CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



EXAM QUESTION PACK

9 GAS EXCHANGE

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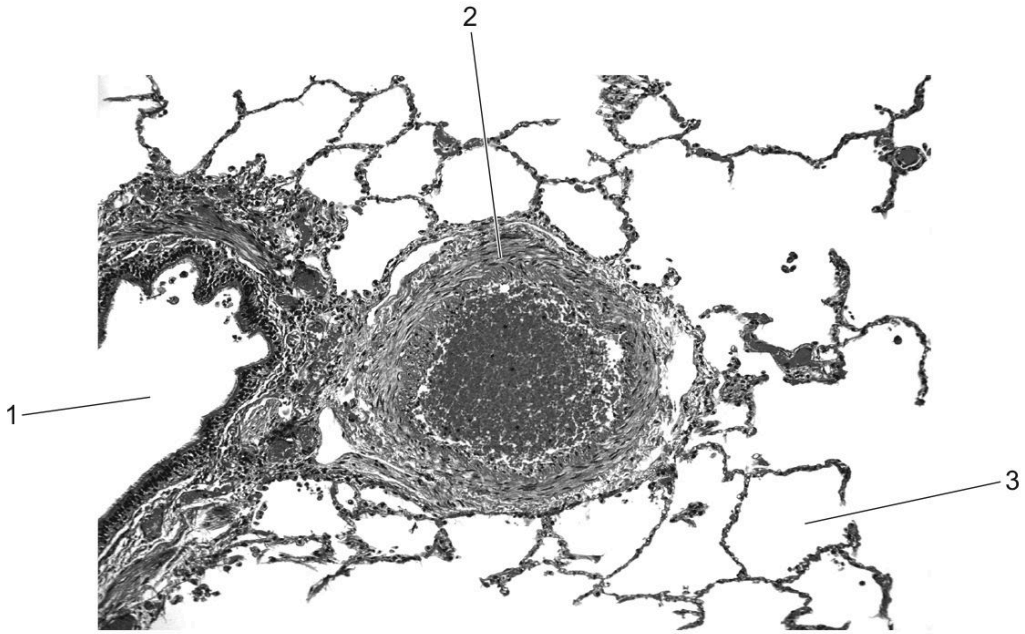
Chapter 9

Gas exchange and smoking

9.1 The gas exchange system

1282. 9700_m20_qp_12 Q: 33

The photomicrograph shows part of the lung as seen using a light microscope.



Which row correctly identifies the features labelled 1, 2 and 3?

	1	2	3
A	alveolus	capillary	bronchiole
B	alveolus	bronchiole	capillary
C	bronchiole	small artery	alveolus
D	small artery	bronchiole	alveolus

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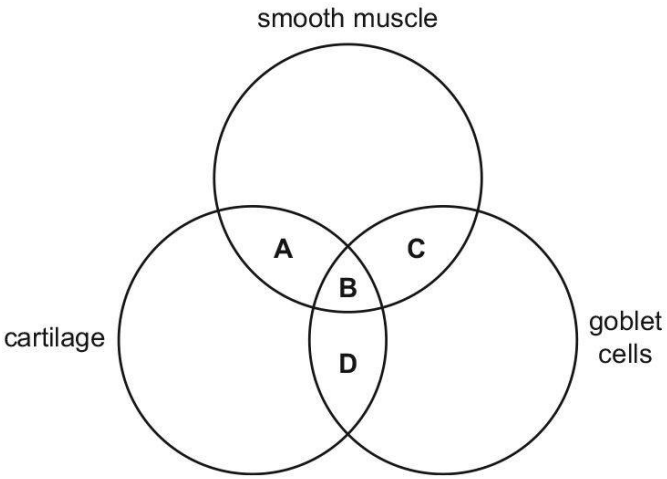
1283. 9700_m20_qp_12 Q: 34

How many times must a molecule of oxygen pass through a cell surface membrane as it diffuses from inside an alveolus, through a cell in the capillary wall, to bind to a molecule of haemoglobin?

A 3 **B** 4 **C** 5 **D** 10

1284. 9700_s20_qp_11 Q: 33

Which structures are found in bronchi?



1285. 9700_s20_qp_11 Q: 34

Which tissue in the respiratory system is correctly linked to its function?

	tissue	function
A	cartilage	stretch and recoil to force air out
B	ciliated epithelium	gives protection from suspended particles in the air
C	elastic fibres	contract and relax to adjust diameter of bronchioles
D	smooth muscle	keeps trachea and bronchi open

1286. 9700_s20_qp_12 Q: 32

Which structures of the human gas exchange system are supported by cartilage?

	bronchus	bronchiole	trachea
A	✗	✓	✓
B	✗	✓	✗
C	✓	✓	✓
D	✓	✗	✓

key

✓ = cartilage present

✗ = cartilage not present

1287. 9700_s20_qp_13 Q: 33

A student was asked to describe the differences between four microscope slides of sections taken from different parts of the gas exchange system.

slide 1 not present: cartilage, glands
present: few goblet cells, ciliated epithelial cells, smooth muscle

slide 2 present: incomplete cartilage rings, glands, goblet cells, ciliated epithelial cells, smooth muscle

slide 3 not present: cartilage, glands, goblet cells, smooth muscle
present: squamous epithelial cells

slide 4 present: plates of cartilage, glands, goblet cells, ciliated epithelial cells, smooth muscle

Which is the correct identification of the parts of the gas exchange system?

	slide 1	slide 2	slide 3	slide 4
A	alveolus	bronchiole	bronchus	trachea
B	bronchiole	bronchus	alveolus	trachea
C	bronchiole	trachea	alveolus	bronchus
D	bronchus	trachea	bronchiole	alveolus

1288. 9700_w20_qp_11 Q: 32

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 active cells to red blood cells and reacts with water.

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

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

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1289. 9700_w20_qp_11 Q: 33

Which statements about all bronchioles are correct?

1 they have goblet cells

2 they have ciliated cells

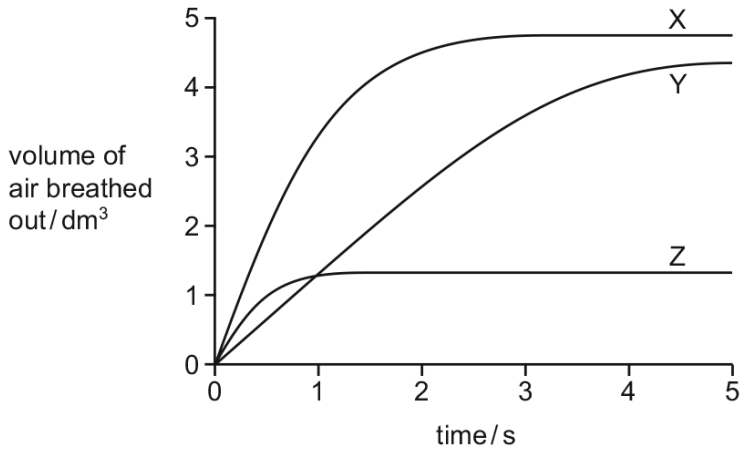
3 they have muscle tissue

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

---

1290. 9700_w20_qp_11 Q: 34

The graph shows the volume of air breathed out quickly and with force, following a deep breath in, for three different people, X, Y and Z.



What is a possible explanation for the differences in the volume of air breathed out by these people shown?

	chronic bronchitis	emphysema	normal lung function
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

1291. 9700_w20_qp_12 Q: 32

Which are present in bronchioles?

1 endothelium

2 ciliated cells

3 smooth muscle tissue

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

---

1292. 9700_w20_qp_12 Q: 33

The partial pressure of oxygen in air inside alveoli is 14 kPa.

The partial pressure of oxygen in pulmonary capillaries is 6 kPa.

What will be the effect of these partial pressures on diffusion?

A Carbon dioxide will not diffuse in any direction.

B Oxygen will diffuse from alveoli into capillaries.

C Oxygen will diffuse from capillaries into alveoli.

D Oxygen will diffuse equally in both directions.

1293. 9700_w20_qp_12 Q: 34

Which can be **directly** linked to a reduction in the surface area available for gas exchange in human lungs?

1 emphysema

2 lung cancer

3 smoking tobacco

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

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1294. 9700_w20_qp_12 Q: 35

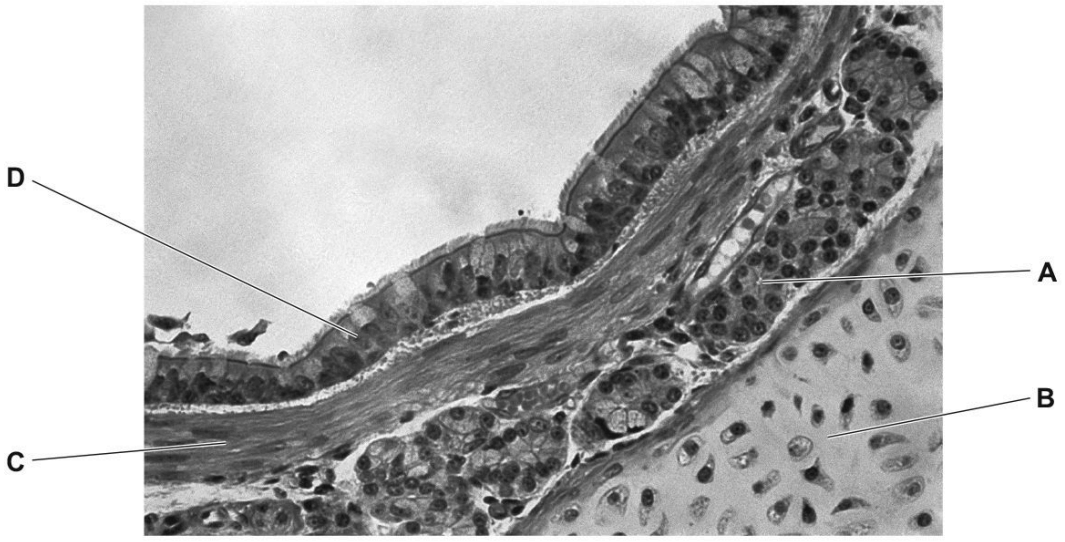
Which row is correct about the affinity between haemoglobin and the gases carbon dioxide, carbon monoxide and oxygen?

	highest affinity	⟶	lowest affinity
A	carbon monoxide	carbon dioxide	oxygen
B	carbon monoxide	oxygen	carbon dioxide
C	oxygen	carbon dioxide	carbon monoxide
D	oxygen	carbon monoxide	carbon dioxide

1295. 9700_w20_qp_13 Q: 32

The diagram shows a photomicrograph of part of a bronchus.

Which label identifies smooth muscle?



1296. 9700_w20_qp_13 Q: 33

Which statements about all bronchioles are correct?

1 They have epithelium.

2 They have goblet cells.

3 They have muscle tissue.

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

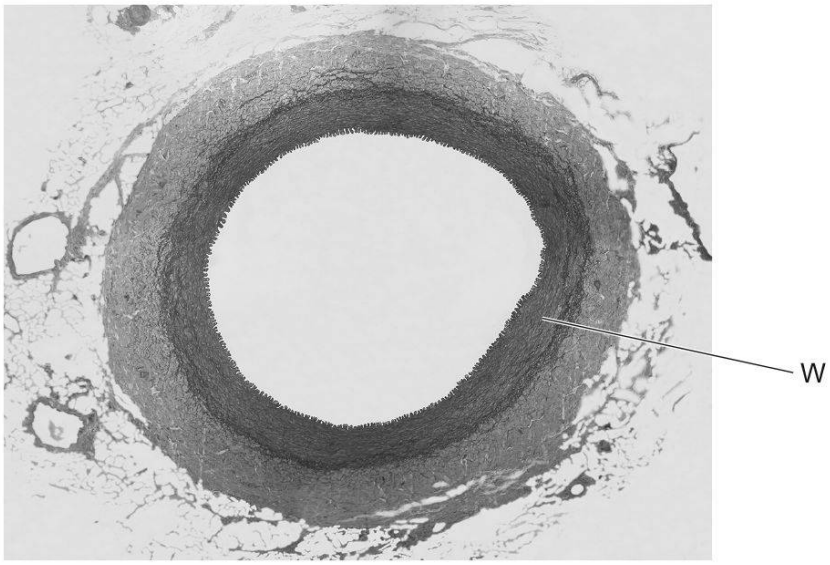
1297. 9700_w20_qp_13 Q: 34

Which row shows the effects of emphysema?

	alveoli	elastin	number of capillaries
A	burst	less	decrease
B	burst	more	increase
C	shrink	less	increase
D	shrink	more	decrease

1298. 9700_m19_qp_12 Q: 28

The photomicrograph shows a section through a structure found in mammals viewed using a light microscope.



