



C



D



1240. 9700_w20_qp_12 Q: 29

Which factors affect blood pressure?

1 the diameter of the blood vessels

2 the systolic pressure of the heart ventricles

3 the volume of blood returning to the heart in each cardiac cycle

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

---

1241. 9700_m19_qp_12 Q: 32

The statements list some of the events in the cardiac cycle. They are not in the correct order.

1 The impulse travels through Purkyne tissue.

2 The ventricles contract.

3 The atrioventricular node delays the impulse for a fraction of a second.

4 The muscle tissue of the sinoatrial node contracts.

5 The wave of excitation sweeps upwards from the base of the ventricles.

6 A wave of excitation sweeps across the atria.

7 The atria contract.

Which statement describes the second of these events to occur in the cardiac cycle?

A 1 **B** 4 **C** 6 **D** 7

1242. 9700_s19_qp_11 Q: 31

What happens during ventricular systole?

1 The atrioventricular node transmits an electrical signal to the apex of the heart.

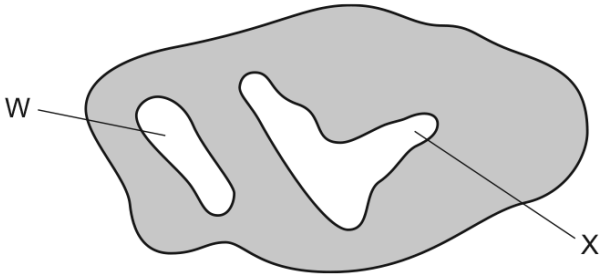
2 The pressure in the ventricles drops below the pressure in the atria.

3 The atrioventricular valves close and the semilunar valves open.

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

1243. 9700_s19_qp_12 Q: 27

The diagram shows a cross-section through a mammalian heart.

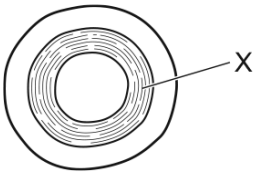


Which chambers of the heart are represented by W and X?

	W	X
A	left ventricle	right ventricle
B	right atrium	left atrium
C	right atrium	right ventricle
D	right ventricle	left ventricle

1244. 9700_s19_qp_12 Q: 30

The diagram shows a transverse section through an artery.



Which statement describes the tissues present in layer X?

A collagen and smooth muscle only

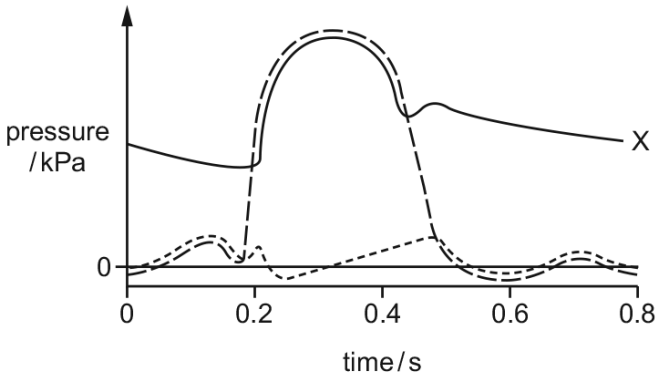
B elastic fibres and collagen only

C elastic fibres and smooth muscle only

D elastic fibres, collagen and smooth muscle

1245. 9700_w19_qp_11 Q: 33

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



Which structure is represented by X?

A pulmonary artery

B right atrium

C right ventricle

D vena cava

1246. 9700_w19_qp_12 Q: 28

The statements list some of the events in the cardiac cycle. They are not in the correct order.

Which statement describes the fifth of these events to occur in the cardiac cycle?

1 The impulse travels through Purkyne tissue.

2 A wave of excitation sweeps across the atria.

3 The atrioventricular node delays the impulse for a fraction of a second.

4 The sinoatrial node contracts.

5 The wave of excitation sweeps upwards from the base of the ventricles.

6 The ventricles contract.

7 The atria contract.

A 1 **B** 3 **C** 4 **D** 7

1247. 9700_w19_qp_13 Q: 30

Which is the correct sequence for the opening of the valves in the mammalian heart during one cardiac cycle?

A

right atrioventricular valve
↓
pulmonary semilunar valve
↓
left atrioventricular valve
↓
aortic semilunar valve

B

left atrioventricular valve
↓
aortic semilunar valve
↓
right atrioventricular valve
↓
pulmonary semilunar valve

C

left atrioventricular valve
and
aortic semilunar valve
↓
right atrioventricular valve
and
pulmonary semilunar valve

D

left atrioventricular valve
and
right atrioventricular valve
↓
aortic semilunar valve
and
pulmonary semilunar valve

1248. 9700_w19_qp_13 Q: 32

Aortic stenosis is a heart valve disorder in which the aortic semilunar 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 atrioventricular 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.

1249. 9700_m18_qp_12 Q: 30

Which statement about the blood flow in the cardiac cycle is correct?

A Blood flows into the aorta through the semilunar valve due to contraction of the right ventricle.

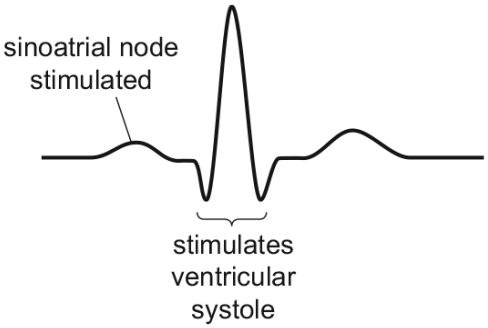
B Blood flows into the left atrium through the pulmonary artery when the wall of the left atrium relaxes.

C Blood flows into the right atrium through the vena cava when the wall of the right atrium relaxes.

D Blood flows into the right ventricle through the semilunar valve due to contraction of the right atrium.

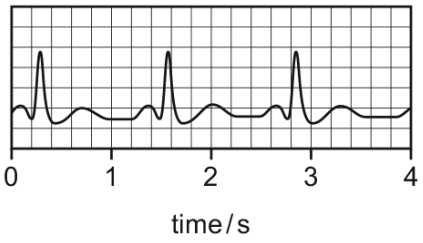
1250. 9700_s18_qp_11 Q: 28

The diagram shows the changes in electrical activity in the heart muscle during one cardiac cycle. This is called an electrocardiograph (ECG).

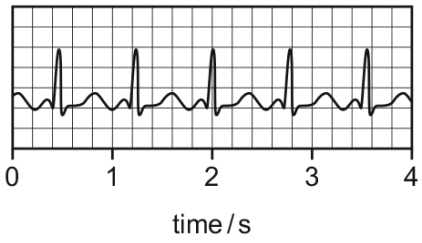


Which electrocardiogram shows a rate of 75 beats per minute?

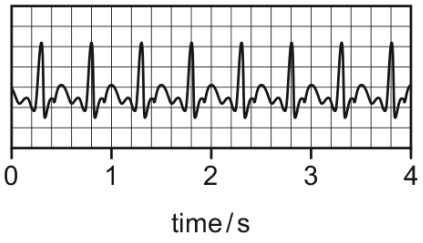
A



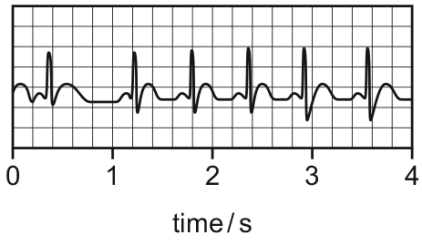
B



C



D



1251. 9700_s18_qp_12 Q: 30

Which statement explains why the ventricles contract after the atria?

A The band of fibres between the atria and the ventricles conducts the excitation wave slowly.

B The excitation wave has to pass through a small area of conducting fibres in the septum.

C The excitation wave has to travel further to reach the base of the ventricles than to spread across the atria.

D The excitation wave travels slowly through the Purkyne tissue to reach the base of the septum.

1252. 9700_s18_qp_12 Q: 31

If the left atrioventricular valve in the heart does not close completely it results in blood flowing back into the atrium during ventricular systole.

What would be the immediate effect of this back flow?

A blood flowing from the heart carries less oxygen because less blood enters the lungs

B diastolic pressure in the left ventricle falls because less blood enters the pulmonary artery

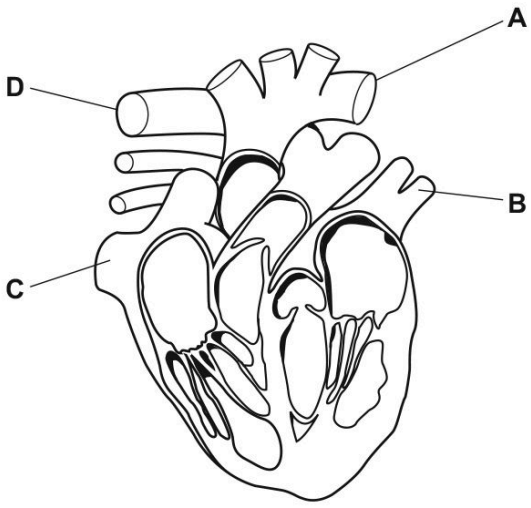
C lower systolic pressure in the left atrium and less blood enters the pulmonary artery

D raised pressure in the left atrium and less blood enters the aorta

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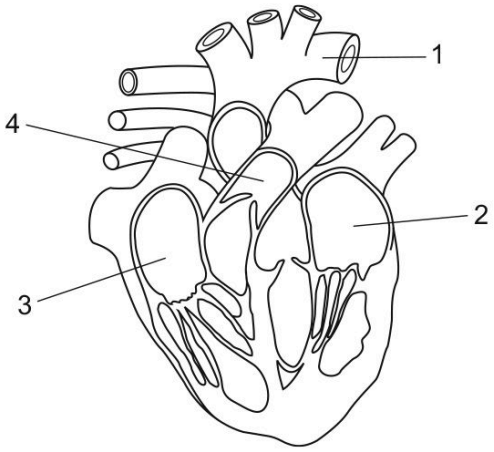
1253. 9700_s18_qp_13 Q: 30

Which blood vessel has the thickest walls?



1254. 9700_w18_qp_11 Q: 29

The diagram shows a section through the heart and the associated blood vessels.



What is correct for the flow of blood through the heart?

A $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$

B $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$

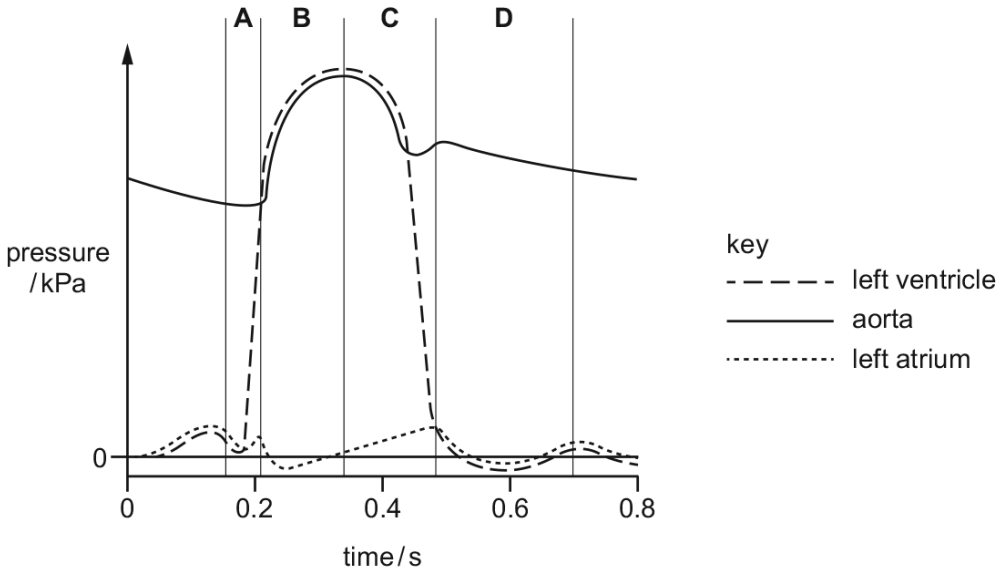
C $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

D $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

1255. 9700_w18_qp_11 Q: 32

The diagram shows the pressure changes in various structures of the left side of the heart during the cardiac cycle.

At the end of which period is the ventricle full of blood?



1256. 9700_w18_qp_12 Q: 29

What describes the role of the atrio-ventricular node of the heart?

A It causes the muscles of the ventricles to contract from the apex upwards.

B It delays the transmission of a wave of electrical activity from the sinoatrial node.

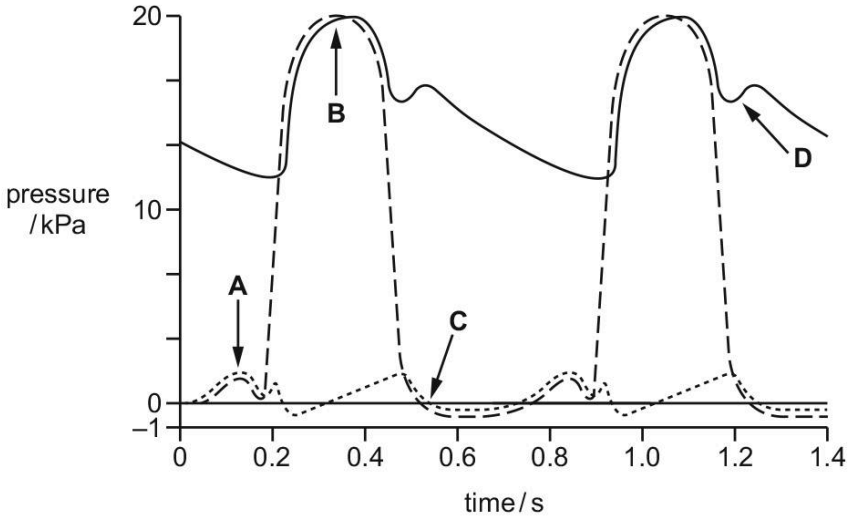
C It initiates a new wave of electrical activity in the ventricles.

D It provides a non-conducting barrier between the atria and the ventricles.

1257. 9700_w18_qp_12 Q: 30

The diagram shows pressure changes during the cardiac cycle.

Which arrow indicates ventricular systole?



1258. 9700_m17_qp_12 Q: 33

The contraction of the heart is coordinated through electrical impulses passing through the cardiac muscle.

What is the correct order of part of the sequence of these impulses?

A right and left atria → atrioventricular node → Purkyne tissue → ventricular walls

B right and left atria → Purkyne tissue → ventricular walls → atrioventricular node

C right and left atria → sinoatrial node → atrioventricular node → ventricular walls

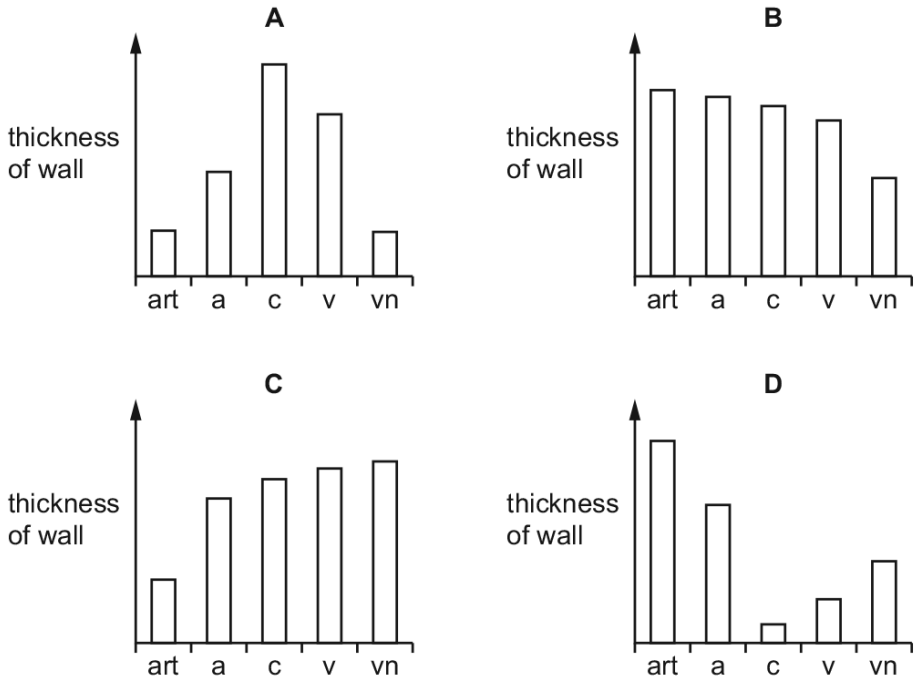
D sinoatrial node → right and left atria → Purkyne tissue → atrioventricular node

---

1259. 9700_m17_qp_12 Q: 34

As blood flows from an artery to a vein, the thickness of the walls of the vessels changes.

Which bar chart shows these changes correctly?



key

art = artery
a = arteriole (small artery)
c = capillary
v = venule (small vein)
vn = vein

1260. 9700_s17_qp_11 Q: 33

The contraction of the heart is coordinated through electrical impulses passing through the cardiac muscle.

Which is the correct order of part of the sequence of these impulses?

A right and left atria → sinoatrial node → atrioventricular node → ventricular walls

B sinoatrial node → right and left atria → atrioventricular node → Purkyne tissue

C sinoatrial node → right and left atria → Purkyne tissue → atrioventricular node

D sinoatrial node → right and left atria → Purkyne tissue → ventricular walls

---

1261. 9700_s17_qp_11 Q: 34

Which features enable the aorta to withstand ventricular systole?

A collagen fibres and elastin fibres

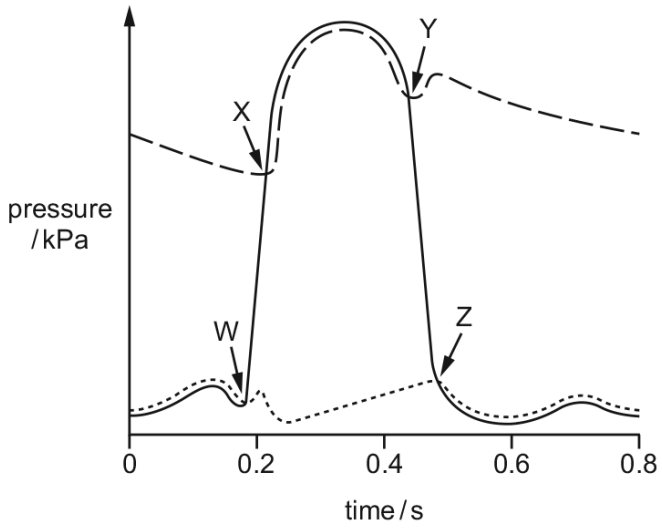
B collagen fibres and smooth muscle

C elastin fibres and endothelium

D endothelium and smooth muscle

1262. 9700_s17_qp_12 Q: 26

The graph shows pressure changes during a cardiac cycle.



Which row correctly identifies W, X, Y, and Z?

	W	X	Y	Z
A	atrioventricular valves close	semi-lunar valves close	semi-lunar valves open	atrioventricular valves open
B	atrioventricular valves close	semi-lunar valves open	semi-lunar valves close	atrioventricular valves open
C	semi-lunar valves close	atrioventricular valves open	atrioventricular valves close	semi-lunar valves open
D	semi-lunar valves open	atrioventricular valves close	atrioventricular valves open	semi-lunar valves close

---

1263. 9700_s17_qp_13 Q: 26

Three areas involved in the control of heart action are listed.

1 atrioventricular node
2 Purkyne tissue
3 sinoatrial node

In which order are they involved?

A $1 \rightarrow 2 \rightarrow 3$ **B** $1 \rightarrow 3 \rightarrow 2$ **C** $3 \rightarrow 1 \rightarrow 2$ **D** $3 \rightarrow 2 \rightarrow 1$

1264. 9700_w17_qp_11 Q: 27

What happens during ventricular systole in a mammalian heart?

A aortic pressure increases

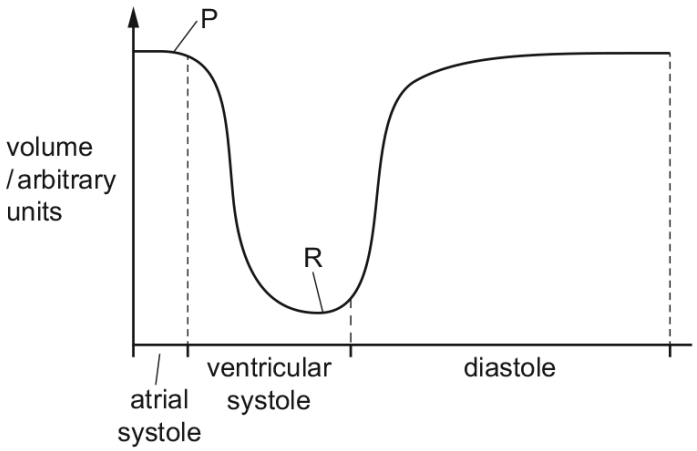
B atrioventricular valves open

C semilunar valves close

D ventricular pressure decreases

1265. 9700_w17_qp_12 Q: 32

The graph shows changes in the volume of the ventricles during the cardiac cycle.



stages of the cardiac cycle

Which valves open and close at P and R?

	atrioventricular valve at P	semilunar valve at R
A	closes	closes
B	closes	opens
C	opens	closes
D	opens	opens

1266. 9700_w17_qp_13 Q: 32

What happens during left ventricular systole?

A The atrioventricular node causes the immediate contraction of the ventricle, causing the atrioventricular valve to close.

B The Purkyne tissue between the atrium and ventricle causes the ventricle to contract, closing the atrioventricular valve and opening the semilunar valve.

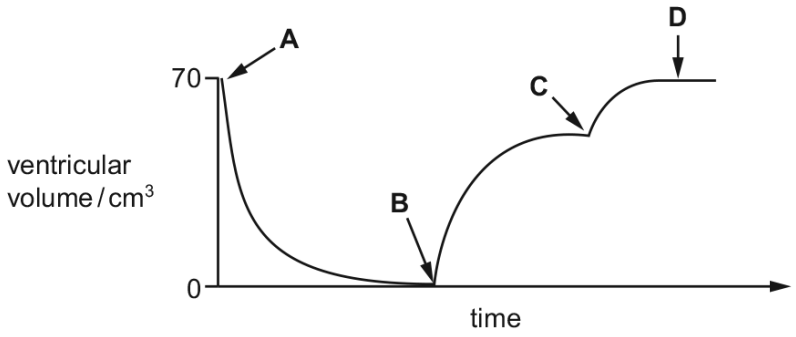
C The sinoatrial node causes the atrium to stop contracting and the blood pressure in the ventricle to increase above that in the atrium.

D The wave of excitation causes the ventricle to contract so that the blood pressure in the ventricle is higher than in the aorta, opening the semilunar valve.

1267. 9700_m16_qp_12 Q: 31

The graph shows the changes that take place in the volume of the left ventricle during one cardiac cycle.

Which point on the graph represents the start of atrial systole?



1268. 9700_m16_qp_12 Q: 32

The following tissues carry an electrical impulse during the cardiac cycle.

1 atrioventricular node

2 muscle wall of atria

3 Purkyne tissue

4 sinoatrial node

In what order does the electrical impulse travel during the cardiac cycle?

A $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$

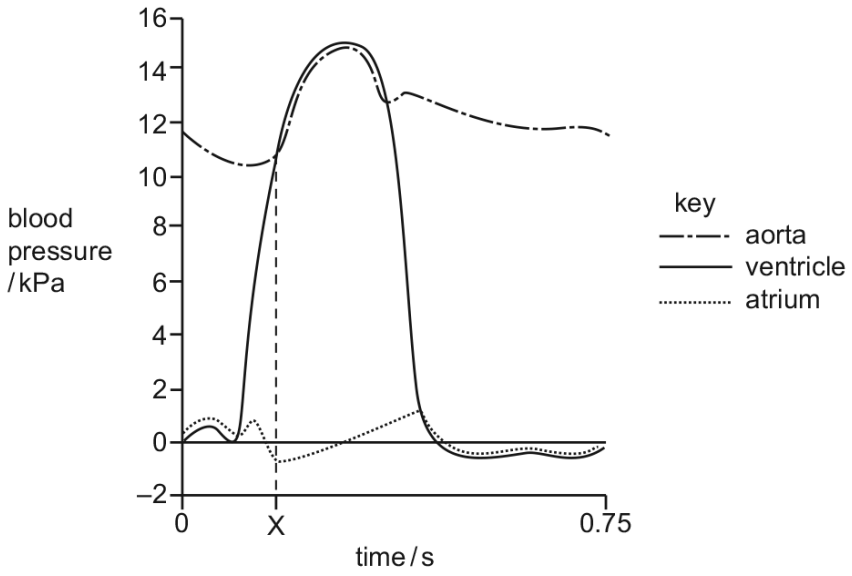
B $1 \rightarrow 4 \rightarrow 2 \rightarrow 3$

C $4 \rightarrow 2 \rightarrow 1 \rightarrow 3$

D $4 \rightarrow 2 \rightarrow 3 \rightarrow 1$

1269. 9700_s16_qp_11 Q: 29

The graph shows changes in blood pressure during one cardiac cycle.



What is happening at time X?

	aortic semilunar valve	atrium
A	closing	emptying
B	closing	filling
C	opening	emptying
D	opening	filling

1270. 9700_s16_qp_11 Q: 32

Which statement concerning events that occur in the heart is correct?

A As the wave of excitation passes through the atrioventricular node there is a time delay before it passes down the conducting fibres in the septum to the ventricles; this allows the atria to fill before ventricular systole.

B Contraction of the ventricle muscles following atrial systole causes the ventricular blood pressure to rise above the blood pressure in the atria, closing the atrioventricular valve and preventing backflow.

C The band of non-conducting fibres between the atria and ventricles prevents the wave of excitation from the atria reaching the ventricles directly; the wave of excitation passes to the Purkyne fibres and then to the atrioventricular node.

D The primary pacemaker, the sinoatrial node in the left atrium, sends out a wave of excitation that spreads across the walls of the atria, resulting in the movement of blood from the atria into the ventricles.

1271. 9700_s16_qp_13 Q: 28

Which events occur during ventricular systole?

1 atrioventricular valves close

2 muscle in ventricle walls relaxes

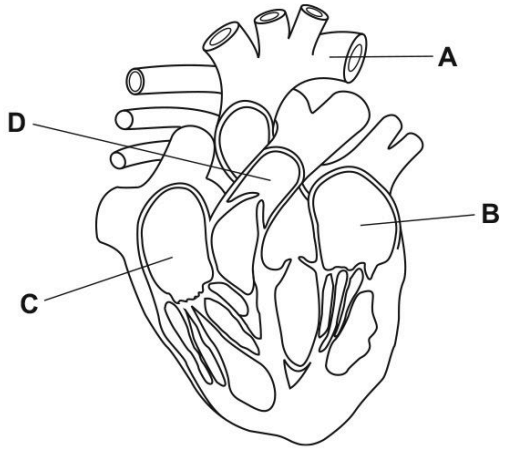
3 semilunar valves open

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

---

1272. 9700_w16_qp_11 Q: 29

The diagram shows a section through the heart.



Which label is correct?

A pulmonary artery

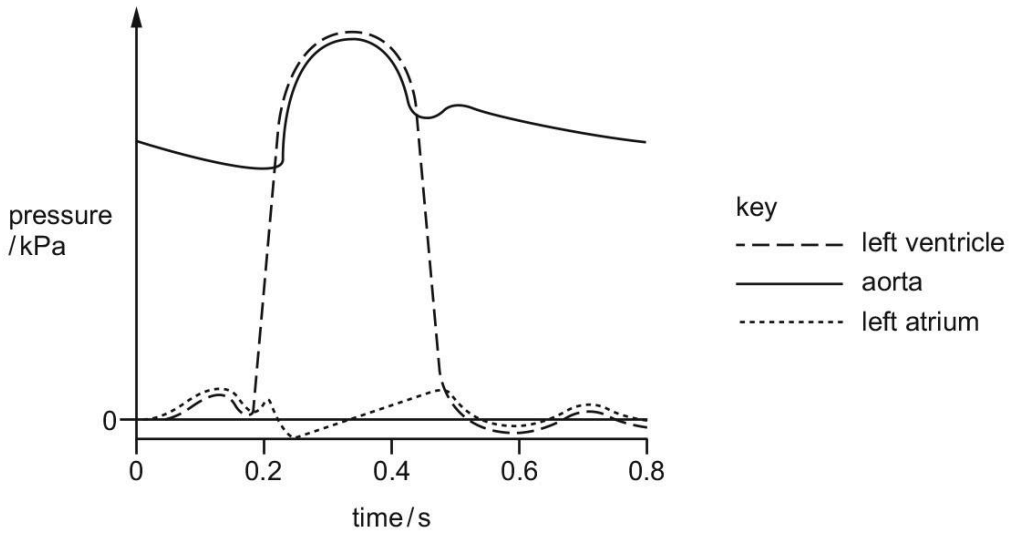
B left ventricle

C right atrium

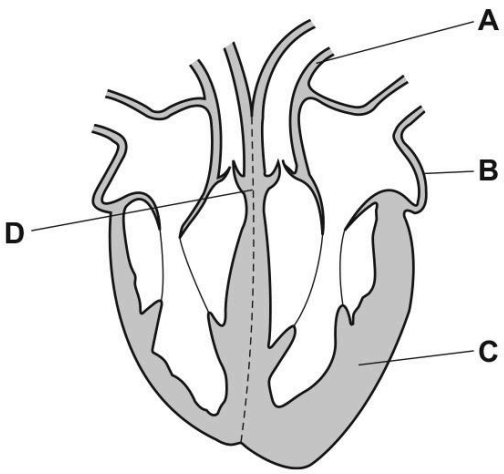
D aorta

1273. 9700_w16_qp_12 Q: 32

The graph shows the pressure in three parts of the heart during one cycle.

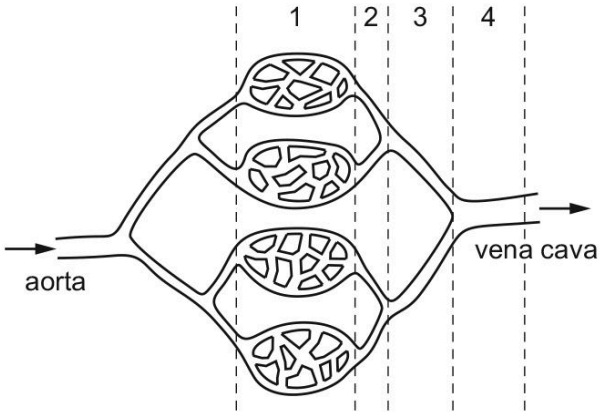


At 0.2 seconds, which part of the heart is responding to the excitatory stimulus?



1274. 9700_w16_qp_12 Q: 33

The diagram shows part of the organisation of the circulation of a mammal.



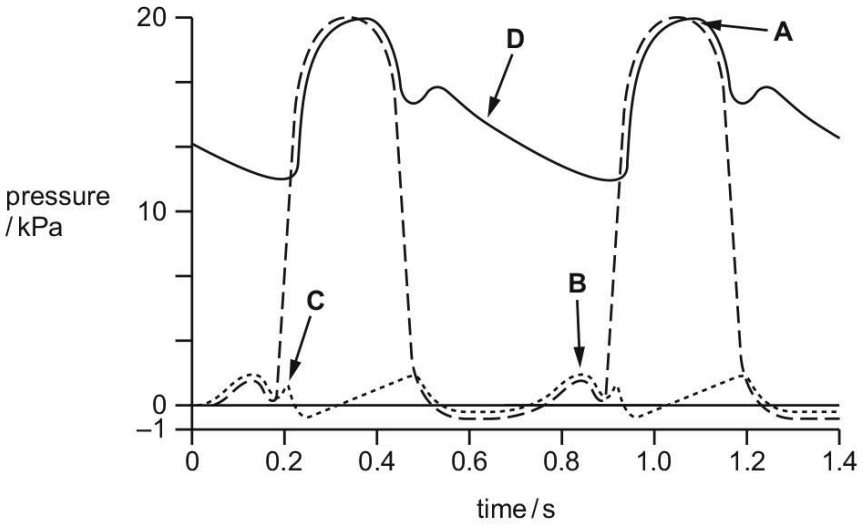
Where are **both** the blood pressure and speed of flow lowest?

	lowest blood pressure	lowest speed of flow
A	1	4
B	2	3
C	3	2
D	4	1

1275. 9700_w16_qp_13 Q: 31

The diagram shows pressure changes during the cardiac cycle.

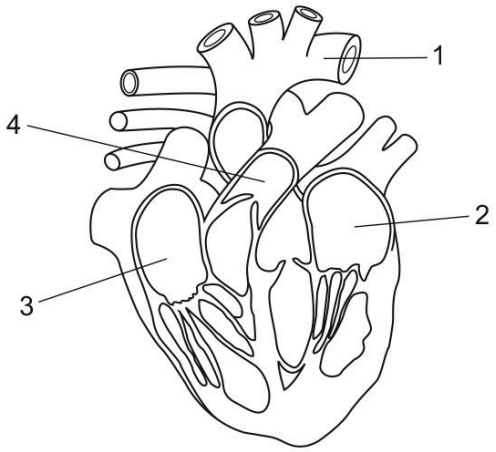
Which arrow indicates atrial systole?



1276. 9700_s15_qp_11 Q: 30

The diagram shows a section through the heart and the associated blood vessels.

What is correct for the flow of blood through the heart?



A 1 → 2 → 3 → 4

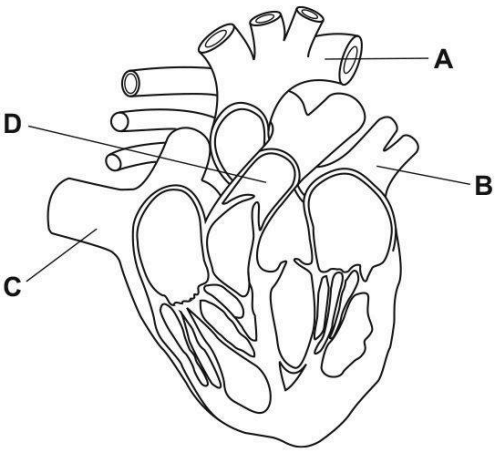
B 2 → 1 → 3 → 4

C 3 → 4 → 1 → 2

D 4 → 3 → 2 → 1

1277. 9700_s15_qp_12 Q: 28

Which structure is correctly identified?



A aorta

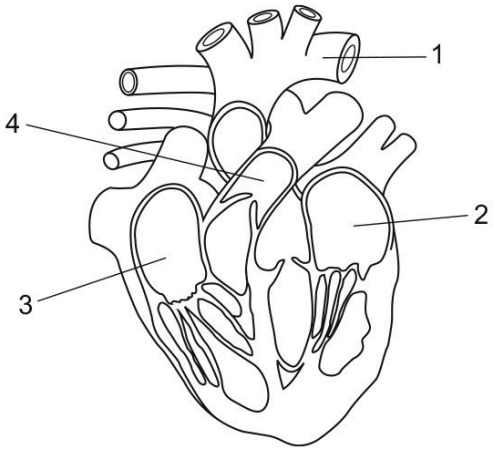
B pulmonary artery

C pulmonary vein

D vena cava

1278. 9700_s15_qp_13 Q: 29

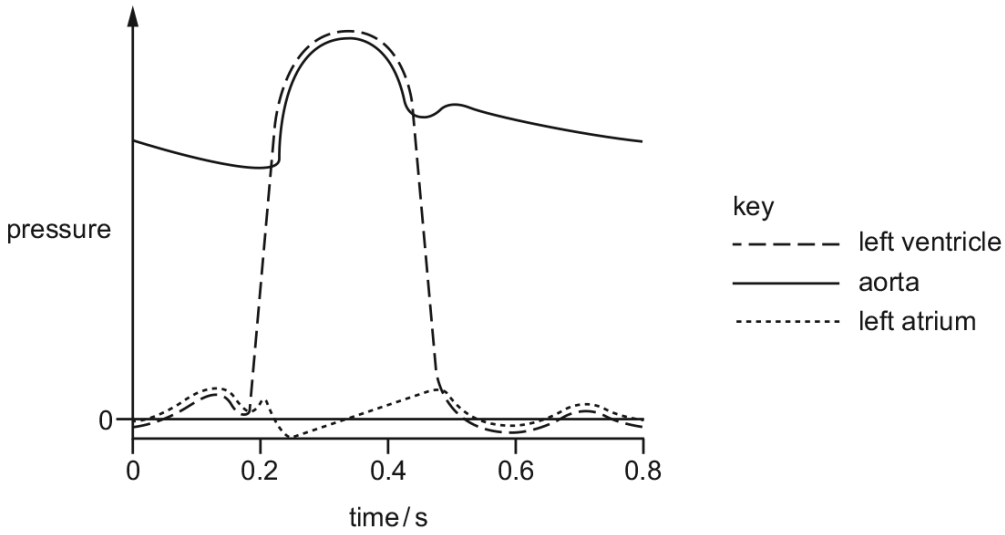
Which structures transport deoxygenated blood?



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

1279. 9700_w15_qp_11 Q: 30

The graph shows the changes in pressure that occur in the left side of the heart during one cardiac cycle.



What is the heart rate in beats per minute?

A 75 **B** 80 **C** 120 **D** 150

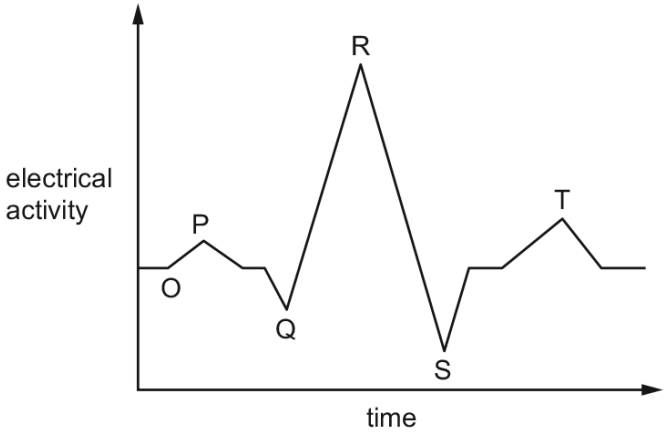
1280. 9700_w15_qp_12 Q: 29

What happens to the atrioventricular valves and to the semilunar valves during atrial systole and ventricular systole?

	atrial systole		ventricular systole	
	atrioventricular valves	semilunar valves	atrioventricular valves	semilunar valves
A	open	closed	closed	open
B	open	closed	open	open
C	closed	open	closed	closed
D	closed	open	open	closed

1281. 9700_w15_qp_13 Q: 29

The diagram shows the electrical activity in cardiac muscle during one heart beat.



What is happening at each of the labelled stages in the cardiac cycle?