×60

What are the main components of layer W?

A collagen fibres only

B elastic fibres and collagen fibres

C smooth muscle and elastic fibres

D squamous epithelial cells forming an endothelium

1299. 9700_m19_qp_12 Q: 33

Which statement about typical bronchioles is correct?

A They have cartilage and ciliated cells.

B They have goblet cells and smooth muscle.

C They have smooth muscle and cartilage.

D They have smooth muscle and ciliated cells.

1300. 9700_s19_qp_11 Q: 35

Which statements about bronchioles are correct?

1 They have ciliated cells.

2 They have goblet cells.

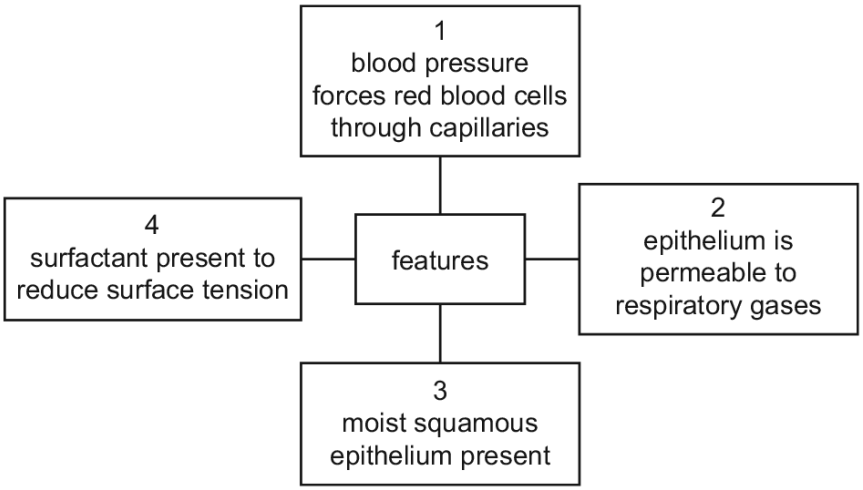
3 They have muscle tissue.

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

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1301. 9700_s19_qp_11 Q: 36

Which features are important for the diffusion of oxygen out of an alveolus?

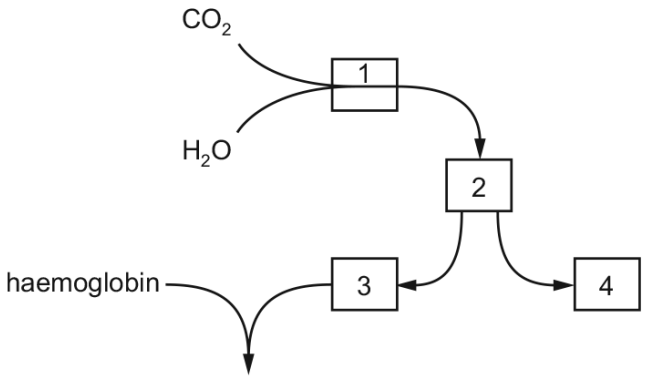


A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 3 only **D** 2 and 4 only

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1302. 9700_s19_qp_12 Q: 29

The diagram shows the pathway for the transport of carbon dioxide that occurs in red blood cells.



Which row is correct?

	1	2	3	4
A	carbaminohaemoglobin	haemoglobinic acid	hydrogen ions	hydrogencarbonate ions
B	carbonic anhydrase	carbonic acid	hydrogen ions	hydrogencarbonate ions
C	carboxyhaemoglobin	carbonic anhydrase	carbonic acid	carbon dioxide
D	haemoglobinic acid	carbonic acid	hydrogencarbonate ions	hydrogen ions

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1303. 9700_s19_qp_12 Q: 31

The large arteries close to the heart have a thick elastic layer in their walls.

Which statements about this layer are correct?

1 helps to maintain the blood pressure in arteries

2 reduces friction within the arteries

3 prevents too much pressure bursting the artery wall

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

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1304. 9700_s19_qp_12 Q: 32

Which tissues are present in the walls of a trachea and an alveolus?

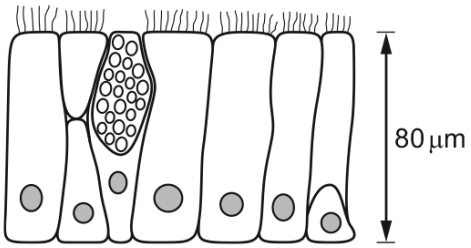
		tissue	
		epithelium with goblet cells	smooth muscle
A	trachea	✓	✓
	alveolus	✗	✗
B	trachea	✓	✓
	alveolus	✗	✓
C	trachea	✓	✗
	alveolus	✓	✓
D	trachea	✗	✓
	alveolus	✗	✗

key

✓ = present
✗ = absent

1305. 9700_w19_qp_11 Q: 34

The diagram shows a section through a type of epithelium.



Where is this type of epithelium found in the respiratory system?

	trachea	bronchus	all bronchioles
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = present
✗ = not present

1306. 9700_w19_qp_12 Q: 32

Which statement is correct?

A Alveoli have goblet cells to produce mucus to trap pathogens from the air.

B Cartilage in the bronchi keeps the bronchi open and allows air to flow through freely.

C Complete rings of cartilage in the bronchioles make sure that air can reach the alveoli.

D During exercise, muscles in the bronchioles and alveoli relax to allow a greater flow of air.

1307. 9700_w19_qp_12 Q: 33

Four types of cell in the gas exchange system are listed.

J alveolus epithelium cell

K ciliated cell

L goblet cell

M smooth muscle cell

The ticks (✓) in the table show specialised features of three of these types of cell.

	many mitochondria	lots of endoplasmic reticulum	many Golgi bodies
1	✓		
2	✓		
3	✓	✓	✓

Which row correctly matches the specialised feature with the correct cell?

	1	2	3
A	J	M	K
B	K	J	M
C	K	M	L
D	M	K	J

1308. 9700_w19_qp_13 Q: 34

Which may contain ciliated epithelium?

A trachea only

B trachea and bronchi only

C trachea, bronchi and bronchioles

D bronchi, bronchioles and alveoli

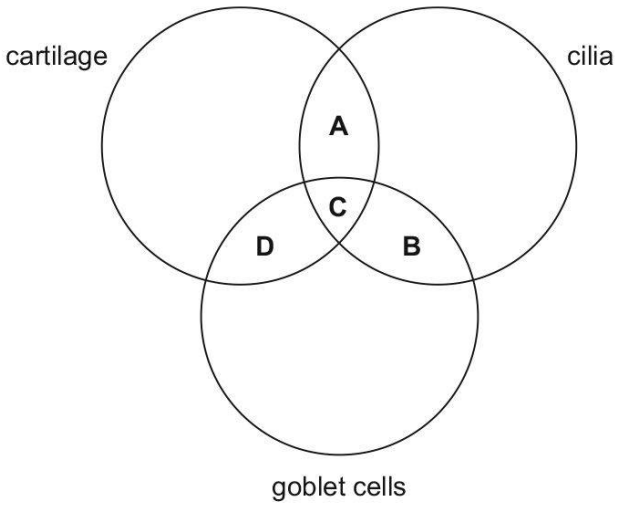
1309. 9700_w19_qp_13 Q: 35

Which row shows the effects of chronic bronchitis?

	lymph glands	alveoli	bronchi	infection
A	destroyed	damaged	inflamed	absent
B	destroyed	inflamed	scarred	present
C	swollen	damaged	scarred	present
D	swollen	inflamed	inflamed	absent

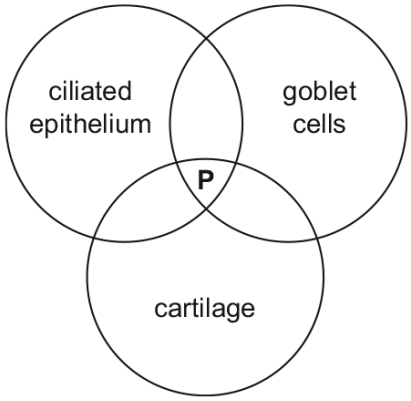
1310. 9700_m18_qp_12 Q: 35

What identifies the structures present in a bronchus?



1311. 9700_s18_qp_11 Q: 31

The diagram shows three features found in tissues of the gas exchange system.



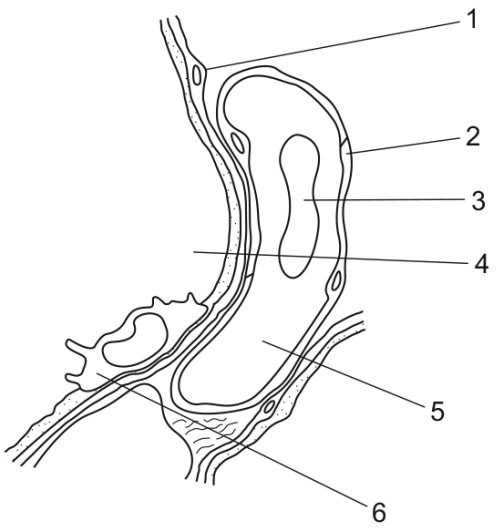
Which tubes of the gas exchange system could be represented at position **P** in the diagram?

	bronchus	bronchiole	trachea
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = yes
✗ = no

1312. 9700_s18_qp_11 Q: 32

The diagram shows a magnified section of part of the lungs containing specialised tissues.



Which row is correct for structures labelled 1 to 6?

	contains high proportion of		
	carbonic anhydrase	HCO_3^- ions	lysosomes
A	1	3	4
B	2	4	5
C	3	5	6
D	4	6	1

1313. 9700_s18_qp_12 Q: 34

Which of these structures contain cartilage and cilia?

1 bronchi

2 bronchioles

3 trachea

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

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1314. 9700_s18_qp_13 Q: 34

What helps to maintain a concentration gradient between blood and the air in the alveolus?

A the flow of blood through the lungs

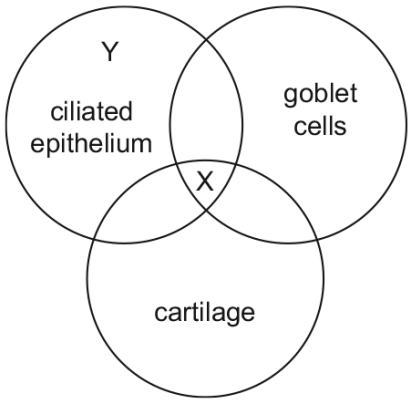
B the presence of haemoglobin in blood cells

C the single-celled alveolar walls

D the squamous epithelium of capillaries

1315. 9700_s18_qp_13 Q: 35

The diagram shows three features found in the tissues of the gas exchange system.



Which structures of the gas exchange system could be represented at position X and at position Y in the diagram?