	O	P	QRS	T
A	atria contract	atrio-ventricular valve opens	atria relax	ventricles contract
B	impulse leaves AVN	ventricles contract	atria relax	atrio-ventricular valve closes
C	impulse leaves SAN	atria contract	ventricles contract	ventricles relax
D	ventricles relax	atria contract	atrio-ventricular valve closes	ventricles relax

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Paper 1 Multiple Choice Answers: Transport in Mammals

Question	Paper	Q. No.	Answer
1114	9700_m20_qp_12	28	B
1115	9700_m20_qp_12	29	A
1116	9700_m20_qp_12	31	A
1117	9700_s20_qp_11	32	C
1118	9700_s20_qp_12	29	C
1119	9700_s20_qp_12	30	A
1120	9700_s20_qp_12	31	A
1121	9700_s20_qp_13	28	B
1122	9700_s20_qp_13	29	D
1123	9700_s20_qp_13	30	A
1124	9700_s20_qp_13	31	B
1125	9700_s20_qp_13	32	D
1126	9700_w20_qp_11	28	A
1127	9700_w20_qp_11	31	C
1128	9700_w20_qp_12	27	B
1129	9700_w20_qp_12	30	C
1130	9700_w20_qp_12	31	C
1131	9700_w20_qp_13	28	D
1132	9700_w20_qp_13	30	C
1133	9700_w20_qp_13	31	B
1134	9700_m19_qp_12	29	D
1135	9700_m19_qp_12	30	B
1136	9700_m19_qp_12	31	A
1137	9700_s19_qp_11	30	B
1138	9700_s19_qp_11	32	D
1139	9700_s19_qp_11	33	B
1140	9700_s19_qp_12	28	C
1141	9700_s19_qp_13	32	A
1142	9700_s19_qp_13	33	A
1143	9700_s19_qp_13	34	B
1144	9700_s19_qp_13	35	C
1145	9700_s19_qp_13	36	B
1146	9700_w19_qp_11	29	D
1147	9700_w19_qp_11	30	D
1148	9700_w19_qp_11	31	D
1149	9700_w19_qp_11	32	D
1150	9700_w19_qp_12	27	A
1151	9700_w19_qp_12	29	D
1152	9700_w19_qp_12	30	D
1153	9700_w19_qp_12	31	C
1154	9700_w19_qp_13	31	B
1155	9700_w19_qp_13	33	A
1156	9700_m18_qp_12	31	D
1157	9700_m18_qp_12	32	B
1158	9700_m18_qp_12	33	D
1159	9700_s18_qp_11	29	B

Paper 1 Multiple Choice Answers: Transport in Mammals (continued)

Question	Paper	Q. No.	Answer
1160	9700_s18_qp_11	30	A
1161	9700_s18_qp_12	32	D
1162	9700_s18_qp_12	33	A
1163	9700_s18_qp_13	31	C
1164	9700_s18_qp_13	32	B
1165	9700_s18_qp_13	33	C
1166	9700_w18_qp_11	30	A
1167	9700_w18_qp_11	31	D
1168	9700_w18_qp_12	31	A
1169	9700_w18_qp_12	32	C
1170	9700_w18_qp_13	28	A
1171	9700_w18_qp_13	29	A
1172	9700_w18_qp_13	30	B
1173	9700_w18_qp_13	31	B
1174	9700_s17_qp_11	35	A
1175	9700_s17_qp_11	36	A
1176	9700_s17_qp_12	27	C
1177	9700_s17_qp_12	28	D
1178	9700_s17_qp_12	29	B
1179	9700_s17_qp_12	30	A
1180	9700_s17_qp_13	27	A
1181	9700_s17_qp_13	28	C
1182	9700_s17_qp_13	29	C
1183	9700_s17_qp_13	30	C
1184	9700_w17_qp_11	28	D
1185	9700_w17_qp_11	29	B
1186	9700_w17_qp_12	31	A
1187	9700_w17_qp_12	33	D
1188	9700_w17_qp_13	34	C
1189	9700_m16_qp_12	28	B
1190	9700_m16_qp_12	30	B
1191	9700_s16_qp_11	28	B
1192	9700_s16_qp_11	30	D
1193	9700_s16_qp_11	31	A
1194	9700_s16_qp_12	27	D
1195	9700_s16_qp_12	28	A
1196	9700_s16_qp_12	29	C
1197	9700_s16_qp_12	30	A
1198	9700_s16_qp_12	31	C
1199	9700_s16_qp_13	29	A
1200	9700_s16_qp_13	30	A
1201	9700_s16_qp_13	31	D
1202	9700_s16_qp_13	32	D
1203	9700_w16_qp_11	28	D
1204	9700_w16_qp_11	30	A
1205	9700_w16_qp_11	31	D

Paper 1 Multiple Choice Answers: Transport in Mammals (continued)

Question	Paper	Q. No.	Answer
1206	9700_w16_qp_11	32	B
1207	9700_w16_qp_12	29	C
1208	9700_w16_qp_12	30	D
1209	9700_w16_qp_12	31	A
1210	9700_w16_qp_13	27	C
1211	9700_w16_qp_13	28	D
1212	9700_w16_qp_13	29	A
1213	9700_w16_qp_13	30	C
1214	9700_s15_qp_11	27	B
1215	9700_s15_qp_11	28	B
1216	9700_s15_qp_11	29	A
1217	9700_s15_qp_12	29	C
1218	9700_s15_qp_12	30	A
1219	9700_s15_qp_13	27	B
1220	9700_s15_qp_13	28	B
1221	9700_s15_qp_13	30	B
1222	9700_w15_qp_11	27	D
1223	9700_w15_qp_11	28	D
1224	9700_w15_qp_11	29	C
1225	9700_w15_qp_11	31	A
1226	9700_w15_qp_11	33	C
1227	9700_w15_qp_12	27	A
1228	9700_w15_qp_12	28	C
1229	9700_w15_qp_12	30	B
1230	9700_w15_qp_13	27	B
1231	9700_w15_qp_13	28	D
1232	9700_w15_qp_13	30	B
1233	9700_w15_qp_13	31	C
1234	9700_m20_qp_12	30	B
1235	9700_s20_qp_11	29	D
1236	9700_s20_qp_11	30	D
1237	9700_s20_qp_11	31	C
1238	9700_w20_qp_11	30	A
1239	9700_w20_qp_12	28	C
1240	9700_w20_qp_12	29	A
1241	9700_m19_qp_12	32	C
1242	9700_s19_qp_11	31	D
1243	9700_s19_qp_12	27	D
1244	9700_s19_qp_12	30	D
1245	9700_w19_qp_11	33	A
1246	9700_w19_qp_12	28	A
1247	9700_w19_qp_13	30	D
1248	9700_w19_qp_13	32	D
1249	9700_m18_qp_12	30	C
1250	9700_s18_qp_11	28	B
1251	9700_s18_qp_12	30	B

Paper 1 Multiple Choice Answers: Transport in Mammals (continued)

Question	Paper	Q. No.	Answer
1252	9700_s18_qp_12	31	D
1253	9700_s18_qp_13	30	A
1254	9700_w18_qp_11	29	B
1255	9700_w18_qp_11	32	A
1256	9700_w18_qp_12	29	B
1257	9700_w18_qp_12	30	B
1258	9700_m17_qp_12	33	A
1259	9700_m17_qp_12	34	D
1260	9700_s17_qp_11	33	B
1261	9700_s17_qp_11	34	A
1262	9700_s17_qp_12	26	B
1263	9700_s17_qp_13	26	C
1264	9700_w17_qp_11	27	A
1265	9700_w17_qp_12	32	A
1266	9700_w17_qp_13	32	D
1267	9700_m16_qp_12	31	C
1268	9700_m16_qp_12	32	C
1269	9700_s16_qp_11	29	D
1270	9700_s16_qp_11	32	B
1271	9700_s16_qp_13	28	C
1272	9700_w16_qp_11	29	C
1273	9700_w16_qp_12	32	C
1274	9700_w16_qp_12	33	D
1275	9700_w16_qp_13	31	B
1276	9700_s15_qp_11	30	B
1277	9700_s15_qp_12	28	A
1278	9700_s15_qp_13	29	C
1279	9700_w15_qp_11	30	A
1280	9700_w15_qp_12	29	A
1281	9700_w15_qp_13	29	C

Chapter 8

Transport in mammals

8.1 The circulatory system

125. 9700_s20_qp_22 Q: 6

The mitotic cell cycle in dividing cells is very carefully controlled.

(a) Complete Table 6.1 to show the correct order of stages in the mitotic cell cycle.

Some of the stages have been completed for you.

Table 6.1

stage of cell cycle	
G_1 phase	
.....	.....
.....	
.....	
.....	mitosis
.....	
telophase	
cytokinesis	

[3]

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At various points during the mitotic cell cycle, checks are made. A cell goes through cell death (apoptosis) if errors occur that cannot be repaired. This makes sure that the daughter cells produced are genetically identical to each other and to the original cell.

Drugs have been developed that can inhibit the mitotic cell cycle and cause the cell to carry out apoptosis. These drugs are used in the treatment of cancer.

(b) Vincristine and 5-fluorouracil are chemical compounds that act as cell cycle inhibitors and can lead to apoptosis.

- Vincristine binds to spindle microtubules and prevents the spindle from carrying out its function.
- 5-fluorouracil prevents the synthesis of thymine nucleotides.

Complete Table 6.2 to show which event in the cell cycle will occur when Vincristine or 5-fluorouracil are added to healthy dividing cells at the start of the interphase stage of the cell cycle.

Place a tick (✓) if the event will occur or a cross (✗) if the event will **not** occur.

All boxes in the table should be completed.

Table 6.2

event in cell cycle / compound	S-phase completes	cell enters prophase of mitosis	chromosomes line up at spindle equator	sister chromatids move towards opposite poles
Vincristine				
5-fluorouracil				

[2]

(c) Vincristine has been used in the treatment of certain types of leukaemia.

Fig. 6.1 is a photomicrograph of a blood smear of a person with one form of leukaemia, which affects lymphocytes.

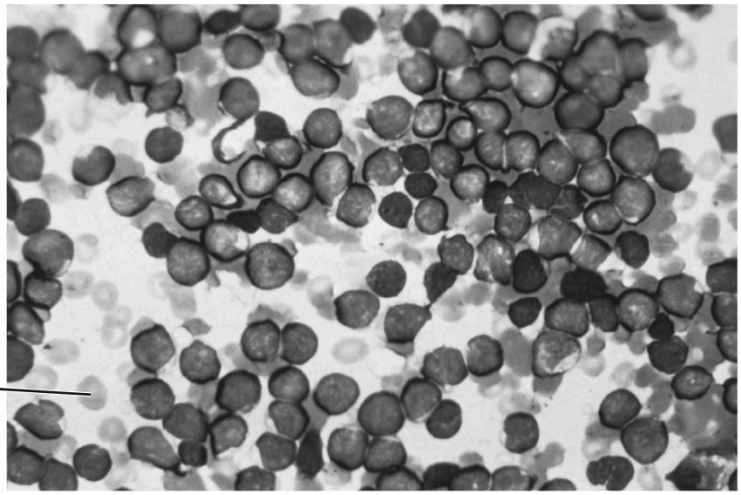


Fig. 6.1

Describe how:

- the blood smear shown in Fig. 6.1 differs from a blood smear of a healthy person
- the lymphocytes in a person with leukaemia, such as those shown in Fig. 6.1, differ from those of a healthy person.

blood smear differences .....

.....

.....

.....

.....

lymphocyte differences .....

.....

.....

.....

.....

..... [3]

[Total: 8]

126. 9700_w20_qp_22 Q: 6

(a) Fig. 6.1 shows an oxygen dissociation curve for adult human haemoglobin.

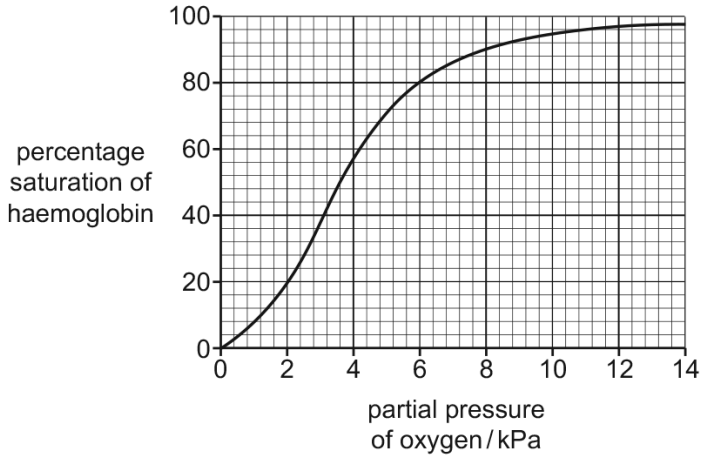


Fig. 6.1

An increase in the partial pressure of carbon dioxide (pCO_2) in respiring tissue causes the Bohr effect.

(i) Sketch on Fig. 6.1 to show how the Bohr effect changes the oxygen dissociation curve. [1]

(ii) Explain how an increase in pCO_2 produces the Bohr effect **and** state the benefit of this effect for the tissue.

.....

.....

.....

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.....

.....

..... [3]

(b) Carbon dioxide (CO_2) is transported across the cell surface membrane of the red blood cell using a different mechanism to the transport of hydrogen carbonate ions (HCO_3^-).

Name the different mechanisms of transport used for CO_2 and for HCO_3^- **and** explain why they are transported across the membrane by different mechanisms.

CO_2 .....

HCO_3^- .....

explanation .....

.....

.....

.....

.....

.....

[4]

[Total: 8]

127. 9700_s19_qp_21 Q: 2

Linoleic acid is an unsaturated fatty acid that is found in some triglycerides and some phospholipids.

Phospholipids are components of cell membranes.

Fig. 2.1 shows a molecule of linoleic acid.

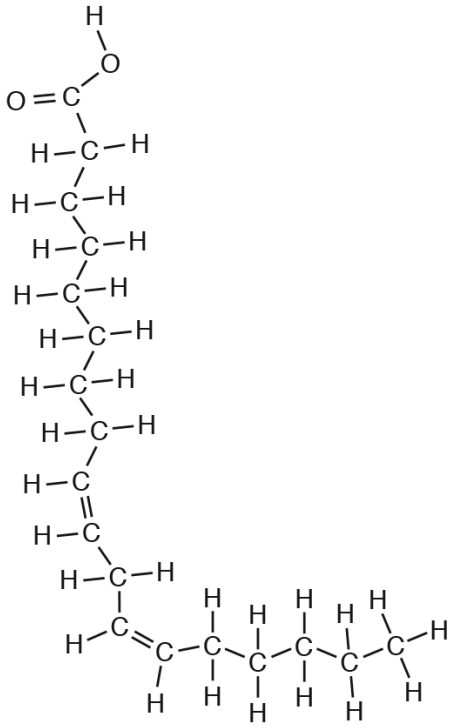


Fig. 2.1

(a) The composition of cell membranes of plants changes in response to changes in temperature.

At the start of the cold season there is an increase in the proportion of phospholipids with unsaturated fatty acids in the chickpea, *Cicer arietinum*. Chickpea plants that do not make this change do not survive.

Suggest how the increase in the proportion of phospholipids with unsaturated fatty acids helps plants, such as chickpea, survive decreases in temperature.

.....

.....

.....

.....

.....

..... [2]

(b) **(i)** State why triglycerides and phospholipids **cannot** be described as polymers.

.....

.....

..... [1]

(ii) State two **differences** in the **structure** of triglycerides and phospholipids.

1 .....

.....

2 .....

.....

[2]

(c) Platelets metabolise linoleic acid to produce a molecule known as thromboxane.

Thromboxane is released by platelets when blood loss occurs. Thromboxane acts on smooth muscle cells in the walls of arteries. This causes arteries to constrict, which reduces blood flow.

Explain why the constriction of arteries following blood loss is an example of cell signalling.

.....

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.....

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.....

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..... [4]

[Total: 9]

128. 9700_s19_qp_23 Q: 5

(a) Fig. 5.1 is a photomicrograph of human blood cells that have been placed in a solution of sodium chloride.

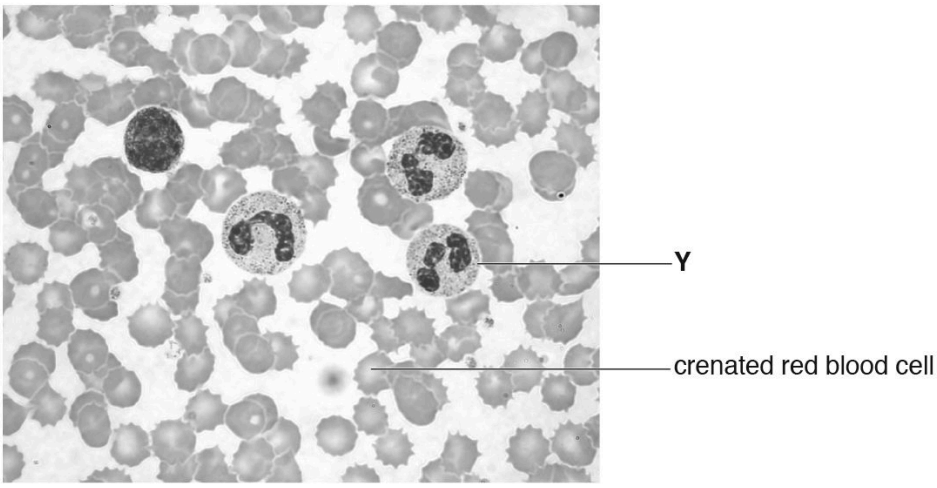


Fig. 5.1

(i) State the function of the cell labelled **Y**.

.....

..... [1]

(ii) The red blood cell labelled in Fig. 5.1 is described as crenated because it has an abnormal, shrivelled appearance.

Explain how this red blood cell has become crenated.

.....

.....

.....

.....

.....

..... [2]

(b) Researchers studied the effect of altitude on the red blood cell count of humans. They recorded the red blood cell count of healthy adults from populations living at four different altitudes in a mountainous region.

The results are shown in Table 5.1.

Table 5.1

population	altitude of population / m above sea level	mean red blood cell count / number of cells $\times 10^6$ mm^{-3}
A	695	4.50
B	1676	5.14
C	2003	5.04
D	2118	5.11

(i) Calculate the percentage increase in mean red blood cell count between population **A** and population **D**.

.....% [1]

(ii) Describe and suggest explanations for the data shown in Table 5.1.

.....

.....

.....

.....

.....

.....

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..... [4]

(c) Carbonic anhydrase is an enzyme found in red blood cells which has an important role in the transport of respiratory gases.

Explain why a non-competitive inhibitor of carbonic anhydrase will reduce the supply of oxygen to actively respiring tissues.

.....

.....

.....

.....

.....

..... [2]

[Total: 10]

---

129. 9700_w19_qp_22 Q: 3

A red blood cell goes through a number of stages in the bone marrow before it is released into the circulation to carry out its role of oxygen transport.

Fig. 3.1 is a transmission electron micrograph of developing red blood cells in the bone marrow. Each cell is known as an erythroblast.

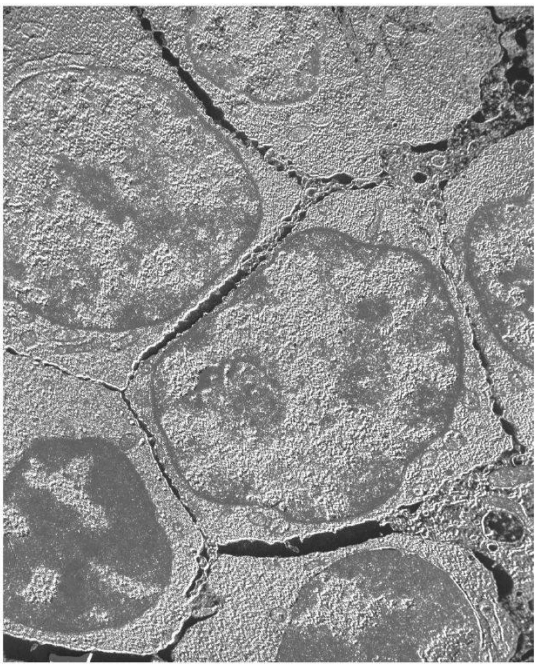


Fig. 3.1

(a) Fig. 3.1 shows erythroblasts at a higher magnification than can be obtained using the light microscope.

Explain the advantages of using an electron microscope to obtain images such as that in Fig. 3.1.

.....

.....

.....

.....

.....

.....

..... [2]

(b) Describe the differences between an erythroblast and a mature red blood cell.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(c) The maturing red blood cell synthesises haemoglobin and other proteins.

(i) Complete Table 3.1 to:

- name **three** organelles (cell structures) that are involved in the synthesis of a fully functioning protein
- state **one** way in which the named organelle is involved in protein synthesis.