1 bronchiole

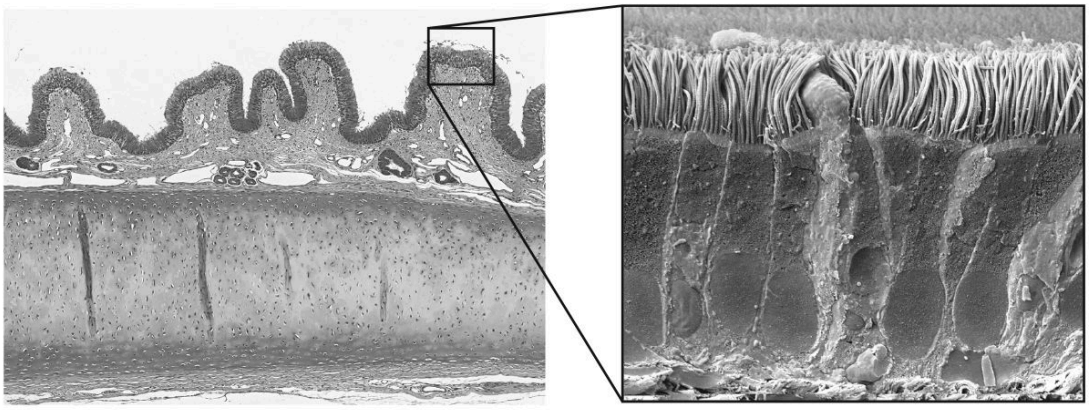
2 trachea

3 bronchus

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

1316. 9700_w18_qp_11 Q: 33

The photomicrographs show a cross-section through the lining of part of the respiratory system.



Which statements are correct?

1 Goblet cells are visible between squamous epithelium cells.

2 Smooth muscle is visible.

3 The section cannot be from a bronchiole as cartilage is visible.

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

---

1317. 9700_w18_qp_11 Q: 34

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

Which row is correct?

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

1318. 9700_w18_qp_12 Q: 33

Which tissues are present in a bronchus?

	cartilage	ciliated epithelium	smooth muscle
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = present
✗ = absent

1319. 9700_w18_qp_13 Q: 32

A person moves from sea level to live at a high altitude.

After three months living at high altitude, which change would be found in this person when at rest?

A increased volume of blood per heartbeat

B increased breathing rate

C increased heart rate

D increased mass of red blood cells

1320. 9700_m17_qp_12 Q: 36

Which tissues may be found in bronchioles?

A cartilage, ciliated epithelium, glandular tissue

B ciliated epithelium, elastic fibres, smooth muscle

C elastic fibres, cartilage, smooth muscle

D smooth muscle, glandular tissue, cartilage

1321. 9700_s17_qp_11 Q: 37

Which characteristic of the human gaseous exchange surface and the lungs, maintains the necessary concentration gradients for carbon dioxide and oxygen?

A good ventilation of the lungs

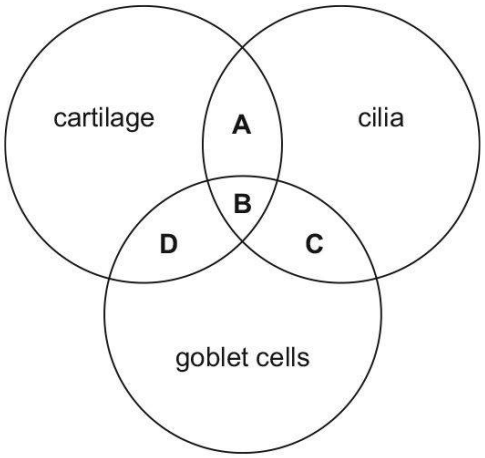
B large surface area of the alveoli

C low resistance to air flow

D the walls of the alveoli are thin

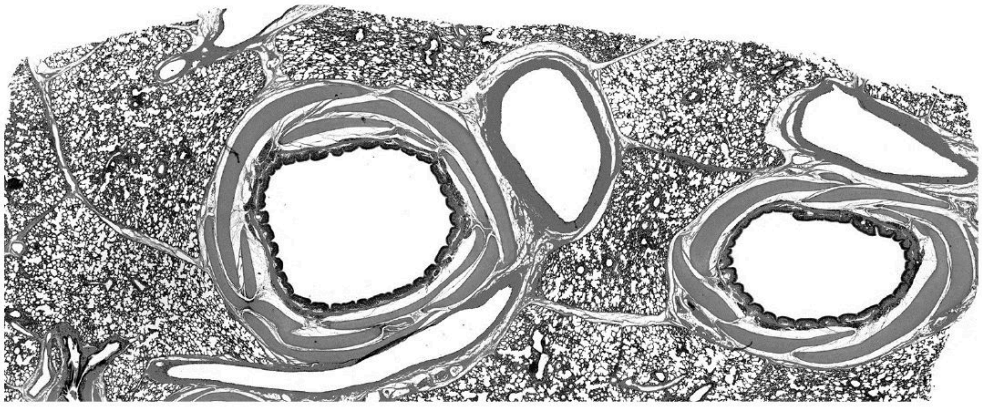
1322. 9700_s17_qp_11 Q: 38

Which identifies the tissues present in the trachea?



1323. 9700_s17_qp_12 Q: 31

The photomicrograph shows a section through lung tissue.



Which structures are present in this photomicrograph?

	artery	vein	bronchioles	bronchus	trachea
A	✓	✓	✗	✓	✗
B	✓	✗	✓	✗	✓
C	✗	✓	✓	✓	✗
D	✗	✗	✗	✓	✓

key
✓ = present
✗ = absent

1324. 9700_s17_qp_12 Q: 33

Some of the requirements of an efficient gas exchange system are a large surface area and a short diffusion distance.

What is correct about how alveoli are adapted to meet these requirements?

	large surface area	short diffusion distance
A	collagen and elastin fibres that allow the alveoli to stretch	an extracellular layer round the alveolus wall contains blood capillaries
B	gases dissolve in a layer of liquid to speed up diffusion	walls of alveoli are squamous epithelium
C	many folded interconnected alveoli	capillaries are next to alveolus wall
D	sac shape of alveoli formed by squamous cells	red blood cells are very close to capillary walls

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1325. 9700_s17_qp_13 Q: 31

Which description of part of the gas exchange system is correct?

	part of gas exchange system	cartilage	ciliated epithelium	goblet cells	smooth muscle
A	alveolus	✗	✓	✗	✗
B	bronchus	✓	✓	✓	✓
C	bronchiole	✗	✓	✓	✗
D	trachea	✓	✓	✓	✗

key
✓ = present
✗ = absent

1326. 9700_s17_qp_13 Q: 32

When a person suffers an asthma attack, the tubes of the gas exchange system narrow and extra mucus is produced.

Which changes occur during an asthma attack?

1 Activity of ciliated epithelium increases.

2 Endocytosis in goblet cells increases.

3 Smooth muscles are more active.

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

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1327. 9700_s17_qp_13 Q: 33

Which factors result from paralysis of cilia caused by smoking?

1 accumulation of mucus

2 increased chance of lung infection

3 emphysema

4 scarring of airway lining

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

1328. 9700_s17_qp_13 Q: 34

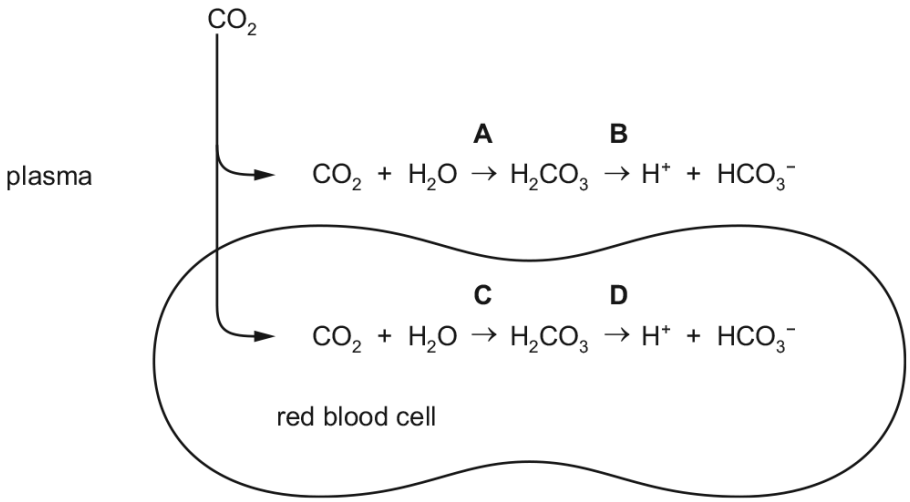
What is the **minimum** number of cell membranes a molecule of carbon dioxide and a molecule of oxygen pass through during gas exchange between alveoli and the plasma in the capillaries?

	carbon dioxide	oxygen
A	2	4
B	3	5
C	4	4
D	4	5

1329. 9700_w17_qp_11 Q: 30

The diagram shows some of the reactions of carbon dioxide when it enters the blood from cells in a metabolically active tissue.

Which reaction is catalysed by the enzyme carbonic anhydrase?



1330. 9700_w17_qp_11 Q: 31

How many phospholipid bilayers does oxygen pass through in diffusing from an alveolar air space to form oxyhaemoglobin in a red blood cell in a mammalian lung?

A 3 **B** 5 **C** 6 **D** 9

1331. 9700_w17_qp_11 Q: 32

Which statements about the human gas exchange system are correct?

1 The absence of cartilage in small bronchioles allows them to expand.

2 The walls of the alveoli are made of cuboidal epithelium.

3 Alveoli secrete surfactant which reduces surface tension in the lungs.

4 The trachea and bronchi are supported by circles of cartilage.

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

1332. 9700_w17_qp_11 Q: 33

A disease damages alveoli walls, causing the alveoli to burst.

What effect does this have on the gas exchange system?

	surface area for gas exchange	maximum volume of air breathed out
A	decreases	decreases
B	decreases	increases
C	decreases	no change
D	no change	no change

1333. 9700_w17_qp_12 Q: 34

A good gas exchange system maintains a steep diffusion gradient, has a large total surface area and a short diffusion distance.

Which feature of the human gas exchange system helps to maintain a steep diffusion gradient?

A A large number of alveoli are present in each lung.

B Alveoli walls contain elastic fibres allowing expansion.

C The air brought into the alveoli by ventilation is high in oxygen.

D The endothelium of the capillary wall is made of flattened cells.

1334. 9700_w17_qp_12 Q: 35

Which statement about bronchioles is correct?

A They have cartilage and ciliated cells.

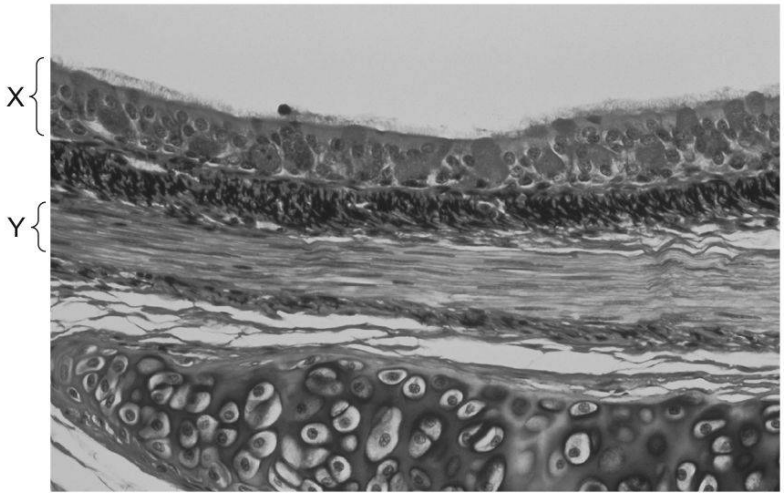
B They have cartilage and elastic tissue.

C They have cartilage and muscle tissue.

D They have elastic tissue and ciliated cells.

1335. 9700_w17_qp_13 Q: 35

The photomicrograph shows a cross-section through a bronchus.



What is the function of the tissues X and Y?

	X	Y
A	secrete mucus	prevent collapse of the airway
B	support the airway	dilate airway
C	trap dust and dirt	secrete mucus
D	waft dust and dirt upwards	constrict airway

1336. 9700_m16_qp_12 Q: 29

Which reactions take place at a higher rate in a capillary in an alveolus than in a capillary in active muscle?