Table 3.1

organelle	how the organelle is involved in protein synthesis

[3]

(ii) Fig. 3.2 shows a reversible reaction that takes place within red blood cells.

$$CO_2 + H_2O \rightleftharpoons H_2CO_3$$

Fig. 3.2

Name the protein that catalyses the reaction shown in Fig. 3.2.

..... [1]

The *SPTB* gene codes for a protein that provides stability and support to the cell surface membrane of the red blood cell.

Mutations in *SPTB* result in red blood cells that are spherical in shape. This mutation leads to a disease known as spherocytosis type 2.

(d) Suggest why a person with spherocytosis type 2 has a reduced ability to take up oxygen in the pulmonary capillaries compared with a person who has normal red blood cells.

.....

.....

.....

.....

..... [2]

(e) Increases in the water potential of the blood plasma have greater effects on red blood cells in people with spherocytosis type 2 than on normal red blood cells.

Compare **and** explain the effects of an **increase** in the water potential of blood plasma on spherocytosis type 2 red blood cells and normal red blood cells.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 14]

130. 9700_w19_qp_23 Q: 1

Fig. 1.1 is a diagram of a molecule of haemoglobin.

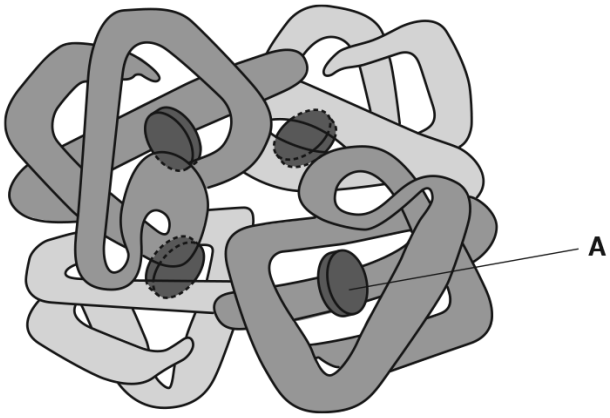


Fig. 1.1

(a) (i) Name the structure labelled **A** on Fig. 1.1.

..... [1]

(ii) State the function of structure **A**.

.....

.....

..... [1]

(b) Haemoglobin is described as a globular protein. Explain why this protein is described as *globular*.

.....

.....

.....

.....

..... [2]

(c) The gene *HBB* codes for the β-globin polypeptide.

State why a polypeptide, such as β-globin, is described as a polymer.

.....

.....

.....

.....

..... [2]

(d) A single base change in the DNA of the gene *HBB* results in a change to the amino acid sequence of β-globin. In the sequence, a single glutamic acid is replaced by valine.

Outline the effects of this change in the amino acid sequence of β-globin on the structure and function of a haemoglobin molecule.

.....

.....

.....

.....

.....

.....

..... [3]

(e) Haemoglobin interacts with carbon dioxide and carbon monoxide.

Outline the role of haemoglobin in the transport of carbon dioxide.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 12]

131. 9700_w19_qp_23 Q: 4

In mammals, arteries branch to form smaller blood vessels called arterioles.

Arterioles branch to form capillaries that supply blood to tissues.

(a) Explain the ways in which the structure of an artery is adapted to its function.

.....

.....

.....

.....

.....

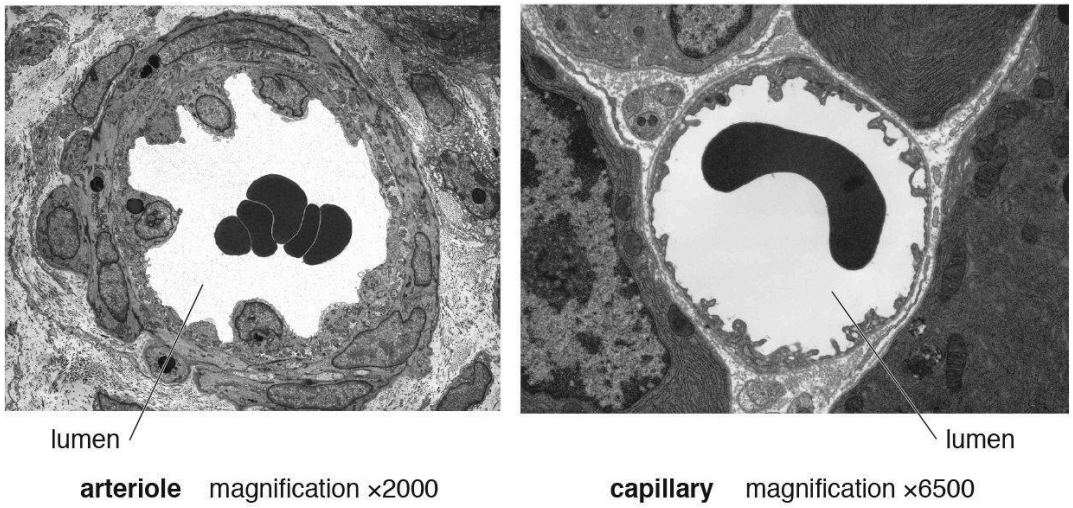
.....

.....

.....

..... [4]

Fig. 4.1 shows transmission electron micrographs of cross-sections through an arteriole and a capillary.



arteriole magnification ×2000 **capillary** magnification ×6500

Fig. 4.1

(b) (i) Identify the cells inside the lumen of the arteriole in Fig. 4.1 **and** state **one** reason for your identification.

.....

.....

.....

..... [2]

(ii) Describe the differences between the arteriole and the capillary that are **visible** in Fig. 4.1.

.....

.....

.....

.....

.....

.....

.....

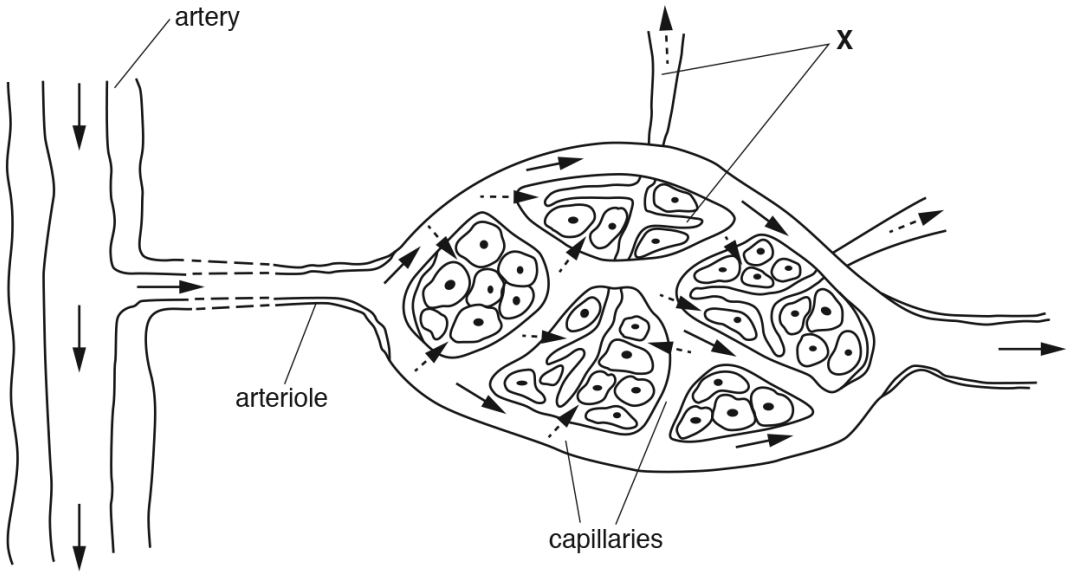
.....

.....

..... [4]

Fig. 4.2 shows a capillary network in a mammalian tissue.

The arrows indicate the direction of flow of body fluids.



not to scale

Fig. 4.2

(c) **(i)** Capillaries have a role in the formation of tissue fluid.

Explain how tissue fluid is formed in the capillary network.

.....

.....

.....

.....

..... [2]

(ii) The vessels labelled **X** in Fig. 4.2 carry excess tissue fluid back into the circulatory system.

Name the fluid inside the vessels labelled **X and** state **one** way in which its composition differs from blood plasma.

name of fluid .....

difference .....

.....

[2]

[Total: 14]

132. 9700_s18_qp_21 Q: 4

Fig. 4.1 is a ribbon model of a molecule of haemoglobin.

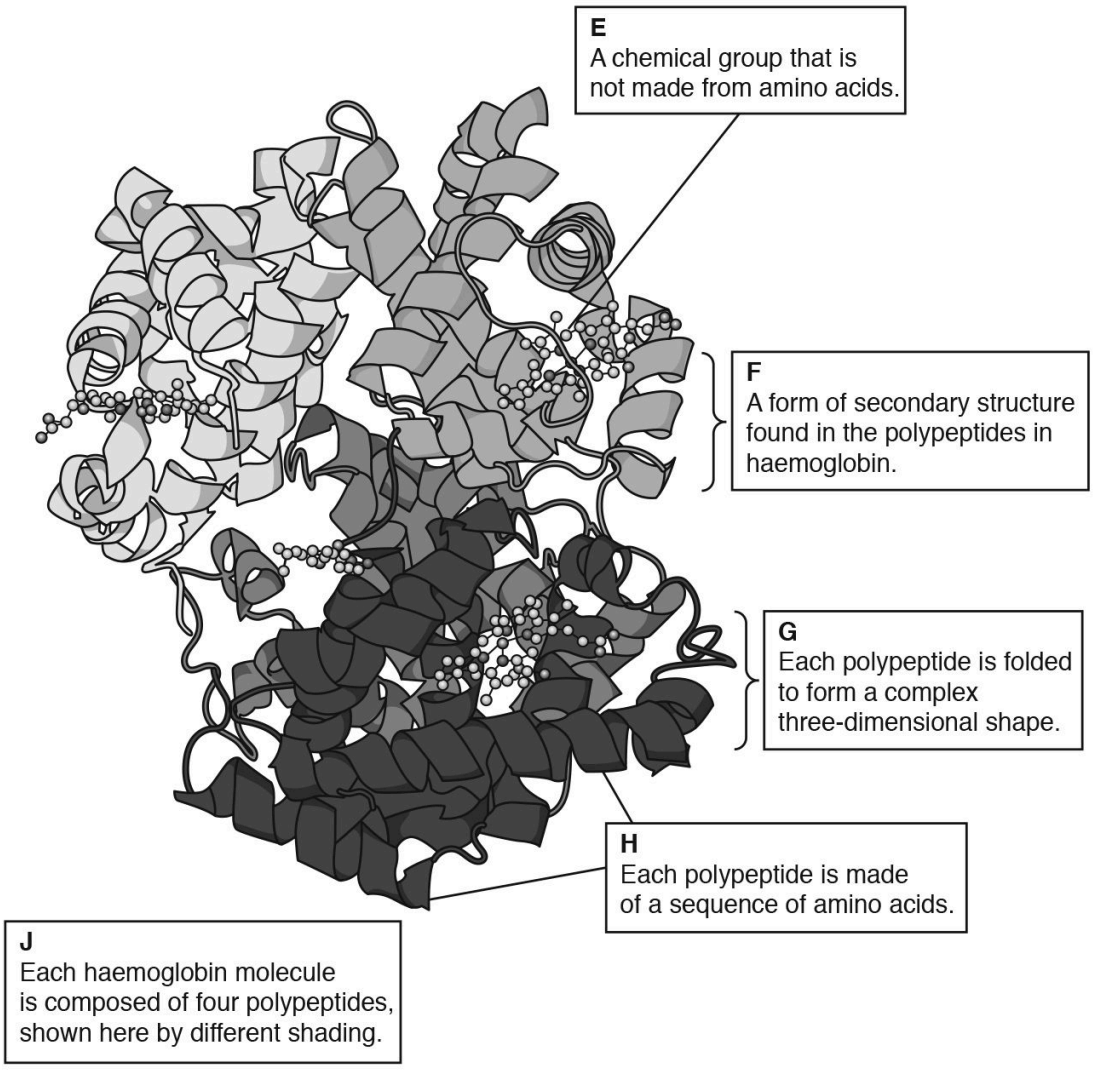


Fig. 4.1

(a) State the term that matches each of the descriptions given in boxes **E**, **F**, **G**, **H** and **J** in Fig. 4.1.

E .....

F .....

G .....

H .....

J .....

[5]

(b) The effect of carbon dioxide on the percentage saturation of haemoglobin with oxygen was investigated.

A sample of mammalian blood was exposed to a gas mixture that contained increasing partial pressures of oxygen (pO_2). Throughout the investigation the partial pressure of carbon dioxide (pCO_2) was maintained at 5.3 kPa. The percentage saturation of haemoglobin in the sample was determined as the pO_2 increased.

The investigation was repeated with a second sample of blood in which the pCO_2 was maintained at 10.7 kPa.

The results are shown in Fig. 4.2.

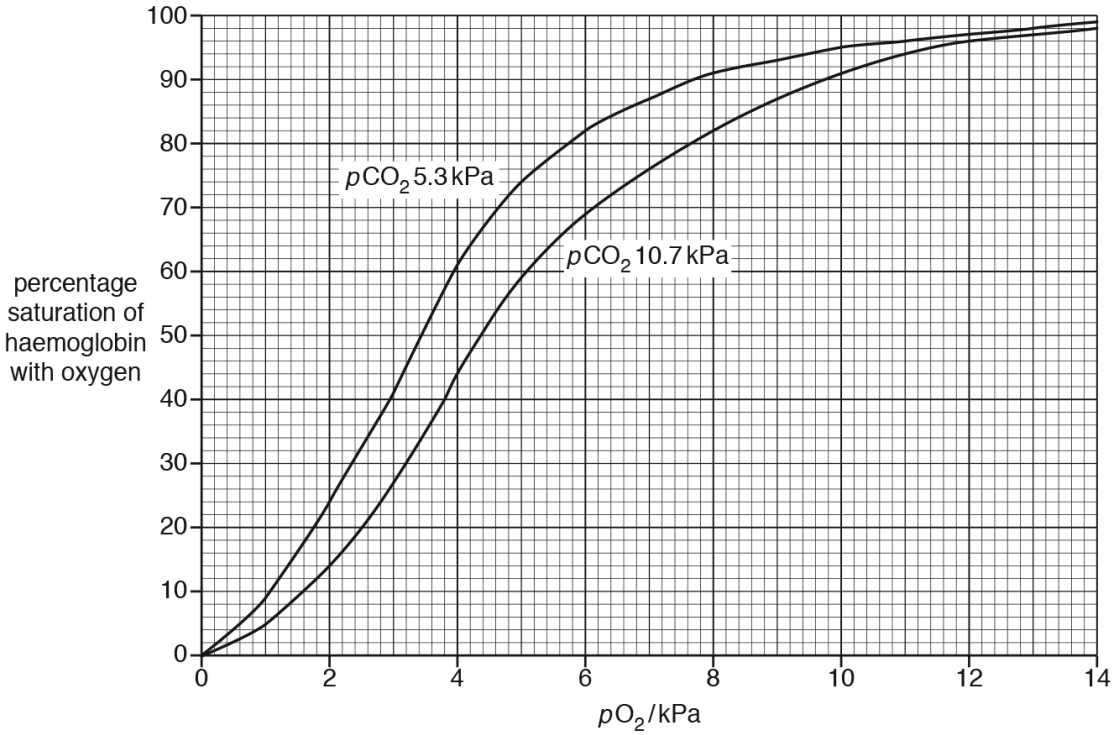


Fig. 4.2

(i) The pO_2 in alveolar air is 13.0 kPa and the pCO_2 is 5.3 kPa.

Use Fig. 4.2 to suggest the percentage saturation of haemoglobin in blood entering the pulmonary veins.

.....[1]

(ii) Use the information in Fig. 4.2 to state **and** explain the effect of increasing pCO_2 in muscle tissues during strenuous exercise.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

133. 9700_w18_qp_21 Q: 6

(a) Haemoglobin is a globular protein which is able to transport oxygen and is soluble in water.

(i) Explain how the structure of a haemoglobin molecule makes it able to transport oxygen efficiently.

.....

.....

.....

.....

.....

..... [3]

(ii) Explain how the structure of a haemoglobin molecule allows it to be soluble in water.

.....

.....

.....

..... [2]

(b) Llamas are mammals that are adapted to live at high altitudes.

Fig. 6.1 shows oxygen dissociation curves for haemoglobin of llamas and humans.

(i) The partial pressure of oxygen in the lungs of mammals at 3500 m is 6.4 kPa.

Use Fig. 6.1 to state the percentage saturation of haemoglobin of llamas and humans at an oxygen partial pressure of 6.4 kPa.

llamas ..... %

humans ..... % [1]

(ii) With reference to Fig. 6.1, explain the advantage to llamas of having an oxygen dissociation curve positioned to the left of the curve for humans.

.....

.....

.....

.....

.....

.....[2]

[Total: 8]

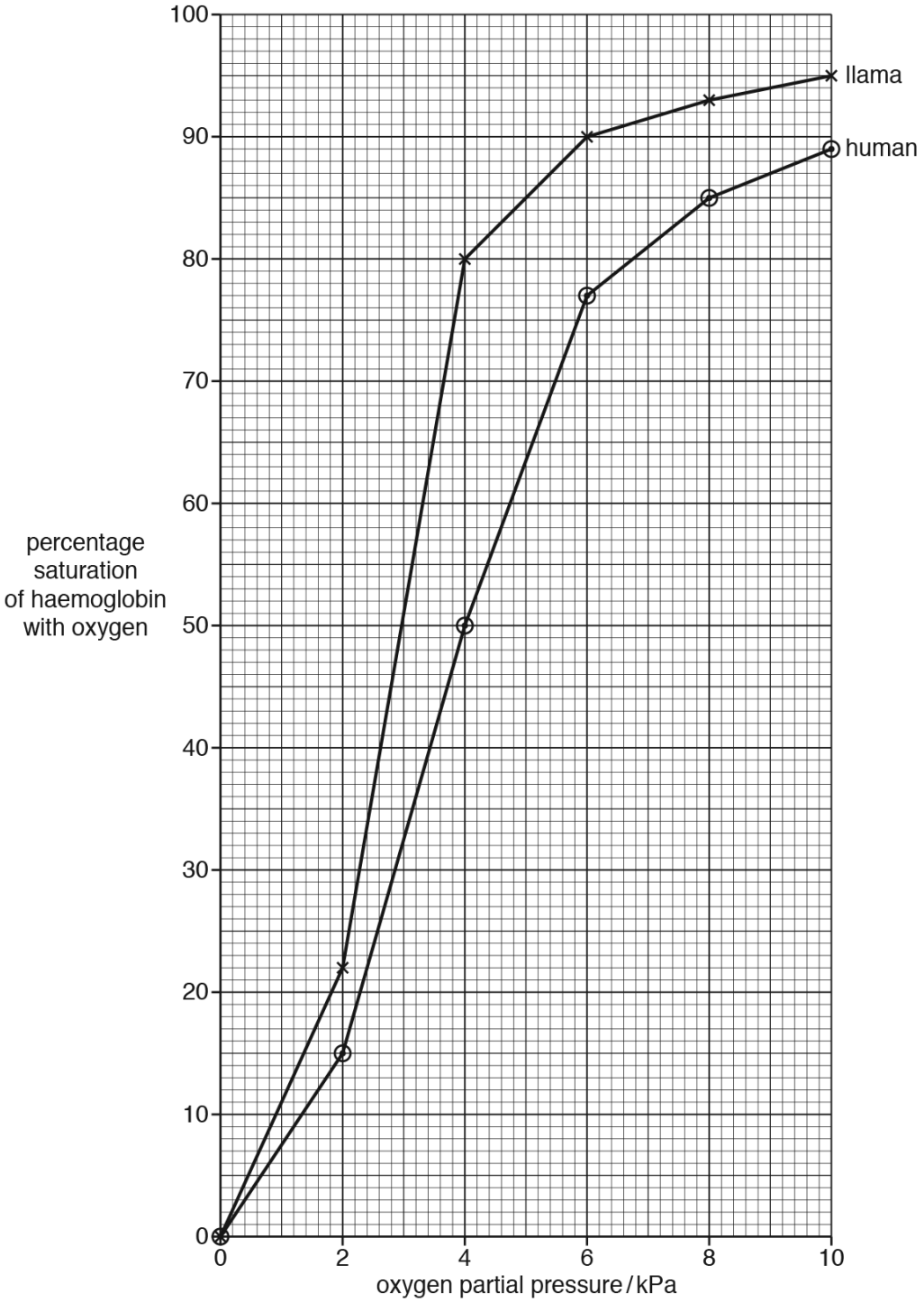

100
90
80
70
60
50
40
30
20
10
0
percentage saturation of haemoglobin with oxygen
llama
human
0
2
4
6
8
10
oxygen partial pressure / kPa

Fig. 6.1

134. 9700_w18_qp_22 Q: 6

As a red blood cell matures, cell organelles are lost from the cell. This provides more space for the haemoglobin molecules that have been synthesised.

(a) The red blood cell has a short lifespan due to the loss of the nucleus and other organelles.

State **one** function performed by each of the organelles listed, before they are lost from the developing red blood cell.

rough endoplasmic reticulum

.....

Golgi body

.....

centrioles

.....

[3]

(b) State the most appropriate term to match each of the descriptions **A** to **C**.

A The part of the haem group that binds oxygen in each haemoglobin polypeptide.

.....

B The compound formed when carbon dioxide binds to haemoglobin.

.....

C The compound formed when hydrogen ions (H^+) bind to haemoglobin.

.....

[3]

[Total: 6]

135. 9700_s17_qp_22 Q: 6

As a result of transcription and translation, a polypeptide chain is produced. Proteins with quaternary structure contain two or more polypeptide chains.

An antibody molecule and a haemoglobin molecule both show quaternary structure.

(a) Table 6.1 shows some features of an antibody molecule and a haemoglobin molecule.

Complete Table 6.1 to produce a summary of the features of the two molecules.

Table 6.1

feature	antibody	haemoglobin
fibrous or globular		
number and names of polypeptide chains	two heavy and two light chains	
type of bond holding polypeptide chains together		ionic

[3]

(b) The base sequence shown in Fig. 6.1 is a short section of a longer length of DNA that is transcribed to produce mRNA. When translated, this short section produces the amino acid sequence threonine (Thr), proline (Pro), cysteine (Cys).

Fill in the two **unshaded** boxes in Fig. 6.1 to show:

- the mRNA codon for Cys
- the tRNA anticodon for Thr.

You do **not** need to give the codon and anticodon sequences in the shaded boxes.

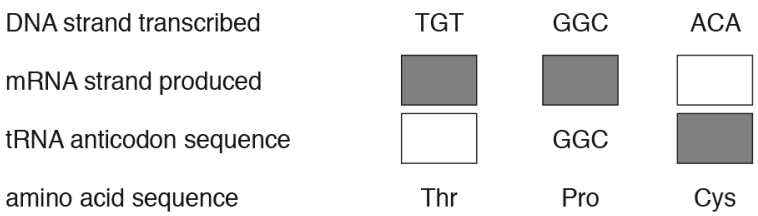


Fig. 6.1

[2]

[Total: 5]

136. 9700_w17_qp_22 Q: 2

Triglycerides and phospholipids are types of lipid.

Fig. 2.1 shows the structure of one type of phospholipid known as phosphatidylcholine.
F1 and F2 are fatty acid residues.

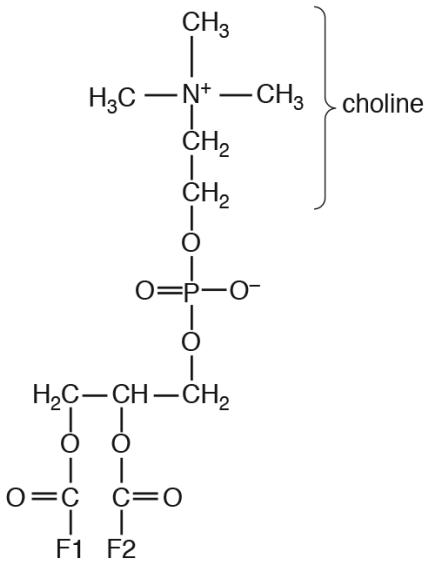


Fig. 2.1

(a) Phospholipase is an enzyme that can break down phospholipids. This enzyme is found in the venom of some insects, such as bees.

Bee venom can destroy red blood cells, a condition known as haemolysis.

Suggest how bee venom destroys red blood cells.

.....

.....

.....

.....

.....

.....

.....[2]

(b) Compare, stating similarities and differences, the structure of the phosphatidylcholine shown in Fig. 2.1 with the structure of a triglyceride molecule.

similarities .....

.....

.....

.....

.....

.....

.....

differences .....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Name **and** describe the cell structure in which the synthesis of triglycerides and other lipids takes place.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 9]

137. 9700_M16_qp_22 Q: 3

Erythropoietin, also known as EPO, is a large glycoprotein synthesised by specialised cells in the kidney. These cells are very sensitive to changes in oxygen concentration in the blood passing through the kidney and respond to a low oxygen concentration by increasing the synthesis of EPO.

EPO acts at the surface of particular target cells, such as cells in the bone marrow. These bone marrow cells are stimulated to produce red blood cells.

(a) (i) A low oxygen concentration also leads to an increase in the quantity of mRNA in the specialised cells in the kidney.

Suggest and explain why there is this increase in the quantity of mRNA.

.....

.....

.....

.....

.....

.....[2]

(ii) EPO is stored in secretory vesicles before being released from the specialised kidney cells.

Outline how EPO is released from the cells.

.....

.....

.....

.....

.....

.....

.....[2]

(b) All cells of the body are exposed to circulating blood plasma containing EPO, but only particular target cells respond.

(i) Suggest and explain how EPO acts on target cells and why other cells are **not** affected.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[3]

(ii) EPO cannot pass through the cell surface membrane to enter the bone marrow cells.

Suggest **one** reason why this is so.

.....

.....

.....[1]

(c) Red blood cells originate from undifferentiated cells in the bone marrow that are capable of continuous mitotic cell division.

State the name of this type of undifferentiated cell.

.....[1]

(d) As part of an investigation into the body's response to EPO, a group of healthy young men were given injections of EPO every day for four weeks.

The haemoglobin (Hb) concentration for each subject was measured at the start of the investigation and then at intervals of one week for the next ten weeks. The first measurement was taken two weeks before the first EPO injection was given.

Fig. 3.1 shows the mean results for the subjects.

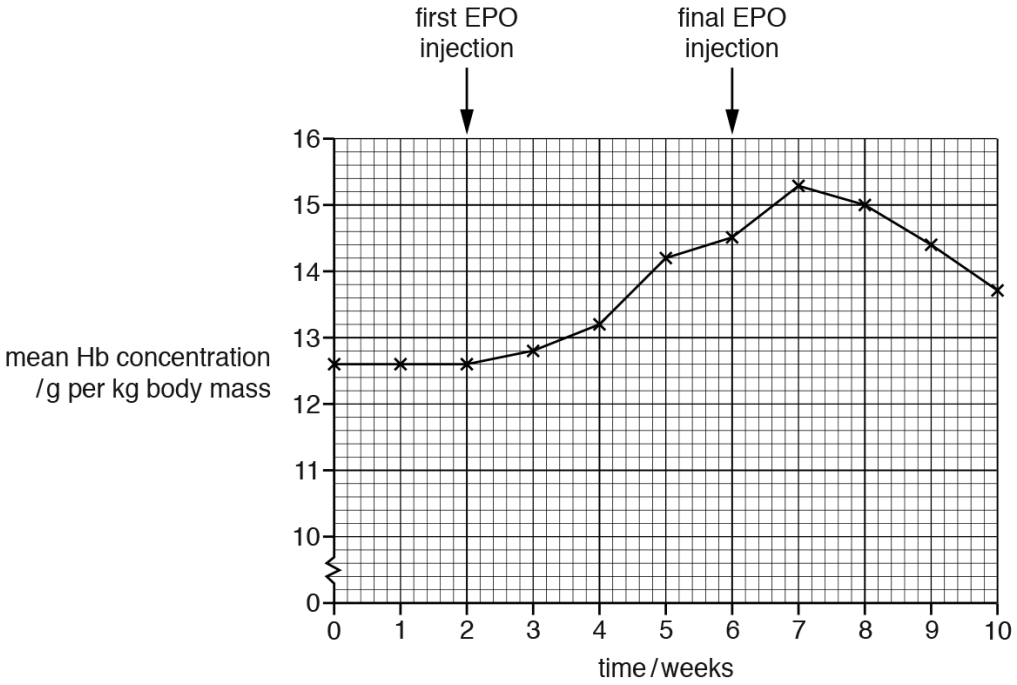


Fig. 3.1

Describe the results shown in Fig. 3.1 **and** suggest explanations for these results.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(e) The concentration of EPO in the blood plasma of a person will increase when travelling from sea level to a high altitude. This is in response to the decrease in oxygen partial pressure in the atmosphere.

Explain why an increase in EPO blood plasma concentration will be of benefit if the person remains at high altitude.

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 16]

138. 9700_s16_qp_21 Q: 5

(a) Fig. 5.1 is a diagram of part of an animal cell in a stage of mitosis.

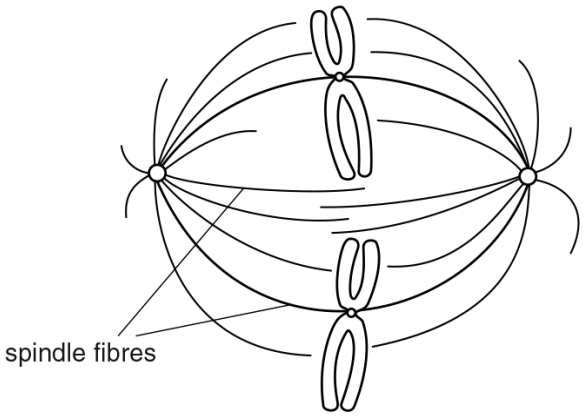


Fig. 5.1

(i) Draw a diagram in the space below to show the stage of mitosis that follows the stage in Fig. 5.1.

[3]

(ii) Describe the roles of the spindle fibres during mitosis.

.....

.....

.....

.....

.....

.....[2]

Bone marrow contains many stem cells. Some of these stem cells are responsible for the replacement of red blood cells.
During the production of red blood cells a series of changes occur to the cell structure.

Fig. 5.2 shows the production of a red blood cell from one of these stem cells.

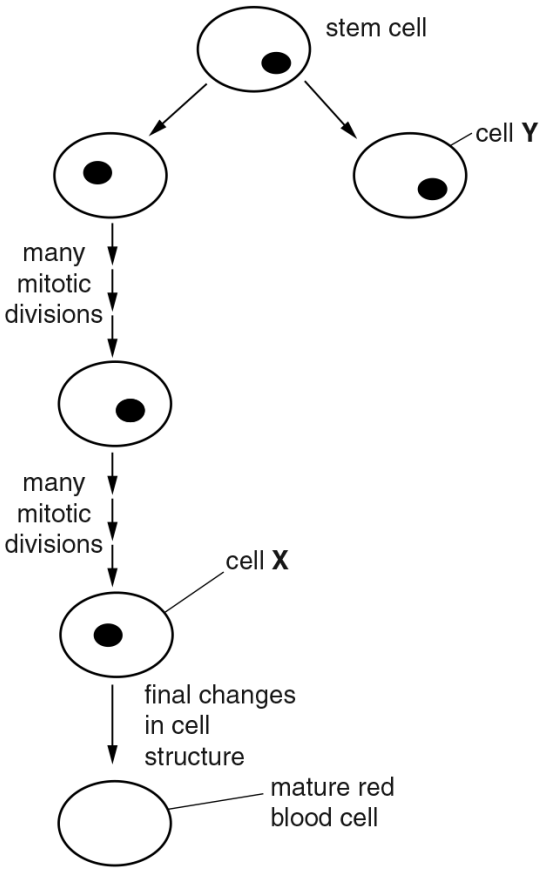


Fig. 5.2

(b) (i) Outline the changes that occur as cell **X** becomes a mature red blood cell.

.....

.....

.....

.....

.....

.....[3]

(ii) Suggest what may happen to cell **Y**.

.....[1]

(c) People who travel to high altitude become acclimatised to the conditions.

Athletes often train at high altitude before competing at sea level.

A group of male and female athletes who trained at sea level moved to high altitude for further training. Sports scientists analysed blood samples taken from the athletes to measure any changes in the concentration of haemoglobin in the blood and changes in the haematocrit.

Haematocrit is the volume of red blood cells expressed as a percentage of the total volume of a sample of blood.

The results are shown in Table 5.1.

Table 5.1

feature of the blood	at sea level	after 19 days at high altitude	percentage increase
mean concentration of haemoglobin in the blood / g 100 cm^{-3}	13.3	15.1	.....
mean haematocrit	41.0	42.5	3.7

(i) Complete Table 5.1 by calculating the percentage increase in haemoglobin concentration. [1]

(ii) Explain why it is necessary for the athletes to increase the concentration of haemoglobin in their blood when acclimatising to high altitude.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 14]

139. 9700_w16_qp_22 Q: 4

Fig. 4.1 is a cross-section of a human renal artery, a vessel that supplies blood to the kidney.

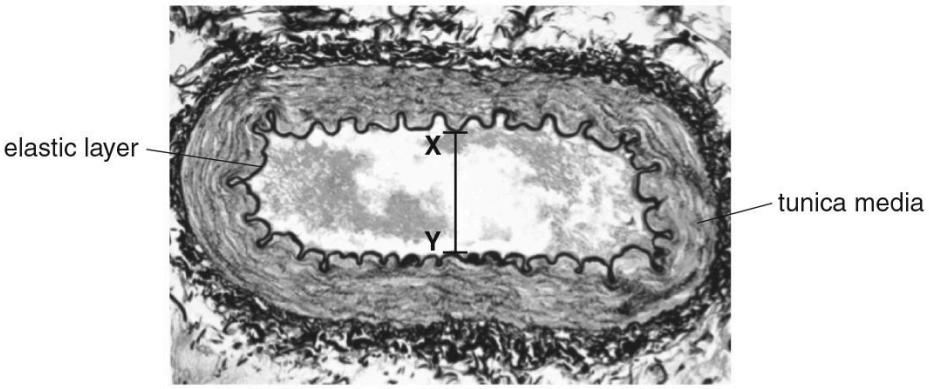


Fig. 4.1

(a) The elastic layer shown in Fig. 4.1, located between the endothelium and the tunica media, is one feature that suggests that the blood vessel is the renal artery and not the renal vein, which may be of a similar size.

Complete the sentence to state **one** additional structural feature, **visible in Fig. 4.1**, that would identify the blood vessel as an artery.

This is an artery because it has .....

.....

.....

.....[1]

(b) Explain the relationship between the structure of the tunica media and the function of an artery, such as the renal artery.

.....

.....

.....

.....

.....

.....[2]

(c) The actual diameter of the lumen of the renal artery at the point **X–Y** in Fig. 4.1 is 5.2 mm.

Calculate the magnification of the image shown in Fig. 4.1. Write down the formula you will use to make your calculation and show your working.

formula

magnification × .....[3]

(d) Blood plasma contains approximately 90% water. Many of the properties of water are due to its ability to form hydrogen bonds.

Outline how the properties of water make it ideal as the largest component of plasma.

.....

.....

.....

.....

.....

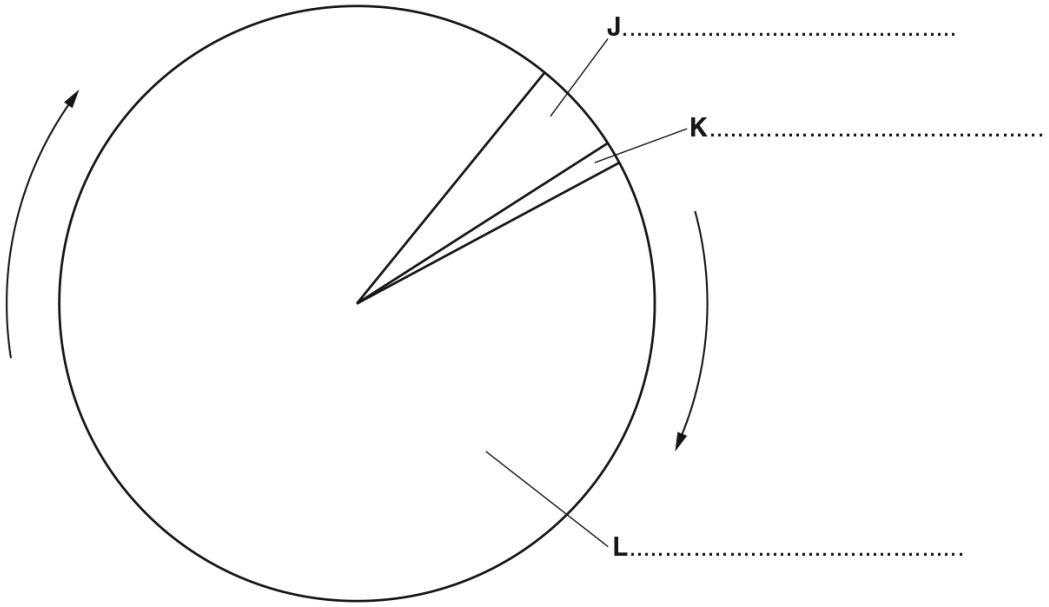
.....[3]

[Total: 9]

140. 9700_w16_qp_22 Q: 6

(a) Fig. 6.1 represents one complete cell cycle for a eukaryotic cell.

(i) Complete Fig. 6.1 by naming the stages represented by **J**, **K** and **L**.



[3]

Fig. 6.1

(ii) Name the stage in the cell cycle in which semi-conservative replication of DNA occurs.

.....[1]

The development of stem cells to become neutrophils occurs in several stages. Some of these stages are capable of cell division.
Fig. 6.2 is a summary of neutrophil development. Some details of cellular structure are included.

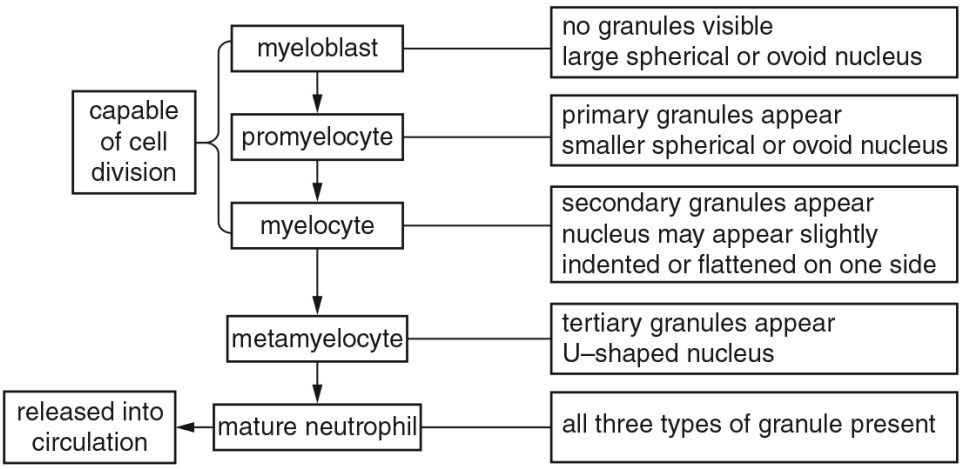


Fig. 6.2

All three types of granule indicated in Fig. 6.2 are membrane-bound cell structures containing hydrolytic enzymes. Each type of granule contains a different group of enzymes and other chemicals that enable the neutrophil to carry out its role.

(b) (i) State the location in the body where development and maturation of the neutrophil occurs.

.....[1]

(ii) Describe the shape of the nucleus in the mature neutrophil.

.....[1]

(iii) State the alternative name of the cell structures described in Fig. 6.2 as “granules”.