1 carbon dioxide + water → carbonic acid

2 carbon dioxide + haemoglobin → carboxyhaemoglobin

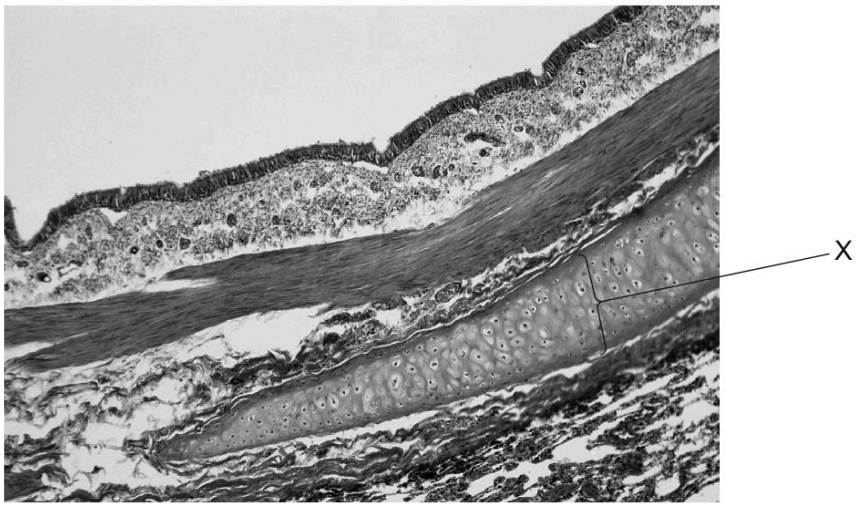
3 haemoglobin + hydrogen ions → haemoglobinic acid

4 hydrogencarbonate ions + hydrogen ions → carbon dioxide + water

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

1337. 9700_m16_qp_12 Q: 34

The photomicrograph shows a section through part of a bronchus wall.



What is the function of the tissue labelled X?

A contracts to constrict the airway

B helps to widen the airway when at high altitudes

C produces mucus to trap dust particles and bacteria

D supports the airway to prevent collapse

1338. 9700_s16_qp_11 Q: 33

What would be seen in an electron micrograph of a bronchus wall?

1 cartilage cells

2 ciliated cells

3 exocytotic vesicles

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

---

1339. 9700_s16_qp_11 Q: 34

Which parts of the human gas exchange system may typically contain macrophages?

	trachea	bronchus	bronchiole	alveolus
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✗	✗	✓	✓
D	✗	✗	✗	✓

✓ = may contain macrophages
✗ = may not contain macrophages

1340. 9700_s16_qp_11 Q: 35

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

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

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

1341. 9700_s16_qp_12 Q: 32

A student was asked to describe the differences between four microscope slides of sections taken from different parts of the gas exchange system.

slide 1 not present: cartilage, glands
present: few goblet cells, ciliated epithelial cells, smooth muscle

slide 2 present: incomplete cartilage rings, glands, goblet cells, ciliated epithelial cells, smooth muscle

slide 3 not present: cartilage, glands, goblet cells, smooth muscle
present: squamous epithelial cells

slide 4 present: plates of cartilage, glands, goblet cells, ciliated epithelial cells, smooth muscle

Which is the correct identification of the parts of the gas exchange system?

	slide 1	slide 2	slide 3	slide 4
A	alveolus	bronchiole	bronchus	trachea
B	bronchiole	bronchus	alveolus	trachea
C	bronchiole	trachea	alveolus	bronchus
D	bronchus	trachea	bronchiole	alveolus

1342. 9700_s16_qp_12 Q: 34

What is correct about the affinity between haemoglobin and the gases carbon dioxide, carbon monoxide and oxygen?

	highest affinity →		lowest affinity
A	carbon monoxide	carbon dioxide	oxygen
B	carbon monoxide	oxygen	carbon dioxide
C	oxygen	carbon dioxide	carbon monoxide
D	oxygen	carbon monoxide	carbon dioxide

1343. 9700_s16_qp_13 Q: 33

Goblet cells are found in the trachea.

Which organelles would be found in large numbers in a goblet cell?

	Golgi body	mitochondria	ribosomes
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key

✓ = present in large numbers

✗ = not present in large numbers

1344. 9700_s16_qp_13 Q: 34

What is the minimum number of layers of phospholipids that a molecule of oxygen passes through when diffusing from the alveoli, through cells, to haemoglobin in the red blood cells?

A 4 **B** 6 **C** 8 **D** 10

1345. 9700_w16_qp_11 Q: 33

A student viewed three slides at both low magnification and high magnification. Each slide was a section through a different airway of the gas exchange system.

The student observed three features in each slide.

slide	three features observed by student
1	irregular arrangement of cartilage highly folded inner layer cilia on epithelial cells
2	very few goblet cells cilia on epithelial cells thick layer of smooth muscle relative to wall thickness
3	smooth muscle tissue blood vessels many goblet cells

Which row is the correct set of identifications for the three slides?

	slide 1	slide 2	slide 3
A	bronchus	bronchiole	trachea
B	bronchus	trachea	bronchiole
C	trachea	bronchiole	bronchus
D	trachea	bronchus	bronchiole

1346. 9700_w16_qp_11 Q: 34

Which organelle is present in large quantities in ciliated epithelial cells?

A Golgi body

B lysosomes

C mitochondria

D rough endoplasmic reticulum

1347. 9700_w16_qp_11 Q: 35

In some cases where a person has lung disease, the partial pressure of oxygen in the pulmonary veins is less than the partial pressure of oxygen in the alveoli.

What could explain the difference in partial pressure of oxygen?

1 A high proportion of alveoli are collapsed and do not have enough alveolar capillaries.

2 The partial pressure of oxygen in the pulmonary arteries is lower than in the alveolar air.

3 The rate of diffusion of oxygen from the alveolar air to the surrounding alveolar capillaries is too slow.

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

---

1348. 9700_w16_qp_12 Q: 34

A student made some labelled drawings of lung tissue using the high-power lens of a light microscope, but did not label two airways, P and Q.

The drawing of the lining layer of P showed both ciliated cells and goblet cells, whilst the drawing of the lining layer of Q showed ciliated cells but very few goblet cells.

What are airways P and Q?

	airway	
	P	Q
A	bronchiole	trachea
B	bronchiole	bronchus
C	bronchus	bronchiole
D	trachea	bronchus

1349. 9700_w16_qp_12 Q: 35

What maintains the steep concentration gradients needed for successful gas exchange in the lungs?

1 Air flow in the alveoli is in the opposite direction to blood flow in the capillaries.

2 Blood arrives in the lungs with a lower oxygen concentration and a higher carbon dioxide concentration than the air in the alveoli.

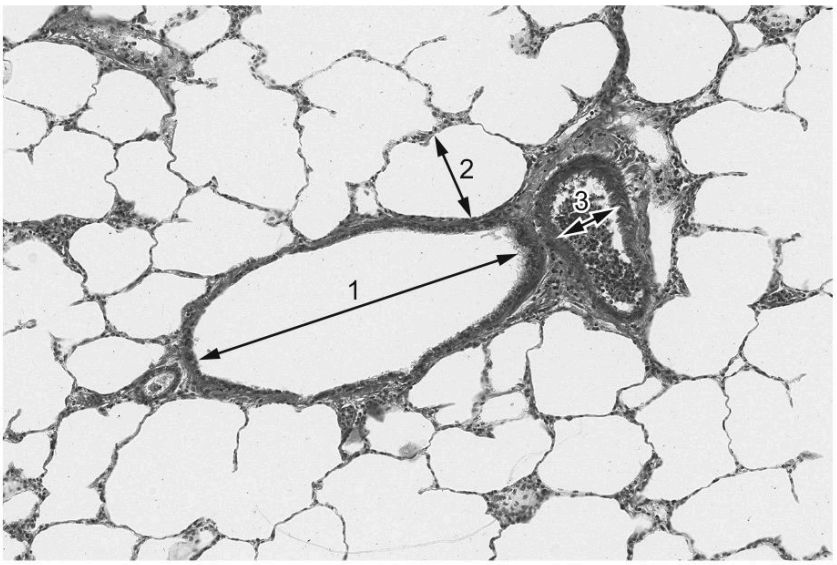
3 Blood is constantly flowing through and out of the lungs, bringing a fresh supply of red blood cells.

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

---

1350. 9700_w16_qp_12 Q: 36

The photomicrograph shows part of the lung as seen using a light microscope.

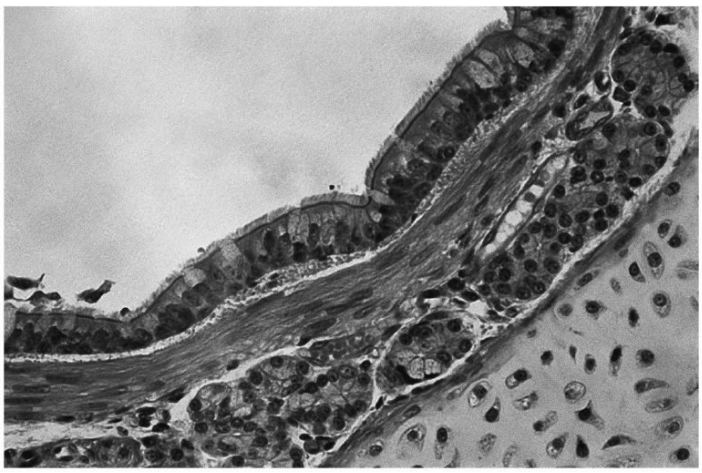


Which row is correct for the features labelled 1, 2 and 3?

	1	2	3
A	alveolus	bronchiole	capillary
B	alveolus	capillary	bronchiole
C	bronchiole	alveolus	small artery
D	small artery	alveolus	bronchiole

1351. 9700_w16_qp_13 Q: 32

The image shown is a photomicrograph of a transverse section of part of the gas exchange system.



What describes the image?

A a thin inner layer of ciliated epithelial cells on top of a layer containing cartilage and supported by elastic fibres

B a very thin epithelial lining with walls containing elastic fibres, surrounded by many blood vessels

C an inner layer of ciliated epithelial and goblet cells on top of elastic fibres and supported by an outer layer consisting of blocks of cartilage

D an inner layer of ciliated epithelial and goblet cells on top of loose tissue with mucous glands supported by an outer layer of cartilage

---

1352. 9700_s15_qp_11 Q: 31

Which row shows a function of each of the named tissues in the gas exchange system?

	cartilage	ciliated epithelium	smooth muscle	elastic fibres
A	keep the airways open	move mucus out of the airways	change the diameter of the bronchioles	allows alveoli to expand during breathing in
B	prevent choking	secrete mucus	contracts to increase air flow	helps to support the trachea
C	prevent the trachea collapsing when coughing	keep a layer of mucus lining the air ways	trap bacteria and dirt in air	cause elastic recoil when breathing out
D	support the small bronchioles	trap bacteria and dirt in air	control the flow of air to and from the alveoli	allows stretching of trachea for movement

---

1353. 9700_s15_qp_12 Q: 27

Which reaction takes place in a capillary in the lungs?

A the formation of carbaminohaemoglobin from carbon dioxide and haemoglobin

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

C the formation of carbonic acid from carbon dioxide and water

D the formation of haemoglobinic acid from haemoglobin and hydrogen ions

---

1354. 9700_s15_qp_12 Q: 31

What correctly describes the role of elastic fibres in the lungs?

A They allow the walls of stretched alveoli to recoil as air is breathed out.

B They increase in the walls of alveoli as a result of the release of the enzyme elastase.

C They increase in the walls of the alveoli as emphysema develops.

D They prevent the walls of the alveoli from collapsing as air is breathed in.

1355. 9700_s15_qp_13 Q: 33

A person breathes in small particles from a very dusty environment.

What effect will this have on B-lymphocytes and goblet cells?

	B-lymphocytes	goblet cells
A	less active	more active
B	less active	no change
C	more active	more active
D	no change	less active

1356. 9700_w15_qp_11 Q: 32

What would be seen in a photomicrograph of the wall of the trachea?

	tissue		
	elastic fibres	epidermis	smooth muscle
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✗

key

✓ = present

✗ = absent

1357. 9700_w15_qp_12 Q: 31

Which row about the human gas exchange system is correct?

		trachea	bronchus	alveolus
A	cartilage	present	present	absent
B	ciliated epithelium	absent	present	absent
C	goblet cells	present	absent	absent
D	smooth muscle	present	present	present

1358. 9700_w15_qp_13 Q: 32

What is a correct location of cartilage and smooth muscle in the human gas exchange system?

	cartilage	smooth muscle
A	bronchioles	bronchioles
B	bronchioles	trachea
C	trachea	alveoli
D	trachea	bronchi

1359. 9700_w15_qp_13 Q: 33

Which factors maintain the diffusion gradient for carbon dioxide at the surface of the alveoli?

1 blood flow past the alveoli

2 breathing movement exchanging air in the lungs

3 thin epithelial lining of the alveoli

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

1360. 9700_w15_qp_13 Q: 34

The surface tension of the layer of liquid lining the alveoli tends to pull the walls inwards so alveoli could collapse.

Which statements could explain how this is prevented?

1 alveolar fluid is moved around by cilia

2 elastic fibres keep the alveoli open

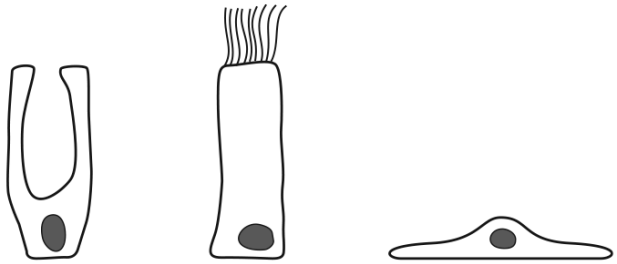
3 epithelial cells secrete a chemical that reduces the cohesion in water

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

9.2 Smoking

1361. 9700_m20_qp_12 Q: 32

The diagram represents three types of cell found in the human gas exchange system.



Which of these cell types could be affected when a person is exposed to tar in cigarette smoke?

A X, Y and Z **B** X and Z only **C** Y and Z only **D** Y only

---

1362. 9700_s20_qp_11 Q: 35

Chronic obstructive pulmonary disease (COPD) includes emphysema.

Which effects does emphysema have on gaseous exchange?

1 surface area to volume ratio of lungs decreases

2 distance of the diffusion pathway decreases

3 volume of oxygen diffused per unit time decreases

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

---

1363. 9700_s20_qp_12 Q: 33

Carbon monoxide, nicotine and tar are components of tobacco smoke.

Which row correctly describes their effect on a smoker's body?

	carbon monoxide	nicotine	tar
A	causes loss of consciousness at very low concentrations	increases the diameter of blood vessels	destroys cilia on cells lining the airways
B	forms a stable compound with haemoglobin	increases blood pressure	stimulates goblet cells to secrete mucus
C	forms carbaminohaemoglobin	increases the diameter of the coronary artery	settles on cells lining the airways
D	forms carboxyhaemoglobin	decreases the heart rate	contains carcinogens

---

1364. 9700_s20_qp_12 Q: 34

Which statements about chronic obstructive pulmonary disease (COPD) are correct?

1 The disease can often be reversed by treatment.

2 The patient's symptoms normally do not change.

3 The patient is normally over 30 years old.

4 The patient coughs frequently, producing a lot of mucus.

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

1365. 9700_s20_qp_13 Q: 34

Cigarette smoke contains carbon monoxide, nicotine and tar.

Which row correctly describes how these substances affect the body?

	carbon monoxide	nicotine	tar
A	stimulates nerve endings	stimulates the nervous system to reduce the diameter of the arteries	leads to obstructive lung disease
B	forms carbaminohaemoglobin	increases the risk of blood clots	blocks goblet cells
C	causes increased blood pressure	combines with haemoglobin	increases the risk of blood clots
D	combines with haemoglobin	stimulates nerve endings	carcinogenic

---

1366. 9700_s20_qp_13 Q: 35

Chronic obstructive pulmonary disease (COPD) includes chronic bronchitis and emphysema.

In what order do these events occur as emphysema develops?

1 Macrophages move into alveolar air spaces.

2 Tar paralyses cilia.

3 Macrophages secrete elastase.

4 Bacteria accumulate in alveoli.

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

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

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

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

1367. 9700_s20_qp_13 Q: 36

If someone smokes cigarettes, what will be the immediate result of this action on the red blood cells?

A Carbon monoxide will combine with the globin in haemoglobin.

B Carbon monoxide replaces carbon dioxide in carbaminohaemoglobin.

C Less oxyhaemoglobin will form.

D More haemoglobinic acid will be formed.

1368. 9700_m19_qp_12 Q: 34

Tobacco smoke contains substances that affect the functioning of the human body.

substance		effect	
w	nicotine	1	decreases oxygenation of haemoglobin
x	carbon monoxide	2	increases risk of cancer
y	tar	3	increases risk of blood clotting

What shows the substances matched with their correct effects?

A w-1, x-2, y-3

B w-1, x-3, y-2

C w-2, x-1, y-3

D w-3, x-1, y-2

1369. 9700_s19_qp_11 Q: 34

Which row correctly describes the short-term effects of carbon monoxide and nicotine on the body of a smoker?

	demand for oxygen	concentration of oxygen in blood
A	decreased by carbon monoxide	increased by nicotine
B	decreased by nicotine	increased by carbon monoxide
C	increased by carbon monoxide	decreased by nicotine
D	increased by nicotine	decreased by carbon monoxide

1370. 9700_s19_qp_12 Q: 33

The surface tension of the layer of liquid lining the alveoli tends to pull the walls inwards so alveoli could collapse.

Which statements could explain how this is prevented?

1 Alveolar fluid is moved around by cilia.

2 Elastic fibres keep the alveoli open.

3 Epithelial cells secrete a chemical that reduces the cohesion in water.

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

1371. 9700_w19_qp_11 Q: 35

In chronic obstructive pulmonary disease (COPD), airflow through the airways is reduced.

Which statements explain the reduced airflow?

1 More mucus is secreted into the airways.

2 Airways and alveoli lose their elasticity.

3 Many of the alveoli are destroyed.

4 Carbon monoxide binds irreversibly to haemoglobin.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1, 3 and 4 only

D 2, 3 and 4 only

1372. 9700_w19_qp_12 Q: 34

Some symptoms of chronic obstructive pulmonary disease (COPD) are listed.

1 bursting of alveoli

2 loss of elastic fibres

3 increase in secretion of mucus

4 reduction in surface area for gaseous exchange

5 narrowing of airways

Which of these are also the symptoms of emphysema?

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

1373. 9700_m18_qp_12 Q: 34

Chronic obstructive pulmonary disease (COPD) includes bronchitis and emphysema.

Which symptom is specific to emphysema?

A excess mucus secretion by the goblet cells

B inflammation of the bronchial epithelium

C loss of elasticity of the alveolar walls

D thickening of the smooth muscle of the bronchi

1374. 9700_s18_qp_11 Q: 33

A short-term effect of smoking is a decreased blood supply to the fingers and toes.

Which component of cigarette smoke causes this effect?

A carbon monoxide

B carcinogens

C nicotine

D tar

1375. 9700_s18_qp_11 Q: 34

The symptoms of two diseases are listed.

disease 1	disease 2
coughing up blood	shortness of breath
pain when breathing	difficulty breathing out
loss of weight	fatigue

Which row identifies diseases 1 and 2?

	disease 1	disease 2
A	chronic bronchitis	emphysema
B	emphysema	lung cancer
C	lung cancer	chronic bronchitis
D	lung cancer	emphysema

1376. 9700_s18_qp_12 Q: 35

Which row identifies both the type of pathogen that causes cholera and the way in which cholera is transmitted from person to person?

	type of pathogen	method of transmission
A	bacteria	drinking water contaminated with the pathogen
B	bacteria	inhaling water droplets contaminated with the pathogen
C	virus	drinking water contaminated with the pathogen
D	virus	inhaling water droplets contaminated with the pathogen

---

1377. 9700_s18_qp_13 Q: 36

Blood tests on people who regularly smoke cigarettes show that approximately 5% of their haemoglobin carries carbon monoxide.

People who smoke e-cigarettes inhale a vapour with no carbon monoxide. A person who smokes cigarettes regularly, switches to e-cigarettes and a blood test is carried out after a month.

Which chemical in the blood would be found in a lower concentration in this blood test?

A carbaminohaemoglobin

B carbonic anhydrase

C carboxyhaemoglobin

D hydrogencarbonate ions

1378. 9700_s18_qp_13 Q: 37

Emphysema is a type of chronic obstructive pulmonary disease, COPD. People with emphysema have a very low level of a plasma protein which inhibits the enzyme elastase.

Elastase breaks down the elastic fibres in the bronchioles and alveoli.

Which are effects of the low levels of inhibitor in people with emphysema?

1 alveoli do not stretch and recoil properly during inhalation and exhalation

2 blood is poorly oxygenated resulting in a rapid breathing rate

3 bronchioles collapse during exhalation trapping air in the alveoli

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

---

1379. 9700_w18_qp_11 Q: 35

Which flow diagram correctly describes the effect of tar entering the lungs?

A	carcinogens come into contact with DNA	→	mutation occurs	→	uncontrolled cell division
B	goblet cells secrete more mucus	→	mucus accumulates causing infection	→	phagocytes attracted by inflammation
C	mucus accumulates causing infection	→	phagocytes attracted by inflammation	→	elastase destroys the alveolar walls
D	mutation occurs	→	phagocytes attracted by inflammation	→	causes irritation and coughing

---

1380. 9700_w18_qp_12 Q: 34

Cigarette smoke contains tar.

Which statements describe the effect of tar on the respiratory system?

1 Tar causes goblet cells to increase the secretion of mucus.

2 Tar increases the risk of blood clots forming inside blood vessels.

3 Tar may cause changes to the DNA in epithelial cells.

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

---

1381. 9700_w18_qp_12 Q: 35

Symptoms of chronic obstructive pulmonary disease (COPD) include a cough, breathlessness and chest infections.

Some of the changes in the lungs that result from smoking are listed.

1 Alveoli lose elastin and collapse.

2 Bacteria accumulate in the mucus.

3 Cilia are inactivated.

4 Goblet cells secrete more mucus.

Which changes cause the cough in COPD?

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

---

1382. 9700_w18_qp_13 Q: 34

Chronic obstructive pulmonary disease (COPD) includes bronchitis and emphysema.

Which row shows the effects of bronchitis?

	T-helper cells	bronchioles	infection
A	destroyed	inflamed	absent
B	destroyed	narrowed	present
C	increased	scarred	present
D	increased	stiffened	absent

1383. 9700_m17_qp_12 Q: 37

Which of these statements could describe the effect of carbon monoxide in cigarette smoke?

1 It binds irreversibly to haemoglobin.

2 It causes mucus to accumulate in the bronchioles.

3 It results in more carbon dioxide being transported in the blood.

4 It temporarily increases the heart rate.

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

1384. 9700_s17_qp_12 Q: 32

An athlete who smokes just before a race may not be able to run at their maximum speed because less oxygen is carried by the blood.

Which explanation is correct?

A Carbon dioxide binds to haemoglobin forming carbaminohaemoglobin.

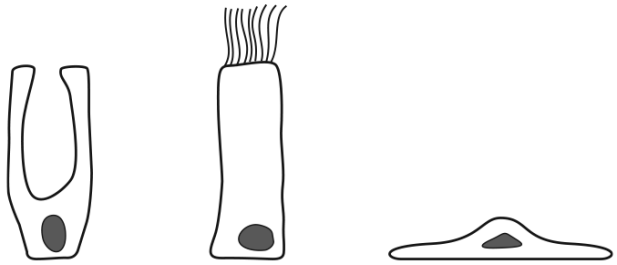
B Carbon dioxide binds to haemoglobin forming carboxyhaemoglobin.

C Carbon monoxide binds to haemoglobin forming carbaminohaemoglobin.

D Carbon monoxide binds to haemoglobin forming carboxyhaemoglobin.

1385. 9700_s17_qp_12 Q: 34

The diagram shows three types of cell found in the human gas exchange system.



Apart from causing cancer, which cell types will be directly affected when a person is exposed to tar in cigarette smoke?