.....[1]

(c) **(i)** Primary granules contain proteins known as defensins. These bind to cell surface membranes of bacteria and form very small pores in the membrane.

Suggest how defensins contribute to the role of the neutrophil in killing bacteria.

.....

.....

.....

.....

.....[2]

(ii) Secondary granules contain lysozyme. This is an enzyme that breaks bonds in peptidoglycan molecules.

Explain how the action of lysozyme will lead to the destruction of the bacterial cell.

.....

.....

.....

.....

.....[2]

[Total: 11]

141. 9700_w16_qp_23 Q: 5

In an investigation, the volume of oxygen that combined with haemoglobin at different partial pressures of oxygen was determined. The results are shown in Fig. 5.1.

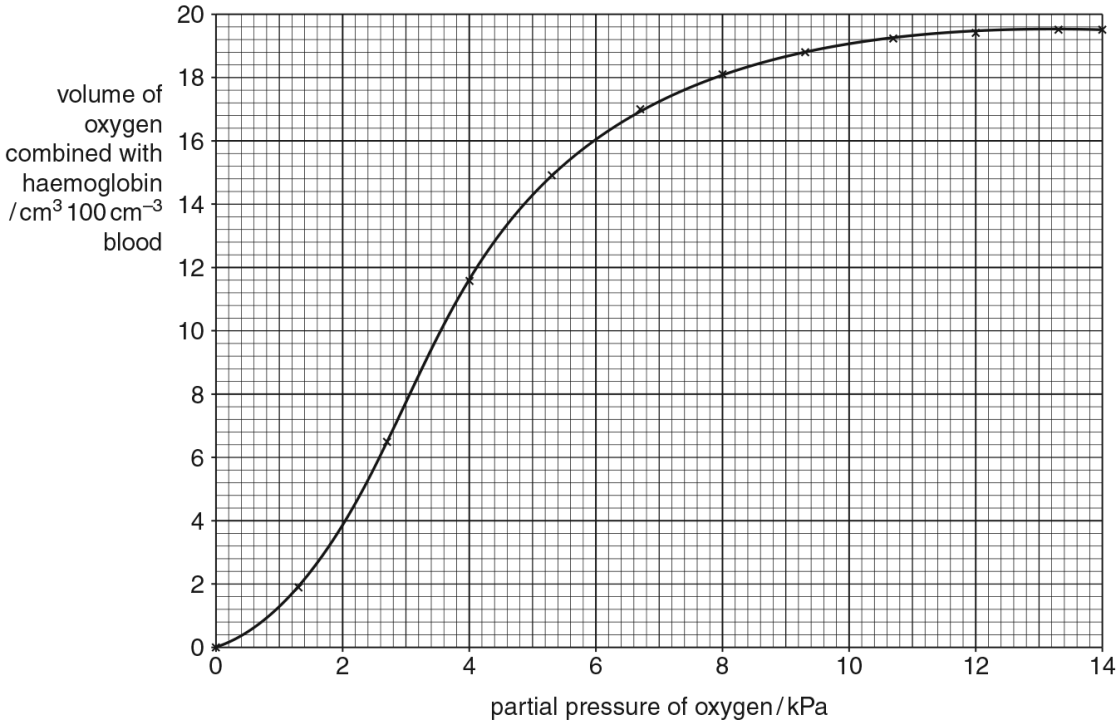


Fig. 5.1

(a) The partial pressure of oxygen in the alveoli is 13.3 kPa. At this partial pressure of oxygen the **total volume of oxygen** that is carried by 100 cm^3 blood is 19.78 cm^3 at pH 7.4 and 37 °C.

The volume of oxygen that combines with haemoglobin at 13.3 kPa is 19.48 cm^3 100 cm^{-3} blood.

(i) Calculate the percentage of oxygen that is combined with haemoglobin in 100 cm^3 blood.

answer .....% [1]

(ii) Suggest how the oxygen that is **not** combined with haemoglobin is transported in the blood.

.....

.....[1]

(iii) Explain why a long-term smoker would have a lower volume of oxygen combined with haemoglobin in the alveoli at 13.3 kPa.

.....

.....

.....

.....

.....[2]

(b) Describe the role of carbonic anhydrase in the transport of carbon dioxide.

.....

.....

.....

.....

.....

.....

.....[3]

(c) The investigation was repeated in the presence of carbon dioxide. The volumes of oxygen combined with haemoglobin at partial pressures of oxygen below 8.0 kPa were less than shown in Fig. 5.1.

Name this effect **and** explain the advantage of this decrease at partial pressures of oxygen below 8.0 kPa.

name .....

advantage .....

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

142. 9700_s15_qp_21 Q: 4

(a) Fig. 4.1 shows two ways in which enzymes interact with their substrates.

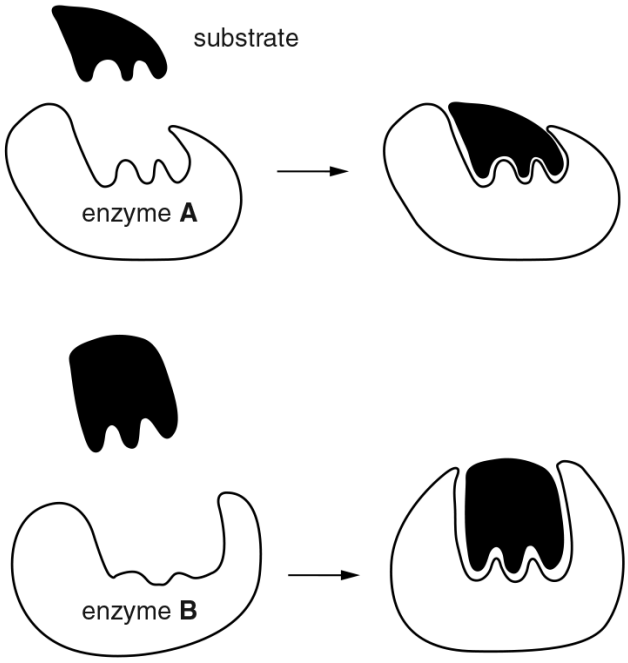


Fig. 4.1

Explain the difference between the two ways in which enzymes interact with their substrates as shown in Fig. 4.1.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Carbonic anhydrase is an enzyme that is found in blood, liver and kidneys.
Fig. 4.2 shows a molecular model of this enzyme.

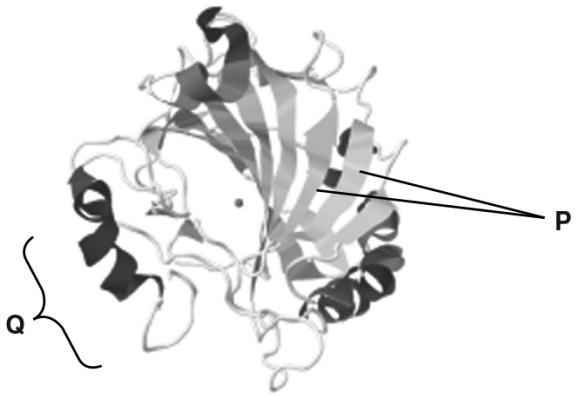


Fig. 4.2

(i) With reference to Fig. 4.2 and the parts labelled **P** and **Q**, explain the term *secondary structure*.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) Describe the role of carbonic anhydrase in the blood.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

143. 9700_s15_qp_22 Q: 3

Outside the body, red blood cells can be maintained in an intact state by keeping the cells in a 0.9% solution of sodium chloride. This is known as a normal saline solution.

Fig. 3.1 shows intact red blood cells.

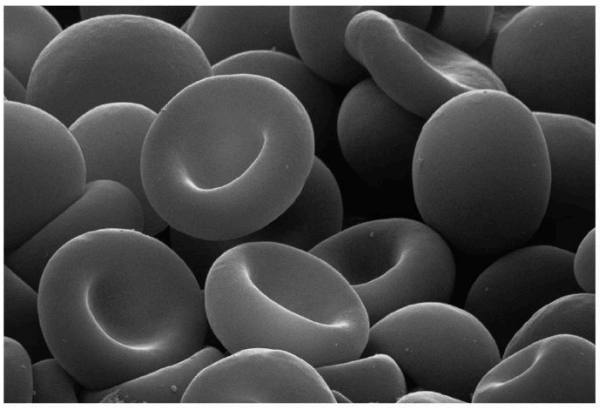


Fig. 3.1

(a) Explain why red blood cells can be maintained in an intact state by keeping them in a normal saline solution.

.....

.....

.....

.....

.....[2]

(b) In the blood, red blood cells are suspended in plasma. The main component of blood plasma is water.

Suggest **one** other component of blood plasma that could enter red blood cells **and** describe how it would cross the cell surface membrane.

component .....

description .....

.....

.....

.....

.....

.....[3]

Fig. 3.2 shows red blood cells within a capillary. The capillary shown in Fig. 3.2 allows the rapid exchange of substances between the blood, tissue fluid and body cells.

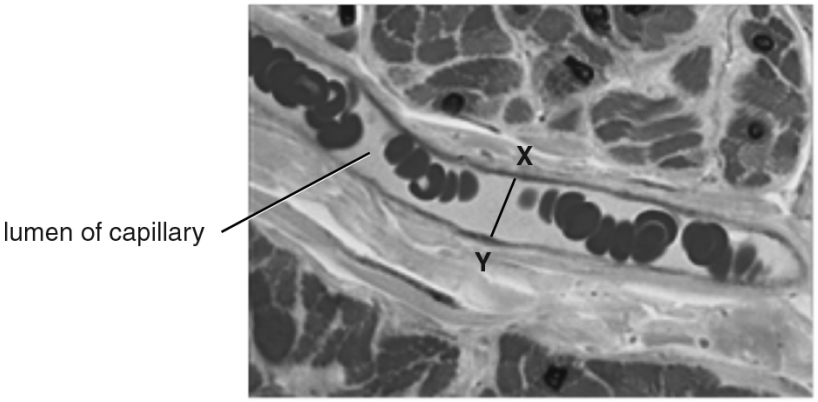


Fig. 3.2

(c) The actual diameter of the lumen of the capillary at the point **X**–**Y** in Fig. 3.2 is 9.5 μm.

Calculate the magnification of the image shown in Fig. 3.2. Show your working.

magnification × ..... [2]

(d) With reference to Fig. 3.2, explain **one** feature that enables the surrounding body cells to receive an adequate supply of oxygen from the blood supplied by the capillary.

.....

.....

.....

.....[2]

(e) Some areas of the brain, known as blood-brain barriers, have a type of capillary that is relatively impermeable to substances.

Suggest **one** way in which the structure of a capillary in the blood-brain barrier differs from the structure of the capillary shown in Fig. 3.2.

.....

.....[1]

[Total: 10]

144. 9700_s15_qp_23 Q: 4

Fig. 4.1 shows how blood pressure changes in the human systemic circulation.

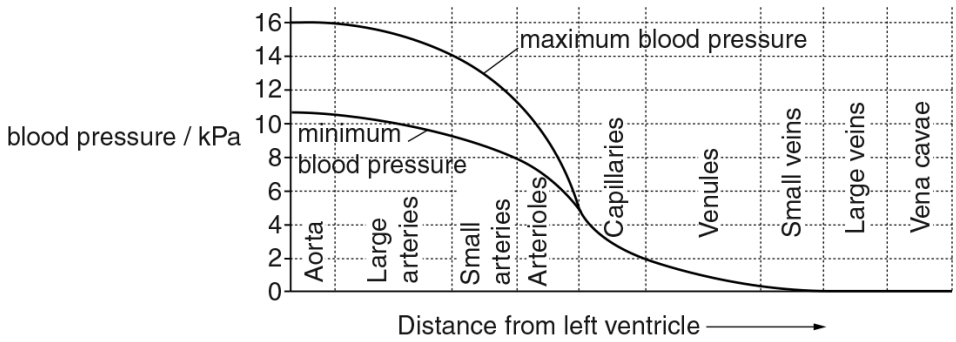


Fig. 4.1

(a) (i) Describe the changes in blood pressure shown in Fig. 4.1.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) Explain how the structure of veins is related to their function in returning blood to the heart.

.....

.....

.....

.....

.....[2]

(b) Angiotensin is a polypeptide produced in the body to raise blood pressure.
Angiotensin converting enzyme (ACE) catalyses the final step in angiotensin production.
Fig. 4.2 shows this step.



Fig. 4.2

Describe the step shown in Fig. 4.2.

.....

.....

.....

.....

.....

.....

.....[3]

(c) People with high blood pressure can be treated with a drug which lowers the concentration of angiotensin in the blood.

This drug is a competitive inhibitor of ACE.

Explain how this drug acts as a competitive inhibitor.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 11]

8.2 The heart

145. 9700_m20_qp_22 Q: 3

During one cardiac cycle:

- blood enters the heart from the lungs and from the rest of the body
- blood leaves the heart to be transported to the lungs and to the rest of the body.

(a) Name the blood vessels entering the heart that bring blood from the rest of the body.

.....

..... [1]

(b) One phase of the cardiac cycle is ventricular diastole (ventricular relaxation). A number of events occur in the heart during this phase.

Outline **and** explain the events that occur in the heart during ventricular diastole.

.....

.....

.....

.....

.....

.....

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.....

..... [4]

Blood arriving in the lungs from the heart is oxygenated as it passes through the pulmonary capillaries.

Sickle-shaped red blood cells are present in a person with sickle cell anaemia. These cells have a very high quantity of abnormal (sickle cell) haemoglobin and take up and transport less oxygen than red blood cells containing normal haemoglobin.

(c) The cause of the differences between sickle cell haemoglobin and normal haemoglobin is a mutation in the gene that codes for one of the two types of polypeptide found in a haemoglobin molecule. This mutation leads to a change in the mRNA produced during transcription, causing a change in the primary structure of the polypeptide formed.

Fig. 3.1 shows some of the changes that occur as a result of this gene mutation.

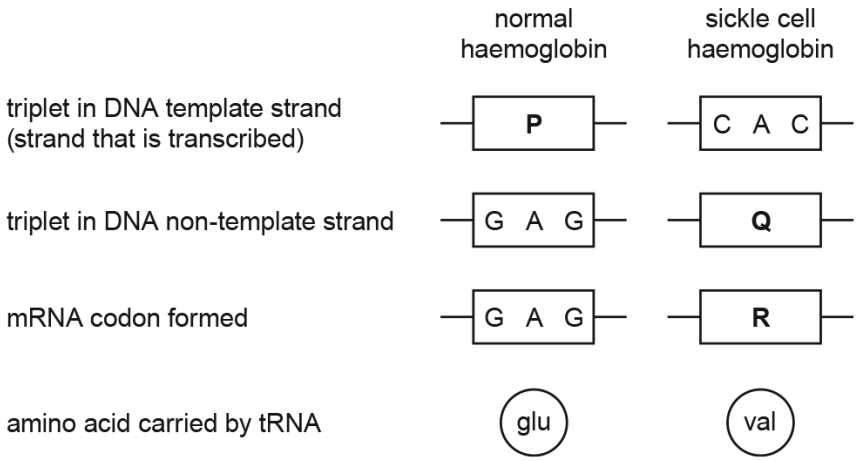


Fig. 3.1

(i) With reference to Fig. 3.1, state:

- the base sequence of DNA triplet **P**

  .....

- the base sequence of DNA triplet **Q**

  .....

- the base sequence of mRNA codon **R**.

  .....

[3]

(ii) Name the type of polypeptide in a haemoglobin molecule that is different in sickle cell haemoglobin compared to normal haemoglobin.

..... [1]

(d) Fig. 3.2 shows the oxygen dissociation curve for adult haemoglobin in a person who does not have sickle cell anaemia.

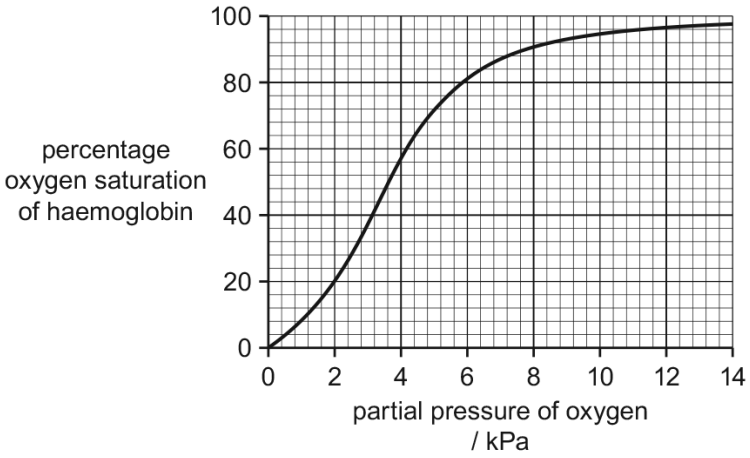


Fig. 3.2

Compared to Fig. 3.2, the oxygen dissociation curve for adult haemoglobin in a person with sickle cell anaemia is shifted to the right.

The uptake of oxygen by haemoglobin in the lungs and the release of oxygen by haemoglobin in respiring tissues is different in a person with sickle cell anaemia compared with a person who does not have the disease.

With reference to Fig. 3.2, state **and** explain these differences.

uptake of oxygen .....

.....

.....

.....

.....

release of oxygen .....

.....

.....

.....

.....

.....

[3]

[Total: 12]

146. 9700_s20_qp_22 Q: 2

In a healthy mammalian heart, contraction of the four chambers is coordinated by the action of the sinoatrial node (SAN) and atrioventricular node (AVN).

(a) After the atria fill with blood, atrial systole (contraction) occurs.

State the events that occur to initiate and cause atrial systole.

.....

.....

.....

.....

.....

..... [2]

(b) State **and** explain how the structure of the heart allows the atria to contract before the ventricles.

.....

.....

.....

.....

.....

.....

.....

..... [2]

(c) Fig. 2.1 shows blood pressure changes that occur in the left ventricle, left atrium and aorta during one cardiac cycle.

E, **F**, **G** and **H** are the points at which a valve opens or closes as a result of blood pressure changes.

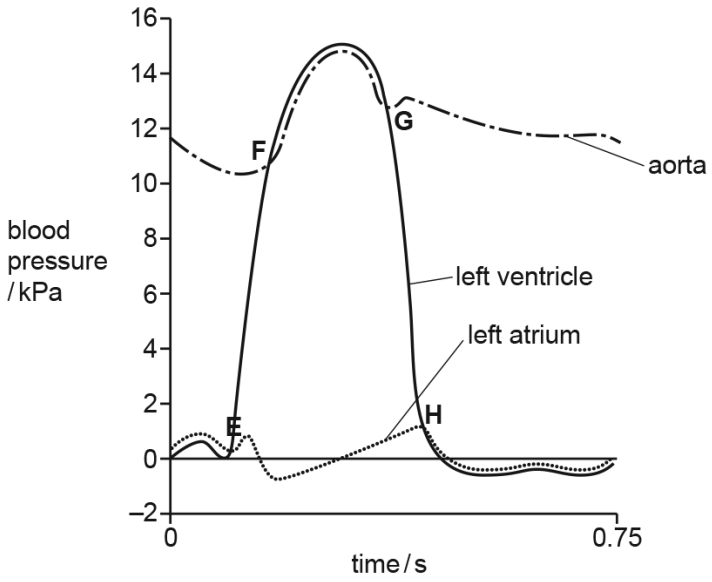


Fig. 2.1

(i) For each of the points **E**, **F**, **G** and **H** on Fig. 2.1, name the valve concerned **and** state whether the valve opens or closes.

E .....

F .....

G .....

H ..... [3]

(ii) Explain how Fig. 2.1 provides evidence that the wall of the left atrium has a different thickness to the wall of the left ventricle.

.....

.....

.....

.....

..... [2]

[Total: 9]

147. 9700_s19_qp_21 Q: 5

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

Explain why it is called a *closed* **and** *double* circulation.

closed .....

.....

double .....

..... [2]

(b) Fig. 5.1 shows a drawing of an external view of a mammalian heart.