A X, Y and Z **B** X and Y only **C** X and Z only **D** Y and Z only

---

1386. 9700_w17_qp_11 Q: 34

What are short-term effects of nicotine on the cardiovascular system?

1 constriction of small arteries

2 increase in heart rate

3 increase in blood pressure

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

---

1387. 9700_w17_qp_12 Q: 36

In which regions of the human gas exchange system is the function of some types of cell **directly** affected by tar in cigarette smoke?

A bronchioles and alveoli only

B trachea, bronchus, bronchioles, alveoli

C trachea and bronchus only

D trachea, bronchus and bronchioles only

1388. 9700_w17_qp_13 Q: 36

Which flow diagram correctly describes the effect of tar entering the lungs?

A	carcinogens come into contact with DNA	→	mutation occurs	→	uncontrolled cell division	→	mass of cells produced
B	goblet cells secrete more mucus	→	mucus accumulates causing infection	→	phagocytes attracted by inflammation	→	causes irritation and coughing
C	goblet cells secrete more mucus	→	mutation occurs	→	phagocytes attracted by inflammation	→	mass of cells produced
D	phagocytes attracted by inflammation	→	mutation occurs	→	uncontrolled cell division	→	elastase destroys the alveolar walls

---

1389. 9700_m16_qp_12 Q: 33

Some of the effects of smoking are listed.

1 It causes coughing.

2 It increases blood pressure.

3 It decreases the transport of oxygen.

4 It increases the risk of cancer.

5 It prevents cilia from moving.

Which components of tobacco smoke cause these effects?

	tar	carbon monoxide	nicotine
A	1, 3 and 4	2	4 and 5
B	1, 4 and 5	3	2
C	1 and 5	3 and 5	4
D	3 and 4	1, 2 and 5	2 and 4

1390. 9700_s16_qp_11 Q: 36

Which short-term effects of smoking are caused by carbon monoxide?

1 formation of carboxyhaemoglobin

2 increased risk of blood clotting

3 narrowing the lumen of arteries

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

1391. 9700_s16_qp_12 Q: 33

Which components of the human gas exchange system help to reduce the effects of carcinogens in tar?

A cilia and goblet cells only

B cilia and mucous glands only

C mucous glands and goblet cells only

D mucous glands, goblet cells and cilia

1392. 9700_s16_qp_13 Q: 35

Which symptoms may be seen in a person affected by chronic obstructive pulmonary disease (COPD)?

1 persistent cough

2 less elastic alveoli

3 increased risk of lung infection

4 shortness of breath

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2, 3 and 4 only

D 1 and 4 only

1393. 9700_w16_qp_13 Q: 33

The table lists some of the effects of smoking.

Which row shows the effect of nicotine and carbon monoxide?

	nicotine	carbon monoxide
A	decreases heart rate	decreases blood pressure
B	increases blood flow to the feet	increases blood pressure
C	increases blood pressure	combines with haemoglobin
D	increases blood pressure	increases heart rate

1394. 9700_w16_qp_13 Q: 34

Which statement about chronic obstructive pulmonary disease (COPD) is correct?

A The disease can often be reversed by treatment.

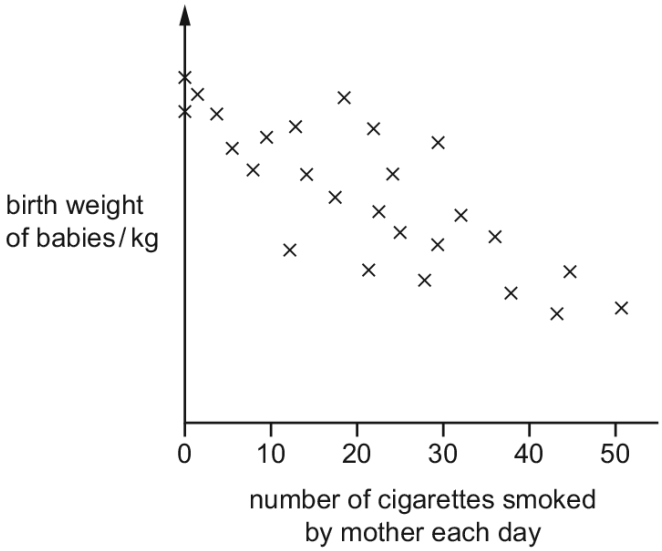
B The disease occurs in people of all ages.

C The patient coughs a lot, bringing up mucus.

D The patient's symptoms change over time.

1395. 9700_s15_qp_11 Q: 32

The graph shows the results of a study to determine whether there is a link between the number of cigarettes smoked by a mother and the birth weight of her baby.



Which conclusions can be drawn from this graph?

1 As the number of cigarettes smoked increases, the weight of the baby always decreases.

2 Factors, other than smoking, affect the birth weight of a baby.

3 Nicotine, tar and carbon monoxide slow the growth of an unborn baby.

4 The majority of all smokers smoke between 10 and 35 cigarettes per day.

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

1396. 9700_s15_qp_11 Q: 33

What is a feature of coronary bypass surgery?

A A section of a healthy vein or artery is attached to the aorta at one end and a coronary artery at the other end to bypass diseased sections of coronary artery.

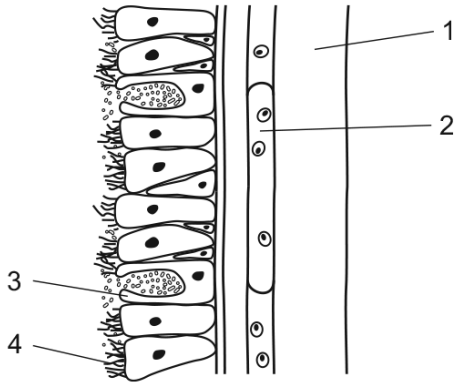
B A section of healthy vein or artery is used to bypass the diseased section of aorta in the region where the branches to the coronary arteries occur.

C Blockages in coronary arteries with atherosclerosis are cleared surgically by temporarily using an artificial heart to re-route blood and bypass the heart.

D The section of diseased coronary artery is removed and then replaced by using a section of a healthy vein or artery of a similar diameter.

1397. 9700_s15_qp_12 Q: 32

The diagram represents a section through the wall of a bronchus (not to scale).



In a person with chronic obstructive pulmonary disease (COPD), what happens in each of the numbered structures?

	1	2	3	4
A	contracts	contracts	inhibited	not affected
B	contracts	not affected	overactive	inhibited
C	relaxes	contracts	inhibited	paralysed
D	relaxes	not affected	overactive	overactive

1398. 9700_s15_qp_12 Q: 33

The symptoms of two diseases are listed.

disease 1	disease 2
persistent cough	shortness of breath
pain when breathing	wheezing
loss of weight	fatigue

Which row identifies diseases 1 and 2?

	disease 1	disease 2
A	chronic bronchitis	emphysema
B	emphysema	lung cancer
C	lung cancer	chronic bronchitis
D	lung cancer	emphysema

1399. 9700_s15_qp_13 Q: 31

Which row identifies the effects on the body of nicotine in tobacco smoke?

	reduces the diameter of small arteries (arterioles)	increases the secretion of adrenaline	combines with haemoglobin
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = true
✗ = false

1400. 9700_s15_qp_13 Q: 32

Lung cancer and chronic obstructive pulmonary disease (COPD) share a number of common symptoms.

Which symptom is typical of lung cancer and not COPD?

A coughing up blood

B mucus production increases

C persistent cough that does not go away

D wheezing (difficulty breathing)

1401. 9700_w15_qp_11 Q: 34

Some symptoms of chronic obstructive pulmonary disease (COPD) are listed.

1 bursting of alveoli

2 increase in secretion of mucus

3 loss of elastic fibres

4 narrowing of airways

5 reduction in surface area for gaseous exchange

Which of these are also the symptoms of emphysema?

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

1402. 9700_w15_qp_12 Q: 32

Which of the effects are caused by breathing in **both** carbon monoxide **and** nicotine from cigarette smoke?

1 increased heart rate

2 increased risk of cardiovascular disease

3 increased risk of emphysema

4 increased risk of lung cancer

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

---

1403. 9700_w15_qp_12 Q: 33

Which statements about chronic obstructive pulmonary disease (COPD) are correct?

1 The disease can often be reversed by treatment.

2 The patient's symptoms normally do not change.

3 The patient is normally over 30 years old.

4 The patient coughs a lot, bringing up mucus.

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

Chapter 9

Gas exchange and smoking

STEMUP.CO.UK

9.1 The gas exchange system

159. 9700_m20_qp_22 Q: 4

(a) When a section of lung tissue is viewed using a light microscope, it is possible to identify the trachea, the bronchus, the bronchioles and the alveoli.

Other than differences in their diameters, describe **one** structural difference visible between:

- the trachea and a bronchus

  .....

  .....

- a bronchus and a bronchiole

  .....

  .....

- a bronchiole and an alveolus.

  .....

  .....

[3]

(b) The mitotic cell cycle of the stem cells present in the gas exchange system is carefully controlled. During interphase of the mitotic cell cycle, cells grow by increasing in size.

Complete Table 4.1 by:

- listing, in order, the three phases that occur during interphase
- stating **one** process, other than growth and respiration, that occurs in each of these three phases to help prepare the cell for mitosis.

Table 4.1

phase	process occurring during phase

[4]

[Total: 7]

160. 9700_s20_qp_21 Q: 4

Fig. 4.1 shows the site of gas exchange in the mammalian lung.

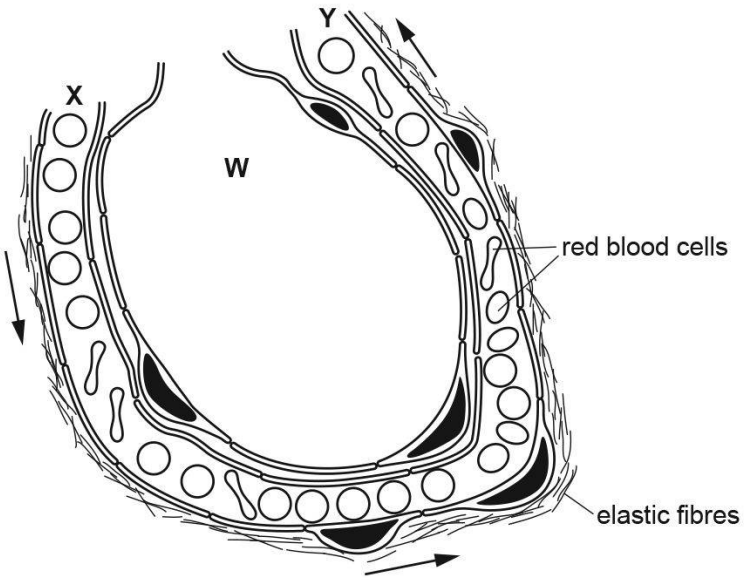


Fig. 4.1

(a) State **two** ways in which carbon dioxide is transported in the blood.

1 .....

2 .....

[2]

(b) Table 4.1 shows the partial pressures of oxygen (pO_2) and carbon dioxide (pCO_2) at locations **W**, **X** and **Y** in Fig. 4.1.

Table 4.1

partial pressure	locations within tissue		
	W	**X**	**Y**
pO_2 / kPa	13.87	5.33	13.87
pCO_2 / kPa	5.33	6.00	5.55

With reference to Fig. 4.1 and Table 4.1, describe the exchanges that occur as blood flows from **X** to **Y**.

.....

.....

.....

.....

.....

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.....

.....

..... [4]

(c) Elastic fibres are present in tissues at the site of gas exchange in the lungs.

Describe the roles of elastic fibres in the gas exchange system **and** in the cardiovascular system.

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..... [4]

(d) Scientists in Peru investigated the effect of moving from sea level to high altitude on the composition of blood. The scientists studied 10 students. Each student had lived at sea level since birth and then moved to live in the Andes at a height of 4500 metres above sea level.

The scientists took samples of blood from each student before they moved to live at high altitude. The scientists took further blood samples at intervals after the students had moved to high altitude.

The relative proportions of red blood cells and plasma in each sample were determined.