Two cross-sections were made of the heart:

- section 1 was made across the line **A**–**B**.
- section 2 was made across the line **C**–**D**.

Drawings of the two sections were viewed from above as shown by the arrow on Fig. 5.1.
Fig. 5.2 is a drawing of section **A**–**B**. Fig. 5.3 is a drawing of section **C**–**D**.

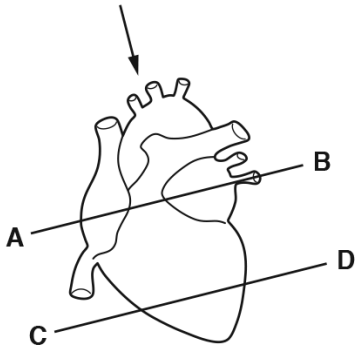


Fig. 5.1

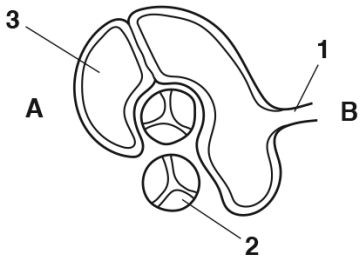


Fig. 5.2



Fig. 5.3

(i) Name structures **1**, **2** and **3**, as shown in Fig. 5.2.

1 .....

2 .....

3 .....

[3]

(ii) Explain why the wall of chamber **Y** is thicker than the wall of chamber **X**, as shown in Fig. 5.3.

.....

.....

.....

.....

..... [3]

(c) Explain how the contractions of the chambers of the heart are coordinated during one cardiac cycle.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 12]

148. 9700_s19_qp_23 Q: 6

Fig. 6.1 is a diagram of a vertical section of the human heart and the associated blood vessels.

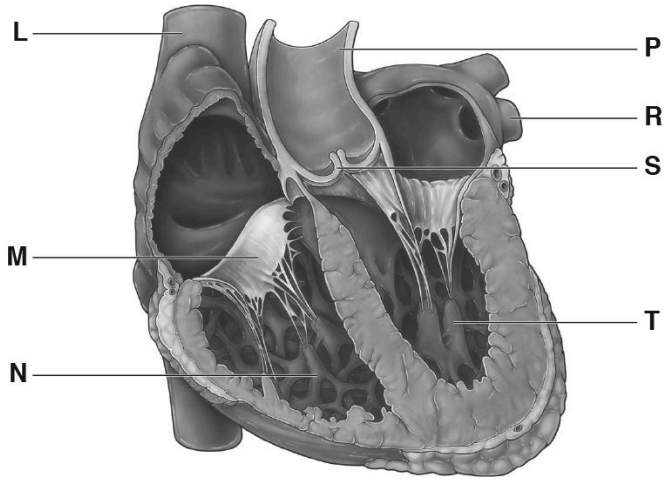


Fig. 6.1

(a) Complete Table 6.2 by writing the letter from Fig. 6.1 that identifies each of the structures described.

Table 6.2

structure in the heart	letter
valve preventing back flow of blood into a ventricle	
blood vessel carrying blood under highest pressure	
chamber that pumps blood to the lungs	

[3]

(b) Describe the short-term effects of nicotine on the cardiovascular system.

.....

.....

.....

.....

.....

..... [3]

(c) Cardiac myocytes are heart muscle cells.

Fetal cardiac myocytes are present before birth and divide rapidly during fetal development.

Soon after birth the cell cycle in most of these fetal cardiac myocytes stops, forming adult cardiac myocytes. Most of the adult cells have completed the cell cycle but in some the cell cycle stops at the end of mitosis.

(i) State the difference between adult cardiac myocytes that have completed the cell cycle and those that have stopped at the end of mitosis.

..... [1]

(ii) Suggest why it could be a disadvantage that the cell cycle has stopped in most adult cardiac myocytes.

.....

.....

.....

.....

..... [2]

[Total: 9]

149. 9700_m18_qp_22 Q: 5

(a) The sinoatrial node (SAN) and the atrioventricular node (AVN) are two regions of the heart.

Outline the roles of the SAN **and** the AVN in the initiation and control of heart action.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Fig. 5.1 shows features that are observed in transverse sections of the three main types of blood vessel.

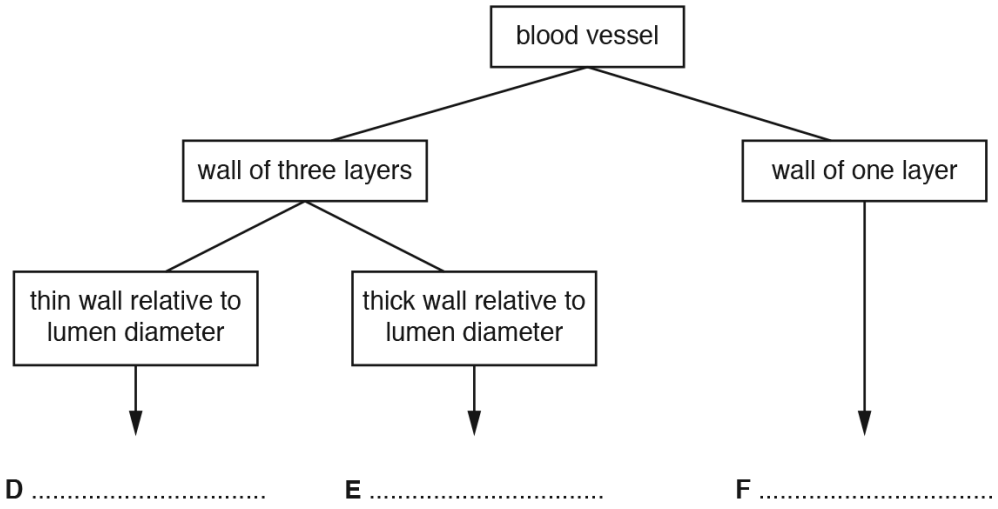


Fig. 5.1

(i) Complete Fig. 5.1 by stating the type of blood vessel indicated by **D**, **E** and **F**. [1]

(ii) The inner layer of the walls of **D** and **E** is composed of endothelial tissue.

List two structural features of this tissue.

1 .....

.....

2 .....

.....

[2]

[Total: 6]

150. 9700_w18_qp_22 Q: 2

Woolly foxglove, *Digitalis lanata*, shown in Fig. 2.1**A**, and common oleander, *Nerium oleander*, shown in Fig. 2.1**B**, are plants grown for the attractive flowers that they produce.

Both plants are poisonous, as their leaves produce toxic organic compounds known as cardiac glycosides. Cardiac glycosides have a powerful effect on the action of cardiac muscle.



A



B

Fig. 2.1

(a) *N. oleander* is able to grow in very dry conditions. The leaves have adaptations to reduce water loss by transpiration.

State the term used to describe a plant, such as *N. oleander*, that has adaptations to allow it to grow in conditions where water is in short supply.

..... [1]

(b) Aphids are small insects that feed on plant fluids using piercing and sucking mouthparts. When aphids feed on the sap present in vascular tissue of leaves and stems, a sugary liquid called honeydew is passed out of the gut. The honeydew can be analysed to find out what is present in the sap.

(i) State the name of the vascular tissue from which the aphids feed.

..... [1]

(ii) An investigation found that aphids feeding on *D. lanata* produced honeydew containing cardiac glycosides.

Suggest why cardiac glycosides were present in the sap from the vascular tissue.

.....

.....

.....

.....

..... [2]

Cardiac glycosides have an effect on the movement of ions into and out of cardiac muscle cells. The outcome is an increased ability for the cells to contract.

(c) Investigations into the action of the cardiac glycoside oleandrin, extracted from *N. oleander*, have shown that it acts to prevent the correct functioning of Na/K-ATPase, a membrane transport protein.

Na/K-ATPase has a role as an enzyme **and** as a transport molecule.

- ATPase is an enzyme that catalyses the hydrolysis of ATP to ADP and inorganic phosphate.
- Energy released from this hydrolysis is used to transport sodium ions (Na^+) out of cardiac muscle cells and potassium ions (K^+) into the cells.

(i) Explain what is meant by the *hydrolysis of ATP*.

.....

.....

..... [2]

(ii) Name the type of transport mechanism involved in the transport of Na^+ and K^+ across the cell surface membrane of cardiac muscle cells.

..... [1]

(iii) Oleandrin is a non-competitive reversible inhibitor of ATPase.

Describe the mode of action of oleandrin **and** explain how this will affect ion movement through Na/K-ATPase transport proteins of the cell surface membranes of cardiac muscle cells.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) Digoxin, a cardiac glycoside extracted from *D. lanata* leaves, can be purified and used as a drug to treat some heart disorders.

Examples of these heart disorders are:

- atrial fibrillation, where the normal rhythmic cardiac cycle is disrupted
- heart failure, where cardiac muscle is contracting weakly.

(i) Describe the **sequence** of events occurring in the left side of the heart during one **normal** cardiac cycle. Include reference to blood pressure changes.

The first event in the sequence is described for you.

The left atrium fills with blood during relaxation of the left atrium and left ventricle.

..... [4]

(ii) Suggest how the health of a person with heart failure can be improved by treatment with the drug digoxin.

..... [3]

[Total: 18]

151. 9700_w18_qp_23 Q: 4

(a) Describe the roles of the sinoatrial node (SAN) and the atrioventricular node (AVN) in the initiation and control of the cardiac cycle.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) The Purkyne fibres pass down the septum and extend to the cardiac muscle at the base (apex) of the heart.

Explain why it is important that the Purkyne fibres extend to the base of the heart.

.....

.....

.....

.....

..... [2]

(c) The activity of the SAN is controlled by the nervous system. Noradrenaline is released by nerve cells in the SAN.

Fig. 4.1 shows the role of noradrenaline in causing calcium ions (Ca^{2+}) to enter a cell in the SAN.

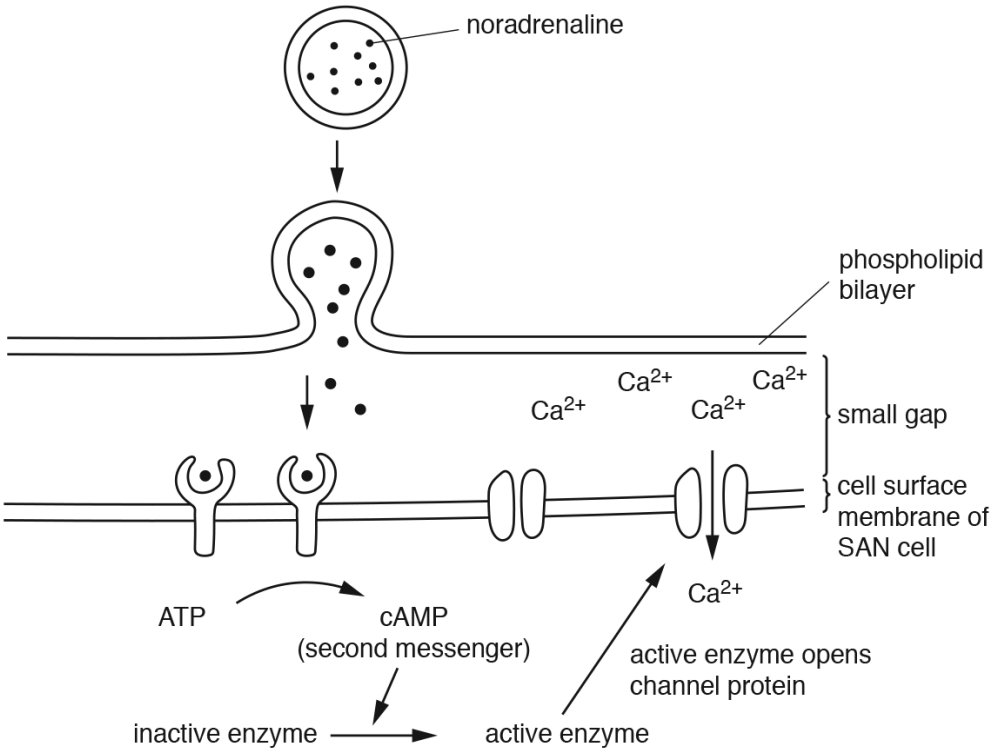


Fig. 4.1

With reference to Fig. 4.1, outline the process of cell signalling.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

152. 9700_m17_qp_22 Q: 4

The transport systems of plants and mammals both function to transport substances to and from cells.

(a) Table 4.1 contains descriptions concerning the mammalian circulatory system and the structure of the heart.

Complete Table 4.1 by writing down the term that matches each description.

Table 4.1

description	term
a transport system where blood is enclosed in blood vessels and passes through the heart twice in one complete circuit of the body	
blood vessel, with a lumen of approximately 7μm in diameter, that supplies substances to cells	
the blood vessel that carries oxygenated blood from the lungs to the heart	
the chamber of the heart that receives deoxygenated blood from the body	
the structure dividing the heart into the left and right sides	

[5]

(b) Water is the main component of the fluids associated with transport in mammals and plants.

(i) One property of water is its ability to act as a solvent.

Suggest why this property is important in the mammalian transport system.

.....

.....

.....

.....

.....

..... [2]

(ii) The transport of water in plants depends on the ability of water molecules to form hydrogen bonds.

Explain how hydrogen bonding is involved with the movement of water in the xylem.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

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153. 9700_w17_qp_21 Q: 2

Fig. 2.1 is a transmission electron micrograph of a section through a blood vessel.

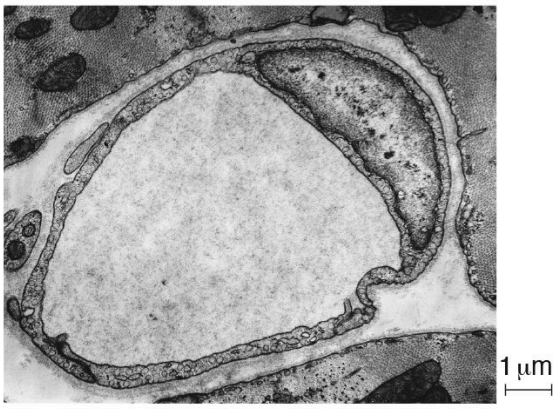


Fig. 2.1

(a) State the type of blood vessel shown in Fig. 2.1 **and** give **two** reasons for your choice.

type of blood vessel .....

reason 1 .....

.....

reason 2 .....

.....[3]

Fig. 2.2 is a graph showing how the blood pressure in the pulmonary artery and in the right ventricle changes during one cardiac cycle.

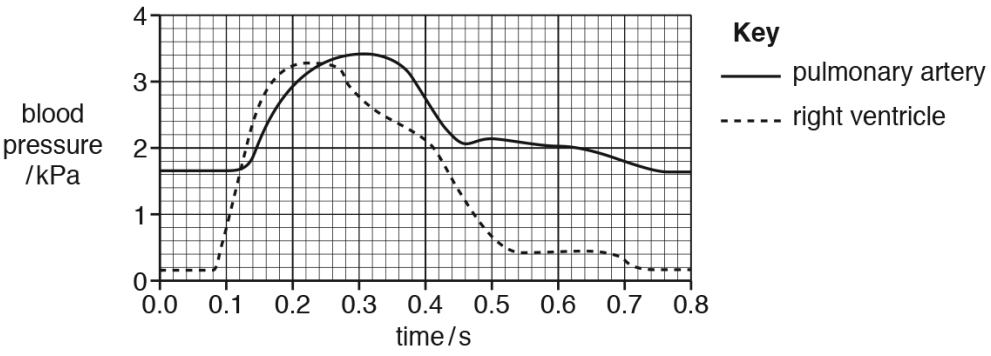


Fig. 2.2

(b) Use Fig. 2.2 to state the time at which:

(i) the valve between the right ventricle and the pulmonary artery closes

.....[1]

(ii) the ventricle begins to contract.

.....[1]

(iii) State **and** explain the similarities and differences between Fig. 2.2 and a graph showing how the blood pressure for the **left** ventricle changes during the same cardiac cycle.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 9]

154. 9700_w17_qp_22 Q: 6

Fig. 6.1 is a diagram of a vertical section through the mammalian heart. The labels **Q** to **X** represent valves and blood vessels of the heart.

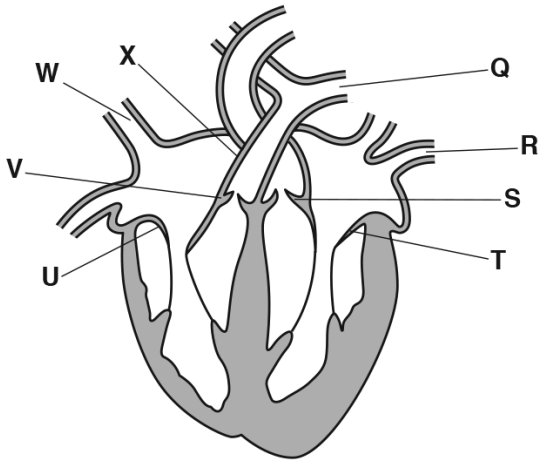


Fig. 6.1

(a) **(i)** State which label represents the valve that prevents the backflow of blood from the aorta into the ventricle.

.....[1]

(ii) Name the blood vessel that carries oxygenated blood from the lungs to the heart **and** state which label represents this blood vessel.

name .....

label .....[2]

(b) State **precisely** where the sinoatrial node is located.

.....[1]

(c) Explain the role of the atrioventricular node in the coordination of heart action.

.....

.....

.....

.....[2]

[Total: 6]

155. 9700_w17_qp_23 Q: 2

(a) Explain why the wall of the left ventricle in the heart is thicker than the wall of the right ventricle.

.....

.....

.....

.....

.....

.....[2]

Fig. 2.1 shows the heart and blood vessels at three stages of the cardiac cycle.

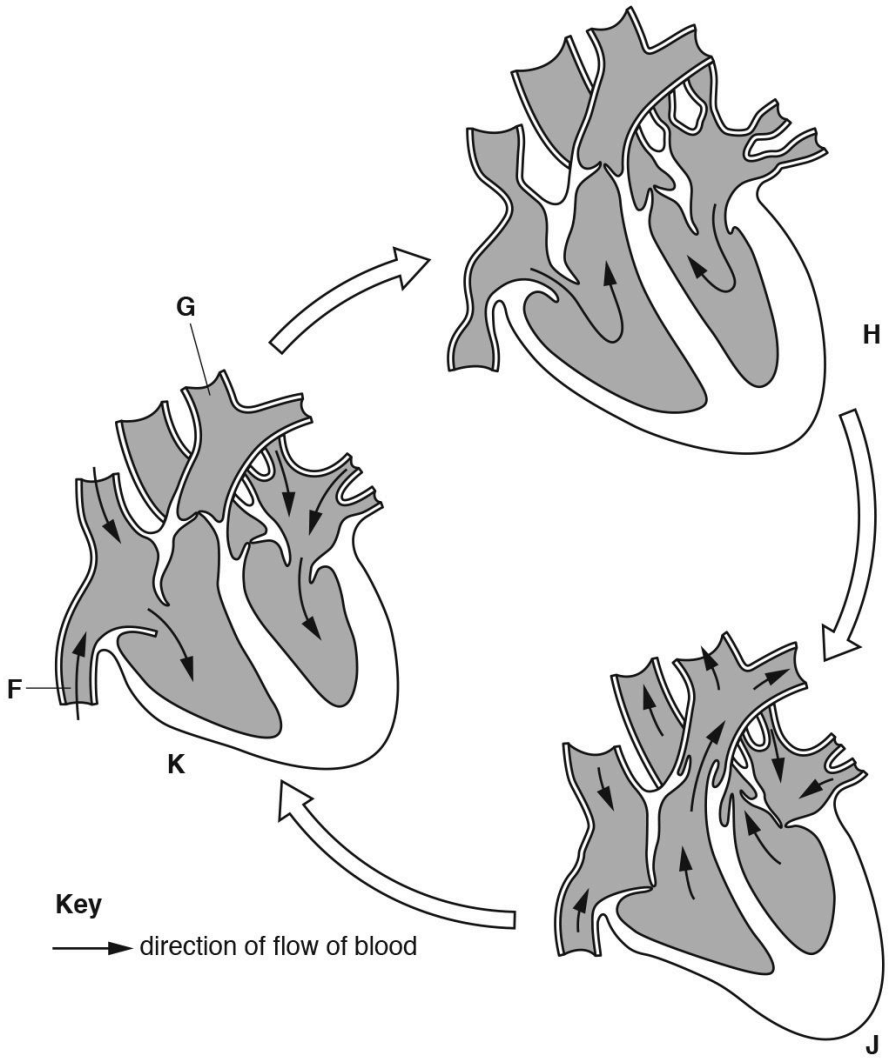


Fig. 2.1

(b) (i) Name the blood vessels labelled **F** and **G**.