The total volume of blood for each student was also determined at each sampling time. As the students were all of different body mass, the total volumes were converted to a volume per kg of body mass ($cm^3 kg^{-1}$).

Fig. 4.2 shows for each sampling time:

- the mean volume of blood per kg of body mass
- the proportions of red blood cells and plasma.

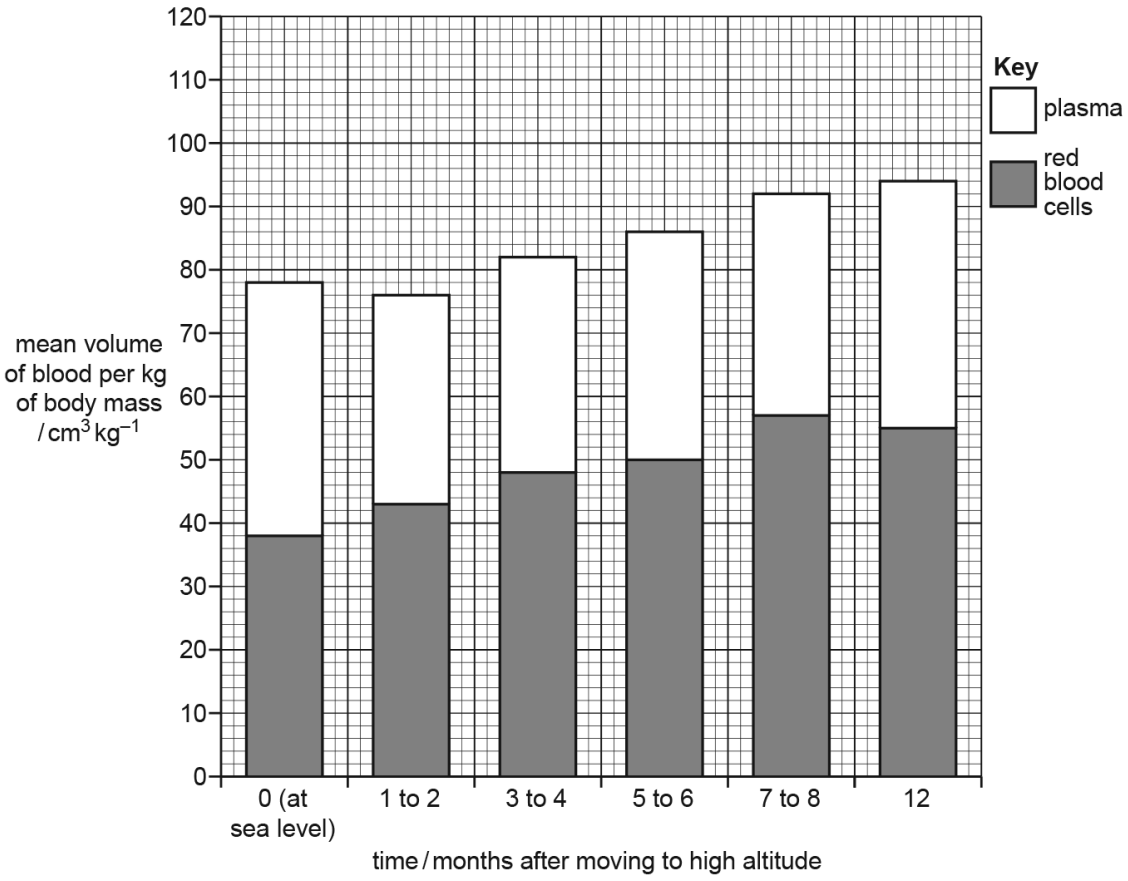


Fig. 4.2

(i) The percentage of mean blood volume that is represented by red blood cells for the samples taken at sea level is 48%.

Calculate the percentage of mean blood volume that is represented by red blood cells at 5 to 6 months after living at high altitude.

Show your working and give your answer to the nearest whole number.

answer = ...% [2]

(ii) Describe **and** explain the results in Fig. 4.2.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 16]

161. 9700_s20_qp_22 Q: 4

Collagen is a major component of the cartilage found in some of the structures of the human gas exchange system. Cells that synthesise and secrete the components of cartilage are known as chondrocytes.

(a) Fig. 4.1 is a transmission electron micrograph of a chondrocyte.

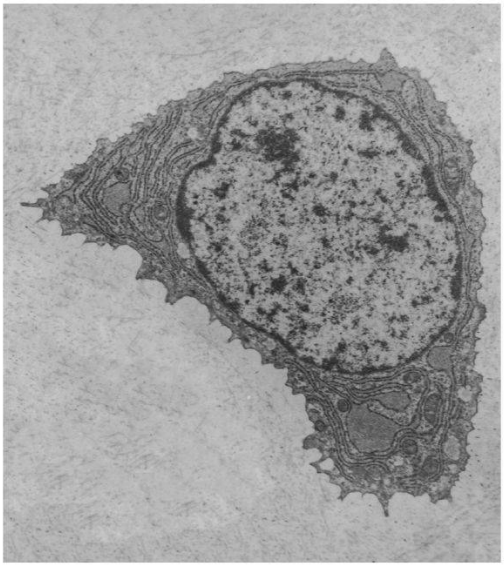


Fig. 4.1

With reference to Fig. 4.1, explain **two** features of the chondrocyte that show how the cell is adapted to its function.

.....

.....

.....

.....

..... [2]

(b) **(i)** Describe the distribution of cartilage in the human gas exchange system.

.....

.....

.....

.....

..... [2]

(ii) Outline the function of cartilage in the human gas exchange system.

.....

.....

.....

.....

..... [2]

(c) Fig. 4.2 shows part of the primary structure of a collagen polypeptide.

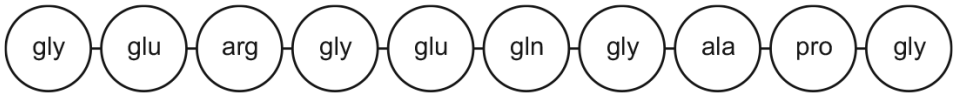


Fig. 4.2

(i) Name the type of covalent bond formed between the amino acids shown in Fig. 4.2.

..... [1]

(ii) Fig. 4.3 shows the molecular structure of the amino acid glycine (gly).

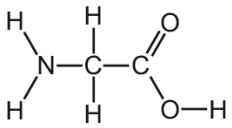


Fig. 4.3

With reference to Fig. 4.2 and Fig. 4.3 and the function of collagen, explain how the structure of a collagen polypeptide makes it suitable to form a collagen molecule.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

162. 9700_s20_qp_23 Q: 3

(a) Fig. 3.1 is a photomicrograph of a section through two different types of blood vessels, **X** and **Y**.

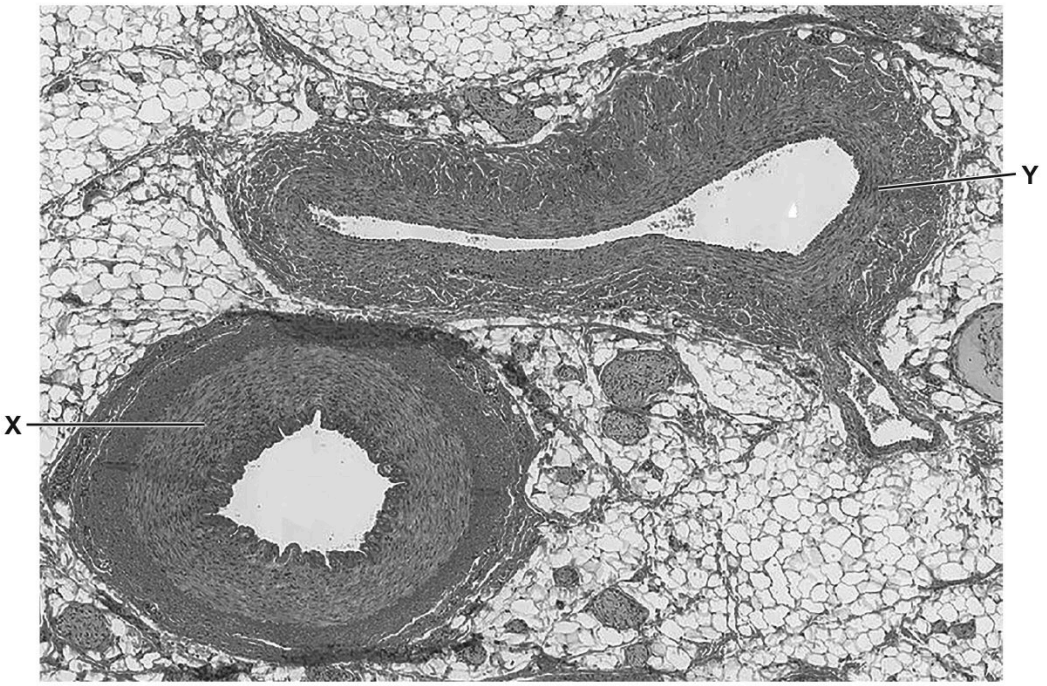


Fig. 3.1

(i) Name the two types of blood vessel shown by **X** and **Y** in Fig. 3.1.

X .....

Y ..... [1]

(ii) State the reasons for your identification of the type of blood vessel shown by **Y** in Fig. 3.1.

.....

.....

.....

.....

..... [2]

(b) Tissue fluid and lymph are formed when blood arrives in the capillary networks of body tissues.

(i) Explain why tissue fluid is more similar to blood plasma than it is to blood.

.....

.....

.....

.....

.....

..... [2]

(ii) Explain why the tissue fluid formed after blood arrives in the capillary network has a **higher** concentration of amino acids than the newly formed lymph draining away from the network.

.....

.....

..... [1]

(c) The trachea, bronchi and bronchioles in the gas exchange system require a supply of glucose and oxygen from the blood for the functioning of smooth muscle.

Outline the function of smooth muscle in the gas exchange system.

.....

.....

.....

.....

..... [2]

[Total: 8]

163. 9700_w20_qp_21 Q: 5

(a) Fig. 5.1 is a photomicrograph of a section through the lungs showing a bronchus and some alveoli.

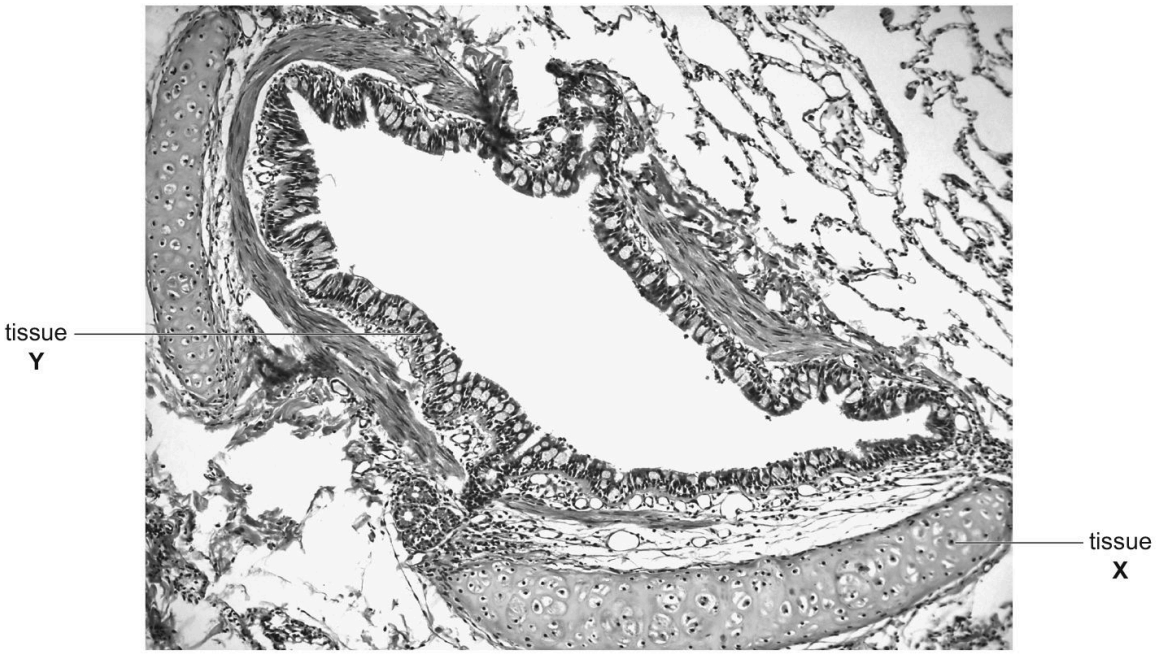


Fig. 5.1

(i) State the function of tissue **X** labelled in Fig. 5.1.