F .....

G .....[2]

(ii) Name the stage of the cardiac cycle at **K**.

.....[1]

(c) Describe what happens in the heart between stages **H** and **J** as shown in Fig. 2.1.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 10]

156. 9700_s16_qp_23 Q: 6

Fig. 6.1 is a diagram of a section through a mammalian heart.

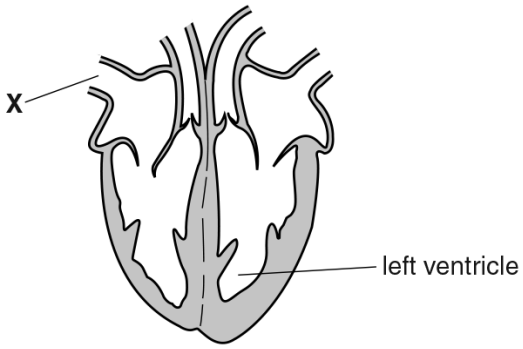


Fig. 6.1

(a) Name the blood vessel labelled **X**.

.....[1]

(b) Explain the difference in thickness between the muscle walls of the left and right ventricles.

.....

.....

.....

.....

.....

.....

.....[3]

(c) Name the structure in the heart that acts as the pacemaker to initiate the cardiac cycle.

.....[1]

[Total: 5]

157. 9700_s15_qp_22 Q: 1

Each of statements **A to E** describe a structure associated with the mammalian heart.

For each statement, identify the structure that is being described.

A The chamber that pumps blood into the pulmonary artery.

.....

B A blood vessel that transports deoxygenated blood into the right atrium.

.....

C The specialised tissue responsible for delaying the conduction of impulses from the atria to the ventricles.

.....

D The blood vessels that supply cardiac muscle with oxygenated blood.

.....

E The valve that prevents the backflow of blood from the ventricle that contains oxygenated blood.

.....

[5]

[Total: 5]

---

158. 9700_w15_qp_22 Q: 6

(a) The thickness of the different chambers of the mammalian heart is due to the amount of cardiac muscle present. The atria have less cardiac muscle than the ventricles, and hence thinner walls.

In terms of their functions, explain why the atria have thinner walls than the ventricles.

.....

.....

.....

.....

..... [2]

(b) Name the dividing wall separating the right and left sides of the mammalian heart.

..... [1]

(c) Transpiration and translocation are both processes occurring in plants.

(i) State **one** way in which transpiration differs from translocation.

.....

.....

..... [1]

(ii) State **one** way in which transpiration and translocation are similar.

.....

.....

..... [1]

[Total: 5]

125. 9700_s20_ms_22 Q: 6

(a)	<table><tr><th>Stage of cell cycle</th></tr><tr><td>(G_1 phase)</td></tr><tr><td>S phase</td></tr><tr><td>G_2 phase ;</td></tr><tr><td>prophase</td></tr><tr><td>metaphase</td></tr><tr><td>anaphase ;</td></tr><tr><td>(telophase)</td></tr><tr><td>(cytokinesis)</td></tr></table> interphase ; (mitosis) *one mark for interphase* *one mark for S phase and G_2 phase in correct sequence* *one mark for prophase, metaphase and anaphase in correct sequence*	3
(b)	Vincristine: ✓ ✓ x x ; 5-fluorouracil : x x x x ;	2
(c)	*any three from* *blood smear differences* large / larger, numbers of lymphocytes ; more lymphocytes than normal blood smear ; *as blood smear or lymphocyte difference* immature / not fully developed ; *ref. to* no large nuclei / nuclei not pronounced small nuclei ; **A** nuclei not visible *lymphocyte difference* non-functional / AW ; detail of lack of function for either B-lymphocytes or T-lymphocytes ; AVP ; e.g. *ref. to* difficult to distinguish between lymphocytes and monocytes ; **A** no monocytes visible	3

126. 9700_w20_ms_22 Q: 6

(a)(i)	same shape and shift to the right ; *must start to rise within 2 small squares of 0 and end at or near to existing curve*	**1**
(a)(ii)	*max 2 if concept of more not mentioned in response* *any **three** from:* **1** actively respiring tissue means more carbon dioxide ; **2** increase in, formation of carbonic acid **/** dissociation of carbonic acid / hydrogen ions, (in the red blood cell) ; **A** from equation **3** more hydrogen ions, bind to haemoglobin / form haemoglobinic acid ; **A** HHb **4** (causes) more oxygen (to be), unloaded / dissociated / AW (from haemoglobin); **I** *ref. to* faster / quicker **I** incorrect *ref. to* affinity causing unloading, e.g. CO_2 **A** lower (percentage) saturation of haemoglobin with oxygen **A** oxygen released, more easily / readily from haemoglobin **5** haemoglobin affinity for oxygen decreases ; **6** more oxygen to meet demand for (aerobic / cellular) respiration ; AW **I** more oxygen for respiring tissues	**3**
(b)	CO_2 = (passive / simple) diffusion ; HCO_3^- = facilitated diffusion ; **I** *ref. to* size CO_2 is, non-polar / not charged / not ionic and can cross, hydrophobic core / phospholipid bilayer ; HCO_3^- is, charged / ionic / hydrophilic and (needs to) cross, via, transport / carrier, protein ; **A** channel protein *if explanation mps not gained,* allow 1 mark for CO_2 is, non-polar / not charged / not ionic and HCO_3^- is, charged / ionic / hydrophilic	**4**

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127. 9700_s19_ms_21 Q: 2

(a)	*any two from:* ('kinks') prevents close packing of, phospholipids / membrane components, (at low temperature) ; keeps / maintains, fluidity ; **A** increases **A** ora - prevents becoming too rigid *idea of* preventing damage to membranes by preventing freezing ; maintains movement of (named) substances across membranes ; **A** any named example of movement across membrane **R** increases AVP ; e.g. maintains movement of proteins within membrane	**2**
(b)(i)	*idea that triglycerides and phospholipids* are not composed of, monomers / repeating (sub-)units ;	**1**
(b)(ii)	*any two from:* *phospholipids have* two fatty acids (residues / tails) not three ; **A** hydrocarbon chains / aliphatic chains **A** one less fatty acid (residue / tail) **A** ora two ester bonds rather than three ; a phosphate (group / head) ; **A** ora **R** 'phosphate not glycerol' AVP ; e.g. may have a (named) additional group, such as choline / AW e.g. triglycerides do not have nitrogen / phospholipids may have nitrogen	**2**
(c)	*any four from:* **1** thromboxane is a (cell) signalling molecule ; **A** 'thromboxane acts as a signal' **I** 'messenger' / hormone **2** released into / circulates in / AW, blood / plasma ; **3** (smooth) muscle, cell / tissue, is <u>target</u> ; **4** thromboxane binds to <u>receptors</u> ; **5** *ref. to* thromboxane is complementary to receptor ; **6** (specific) response is smooth muscle (cell) contraction ; **R** smooth muscle constricts **7** AVP ; e.g. detail of change, such as activating G proteins / secondary messenger / enzyme cascade / chain of reactions / AW	**4**

128. 9700_s19_ms_23 Q: 5

(a)(i)	phagocytosis (of, dead cells / pathogens / AW) ; **A** endocytosis of pathogens	**1**
(a)(ii)	(sodium chloride) solution has lower water potential (than cytoplasm) ; ora **A** Ψ *for water potential* water, leaves / AW, cell by <u>osmosis</u> ;	**2**
(b)(i)	13.56 ; **A** 13.6 / 14	**1**
(b)(ii)	*allow (red) blood cell count for mean red blood cell count* *allow* ***ora*** *any four from:* 1 description of data ; e.g. lowest mean red blood cell count for, (population) **A** / lowest altitude (populations) **B**, **C** and **D** / all other altitudes, have a higher mean red blood cell count than **A** / 695m altitude (population) **B** has highest mean red blood cell count (population) **B** has higher mean red blood cell count than **C** <u>and</u> **D** *physiological explanation population* ***A*** *compared to* ***B/C/D*** 2 decrease in partial pressure of oxygen in the atmosphere with increase in altitude / AW **or** lower partial pressure of / less, oxygen in, inhaled air / lungs / alveoli AW 3 *ref. to* haemoglobin ; e.g. lower saturation of haemoglobin with oxygen (in lungs) lower affinity of haemoglobin for oxygen (in lungs) more haemoglobin required to carry sufficient oxygen to tissues 4 suggestion of increase in count at 1676 m and above ; e.g. rate of production of red blood cells increases higher erythropoietin (EPO) levels *ref. to* changed proportion of plasma to red blood cells / plasma volume decreases 5 little difference between **B**, **C** and **D** / AW ; 6 differences in altitude are not great / AW ; *in context of* ***B***, ***C***, ***D*** 7 *ref. to* genetic differences / adaptation to environment ; *allow if general statement includes population* ***A*** 8 AVP ; e.g. *ref. to* differences in demographics	**4**
(c)	less haemoglobinic acid is formed / fewer hydrogen ions to bind to haemoglobin (to cause dissociation of oxygen) ; *any one from:* binds to allosteric site / site other than active site (of enzyme), qualified ; e.g. causes change in shape of active site substrate cannot bind to active site fewer / no, enzyme-substrate / ES, complex formation prevents / reduces / AW, carbonic acid / H_2CO_3, formation / AW ; **A** fewer hydrogen ions produced from carbonic acid dissociation	**2**

129. 9700_w19_ms_22 Q: 3

(a)	*any two from:* **1** higher / better, resolution **A** higher resolving power **I** clearer resolution **or** greater ability to distinguish between two points / AW ; *ignore wavelength values if stated as wavelength but **R** if stated as resolution values* **2** *ref. to* resolution values ; e.g. able to see points closer together than 200 nm (range 100–300 nm) can see, points up to 0.5 nm (0.0005 µm) apart (range 0.2–1.0 nm) can see structures larger than 0.5 nm **3** thinner sections can be obtained ; **A** idea that complete image will be in better focus **4** able to see, ribosomes / membranes / detail within organelles ;	**2**
(b)	*any three from:* **1** (shape of) red blood cell is biconcave *accept biconcave from a diagram* **or** (shape of) erythroblast is, cuboidal / spherical / not biconcave / irregular / AW ; **2** red blood cell has no nucleus / erythroblast has nucleus ; **3** erythroblast has, mitochondria / organelles / named organelles **or** red blood cell has no, mitochondria / organelles / named organelles ; **4** red blood cell has more haemoglobin / erythroblast has less haemoglobin ; **I** *ref. to* haem *statement only about erythroblast*: **A** erythroblast has no haemoglobin *statement only about rbc: must say more haemoglobin* *statement with both:* **A** red blood cell has haemoglobin, erythroblast has no haemoglobin **5** AVP ; e.g. erythroblast, is larger / basophilic red blood cell is more flexible	**3**

<table>
<tr>
<td>(c)(i)</td>
<td>
3 structures correct and involvement, incorrect / not stated, allow 1 mark
three correct rows
I extra rows added with additional structures
<table>
<tr><td>nucleus / chromosome</td><td>(has) gene / DNA, coding for protein
or (for) transcription / mRNA synthesis ;
A produces ribosomes if stated as made in nucleolus</td></tr>
<tr><td>nucleolus</td><td>produces, rRNA / ribosomes / ribosomal subunits ;</td></tr>
<tr><td>ribosome
A ribosomal subunit</td><td>(site of) polypeptide / protein, synthesis
A described I makes amino acids
A to synthesise enzymes

or (for) translation

or binding of, mRNA / tRNA ;</td></tr>
<tr><td><u>rough</u> endoplasmic reticulum
A rough ER / RER
R wrong word for ‘rough’ if RER also stated</td><td>site of, polypeptide / protein, synthesis
A described
A to synthesise enzymes

or (for) translation

or (for) attachment of ribosomes

or protein / post-translational, modification
A examples

or protein transport ;
I packaging proteins</td></tr>
<tr><td>transport vesicle</td><td>to move protein from RER to Golgi (body / apparatus / complex) ;</td></tr>
<tr><td>Golgi (body / apparatus / complex)</td><td>for, protein / post-translational, modification / AW ;
A examples
I packaging proteins</td></tr>
<tr><td>mitochondrion</td><td>provides / produces, ATP for, tRNA aminoacylation / charging amino acids before attachment to tRNA ;</td></tr>
</table>
</td>
<td>3</td>
</tr>
<tr>
<td>(c)(ii)</td>
<td>carbonic anhydr<u>ase</u> ;
R carbon anhydrase / anhydrase</td>
<td>1</td>
</tr>
</table>

(d)	*assume spherocytosis type 2 unless stated otherwise* *any two from:* spherical means reduced surface area (to volume ratio) (so less oxygen diffuses in) ; **A** SA *for surface area* *idea of* further distance for oxygen to reach, (some) haemoglobin molecules / centre of red blood cell ; not enough time to reach, same level of / 98%, saturation of haemoglobin ; *idea of blood flowing through* *ref. to* spherical shape / larger / less flexible, so less able to pass through, (pulmonary capillary) network / AW ;	**2**
(e)	*any three from:* *(water potential gradient created / loss of equal water potentials, so)* *similarities* **1** water enters cells, by osmosis / down the water potential gradient / from high to low water potential ; **A** Ψ for water potential **2** both type of cell, swell / increase in size ; *differences* **3** spherocytosis cells, burst / lyse, more easily / before red blood cells ; **A** spherocytosis cells burst more quickly **A** spherocytosis cells burst and red blood cells do not burst **4** AVP ; e.g. spherocytosis cells already more swollen spherocytosis cells have more pressure exerted (on their cell surface membrane) than normal red blood cells AW *idea of* spherocytosis cells unable to take in as much water and stay intact ref. to less stable / less support for membrane, so weaker membrane (for spherocytosis cells) **I** less flexible	**3**

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130. 9700_w19_ms_23 Q: 1

(a)(i)	haem ; **A** heme / prosthetic group **I** iron / iron ion / Fe / Fe^{2+} **I** porphyrin ring	**1**
(a)(ii)	*one from* combines with / binds / carries / transports / AW, oxygen (in lungs) ; **R** forms bonds releases / AW, oxygen, in tissues / at low oxygen concentrations ; allows haemoglobin to transport oxygen ;	**1**
(b)	*two from* **1** spherical / ball-like / rounded / AW ; **R** circular / round **ignore** 3D shape **2** (water) soluble / forms H bonds with water ; **3** hydrophilic R-groups on outside of molecule / hydrophobic R-groups on inside ; **R** *ref. to* 'tails' **4** dynamic / metabolic / physiological / AW, function ;	**2**
(c)	made of amino acids ; *one from* joined by peptide bonds ; **R** 'peptide bond between two amino acids' **R** 'dipeptide bond(s)' macromolecule / long-chain (molecule) / large molecule ; repeated / many, (sub-)units / monomers ;	**2**
(d)	*three from* **1** (R-group of) glutamic acid / glu, is polar / hydrophilic **and** (R-group of) valine / val, is non-polar / hydrophobic ; **2** change in tertiary structure ; **A** 'change in globular shape / less globular in shape' **3** change in quaternary structure of haemoglobin ; **R** of β-globin **4** *ref. to* haemoglobin forms fibres (with other Hb) ; **A** 'sticky molecules' **5** haemoglobin is less (water) soluble ; **I** insoluble **6** haemoglobin is less efficient at, binding / transporting, oxygen ; **A** less oxyhaemoglobin **A** haemoglobin / β-globin, has lower affinity for oxygen **A** reduced oxygen carrying capacity **I** haemoglobin, does not / cannot, bind oxygen **7** AVP ;	**3**
(e)	*three from* **1** haemoglobin combines with carbon dioxide ; **2** carbon dioxide reacts with (terminal), amine group(s) / $–NH_2$ / –NH ; **3** to form carbaminohaemoglobin ; **R** carboxyhaemoglobin / carbonylhaemoglobin **4** each polypeptide can carry a molecule of carbon dioxide / haemoglobin can carry four molecules of carbon dioxide ; **5** carbon dioxide remains, bound / AW, to Hb until in, region of low pCO_2 *or* high pO_2 / pulmonary circulation / lungs / alveoli ; **6** *ref. to* (carbonic acid dissociates to form) hydrogen ions, which bind to / AW, haemoglobin ; **A** H^+ forms haemoglobinic acid *or* HHb **I** hydrogen unqualified **7** AVP ; e.g. hydrogencarbonate ions to plasma	**3**

131. 9700_w19_ms_23 Q: 4

(a)	*artery wall* **I** *narrow lumen to maintain high (blood) pressure* **I** *ref. to valves / ref. to inner lining being wrinkled or wavy* **1** thick, walled / tunica media, to withstand high (blood) pressure / prevent bursting ; **2** endothelium / endothelial cells / tunica intima, are smooth, little friction to blood flow / easy flow of blood / no eddies of blood flow / AW ; **3** elastic, tissue / fibres, stretches to allow surges in blood flow / recoils to maintain blood pressure *or* force blood forward ; **4** smooth muscle (contracts to), maintains / regulates / controls blood flow ; **A** smooth muscle distributes blood **5** collagen fibres, avoid rupturing / bursting ;	**4**
(b)(i)	red blood cells / erythrocytes ; **R** red and white blood cells *one from* biconcave (shape) ; no nucleus ; *idea of* uniform, cytoplasm / cell contents ; *idea of* rouleau / stacked cells ; **I** 'clumped' **I** size	**2**
(b)(ii)	*assuming arteriole unless told otherwise, accept alternative terminology for layers of wall of arteriole* **I** *ref. to folding* **1** thicker wall / more than one layer of cells in wall / has tunica intima, tunica media and tunica adventitia whereas capillary has tunica intima ; **A** endothelium for tunica intima **2** more cells forming, perimeter / tunica intima ; **3** wider (vessel) / wider lumen / AW ; **A** actual width(s) **4** nucleus / nuclei, present in wall only in arteriole ; **5** cells lining lumen / endothelial cells, are thicker ; **6** lumen smaller, relative to the, thickness of the wall / overall width ; **7** more (red blood) cells (in lumen) ; **8** nuclei projecting inwards only in arteriole ; **9** AVP ; e.g. *ref. to* smooth muscle cells capillaries are surrounded by cells correct calculation of actual sizes using magnifications in Fig. 4.1 arteriole 20–35 μm and capillary 6–7 μm	**4**
(c)(i)	**1** higher (hydrostatic) pressure of blood (at start of capillary) ; **2** (pressure / ultra) filtration of blood ; **3** (causing) leakage / movement out / pushing out, of plasma ; **R** diffusion **4** *either* glucose / amino acids / salts, (filtered) out *or* (large) plasma proteins not (filtered) out ; **5** AVP ; e.g. *ref. to* pores / fenestrations / gaps, within / between, endothelial / lining, cells e.g. molecules smaller than MM ~68 000 (g mol^{-1} / daltons) can pass out	**2**
(c)(ii)	lymph ; **A** lymphatic (fluid) *one from* **I** *any cells / waste products / toxins / antibodies / fatty acids and glycerol* no, named / large / plasma, proteins, e.g. albumen no / little / less, oxygen / glucose higher concentration of / more, carbon dioxide AVP ; e.g. higher concentration of / more, fat / lipids / lipoproteins *if fluid identified as tissue fluid give one mark as an ECF for a difference between plasma and tissue fluid* e.g. no, named / large / plasma, proteins e.g. albumen	**2**