.....

..... [1]

(ii) Describe how the distribution of tissue **X** in the trachea differs from that shown in Fig. 5.1.

.....

..... [1]

(iii) Describe how the epithelial tissue, **Y**, is adapted for its function.

.....

.....

.....

..... [2]

(b) Fig. 5.2 is a photograph of two African elephants, *Loxodonta africana*.



Fig. 5.2

(i) Describe the difference in surface area to volume ratio between the adult elephant and baby elephant shown in Fig. 5.2.

.....

..... [1]

(ii) Suggest why animals such as elephants require a gas exchange system.

.....

.....

.....

.....

.....

..... [3]

(iii) The feet of elephants are protected by structures under the skin known as cushions. The cushions are made up of a large number of cells surrounded by connective tissue containing many fibres of collagen. The fibres help to maintain the structure of the cushion.

The collagen fibres are made of collagen molecules.

Describe the structure of a **collagen molecule**.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(iv) The cushion in the foot is very strong and is able to resist extremely large forces acting on it due to the large mass of the elephant.

Suggest how the structure of a **collagen fibre** can help the cushion resist these large forces.

.....

.....

..... [1]

[Total: 13]

164. 9700_w20_qp_22 Q: 3

Fig. 3.1 is a photomicrograph of a section through lung tissue.

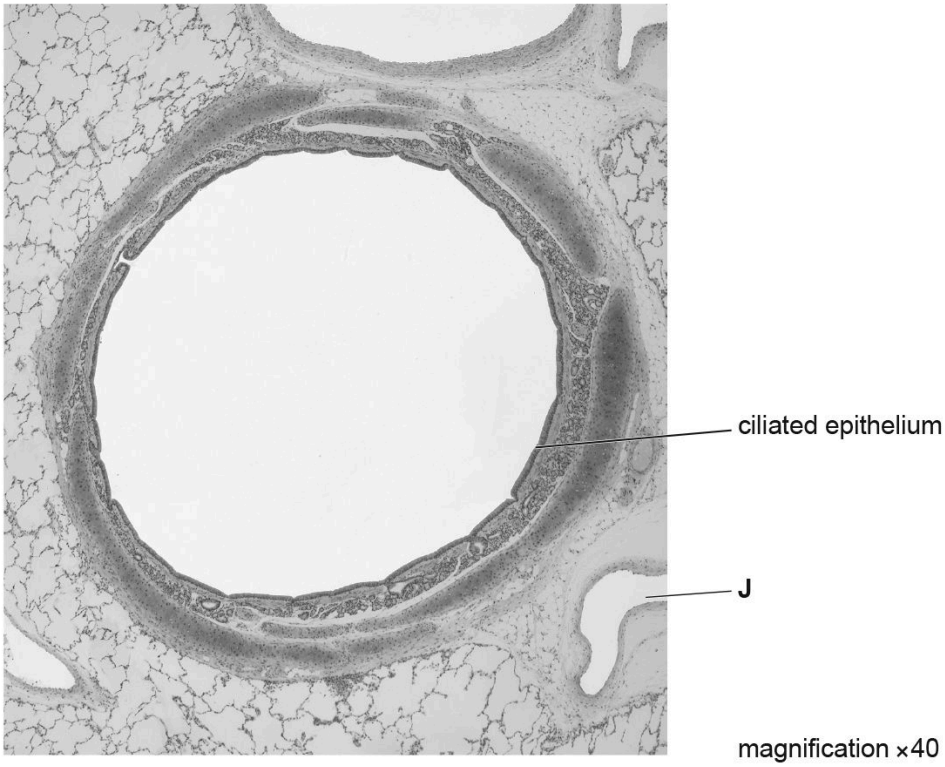


Fig. 3.1

(a) State the feature visible in Fig. 3.1 that identifies the structure in the centre of the image as the bronchus **and** list other visible features that help to confirm this identification.

feature to identify the bronchus .....

.....

.....

other features .....

.....

.....

.....

.....

.....

.....

[3]

(b) Identify the structure labelled **J** in Fig. 3.1.

State the evidence visible in Fig. 3.1 that supports your answer.

.....

.....

.....

.....

.....

.....

[2]

(c) The ciliated epithelium labelled in Fig. 3.1 consists of goblet cells and ciliated epithelial cells.

Outline how goblet cells and cilia work together to maintain healthy lung tissue.

.....

.....

.....

.....

.....

..... [2]

[Total: 7]

165. 9700_m19_qp_22 Q: 2

In mammalian red blood cells, carbonic anhydrase has an important role in the transport of carbon dioxide.

Carbonic anhydrase is an enzyme.

(a) Outline the features of an enzyme.

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..... [4]

(b) Complete Fig. 2.1 to show the reversible reaction involving carbonic anhydrase that takes place within red blood cells.

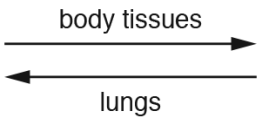


Fig. 2.1

[2]

(c) A ribbon structure of a molecule of carbonic anhydrase is shown in Fig. 2.2. The zinc ion is associated with the active site of the enzyme and is essential for the enzyme to function.

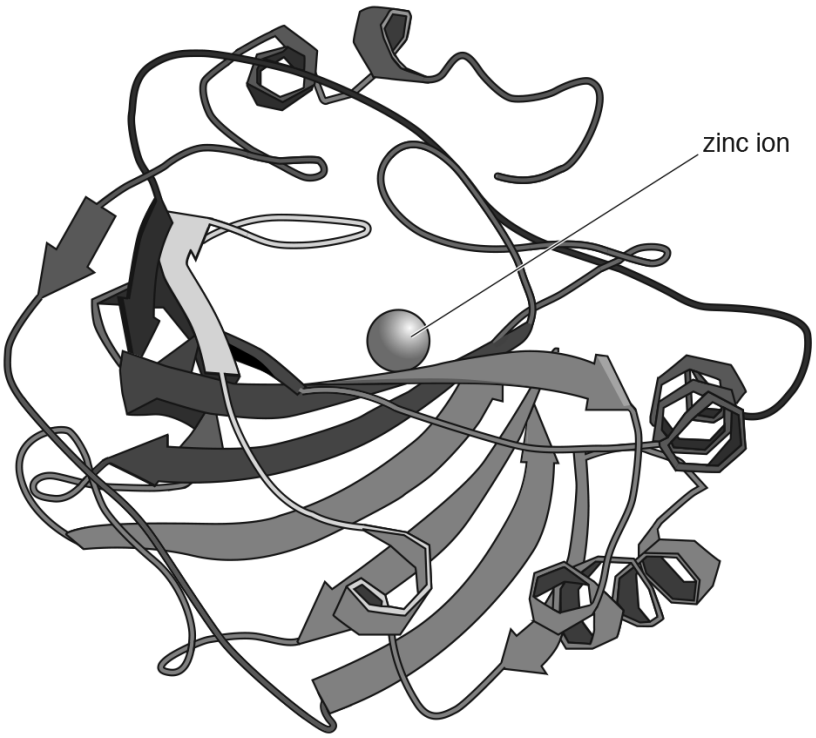


Fig. 2.2

The molecule of carbonic anhydrase has primary, secondary and tertiary structure.

Explain the extent to which Fig. 2.2 shows the primary, secondary and tertiary structure of carbonic anhydrase.

.....

.....

.....

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.....

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.....

.....

..... [4]

[Total: 10]

166. 9700_s19_qp_22 Q: 2

Some tissues of the gas exchange system include cells that are able to produce and secrete mucins. Mucins are stored in vesicles in these cells, ready for secretion. Once outside the cell, mucins adsorb water to form mucus.

(a) Name the structures in the gas exchange system that produce and secrete mucins.

.....

..... [2]

(b) Mucins are described as glycosylated proteins. The process of glycosylation involves the addition of sugar components after polypeptides are synthesised.

Suggest **one** location in the cell where glycosylation of mucin could occur.

..... [1]

(c) The processes that occur in the production and secretion of mucins are listed.

translation **exocytosis** **glycosylation** **transcription**

Complete Table 2.1 by writing the processes in the correct order in which they would take place.

Table 2.1

first process	
second process	
third process	
fourth process	

[2]

(d) Chloride ions move out of the mucin-producing cells at the same time as mucin is secreted.

Suggest **and** explain how the exit of chloride ions helps the formation of mucus from mucin.

.....

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.....

.....

.....

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.....

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..... [3]

(e) The gas exchange system includes some cells that are able to divide by mitosis.

Explain why it is important to have these cells in the gas exchange system.

.....

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.....

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.....

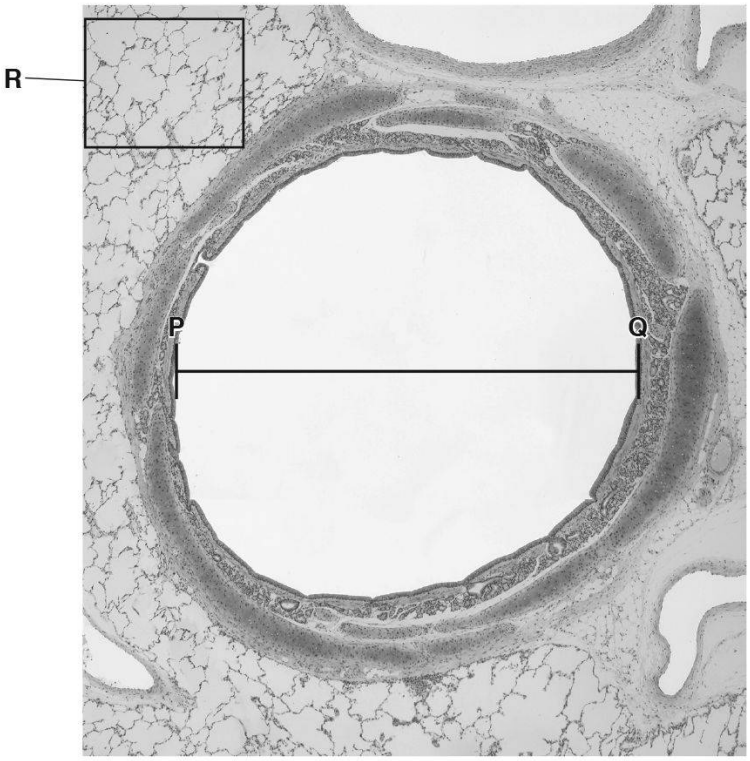
.....

..... [3]

[Total: 11]

167. 9700_s19_qp_23 Q: 2

Fig. 2.1 is a photomicrograph showing a transverse section through a bronchus and the surrounding lung tissue.



magnification x40

Fig. 2.1

(a) Calculate the actual diameter of the lumen of the bronchus using the line **P**–**Q**.

Write down the formula used to make your calculation.

Show your working and give your answer to the nearest micrometre (μm).

formula

actual diameter = ... μm [2]

(b) **(i)** In Fig. 2.1, the area labelled **R** shows a section through some alveoli.

Name the tissue that lines the air spaces of the alveoli.

..... [1]

(ii) Suggest how the alveoli are adapted for gas exchange.

.....

.....

.....

.....

..... [2]

(c) In the leaves of plants, both gas exchange and transpiration occur through open stomata.

Suggest how the arrangement of cells in the leaf of a dicotyledonous plant contributes to the loss of water by transpiration.

.....

.....

.....

.....

.....

..... [3]

(d) Fig. 2.2 shows the mean transpiration rate of a xerophyte between 08:00 and 19:00.

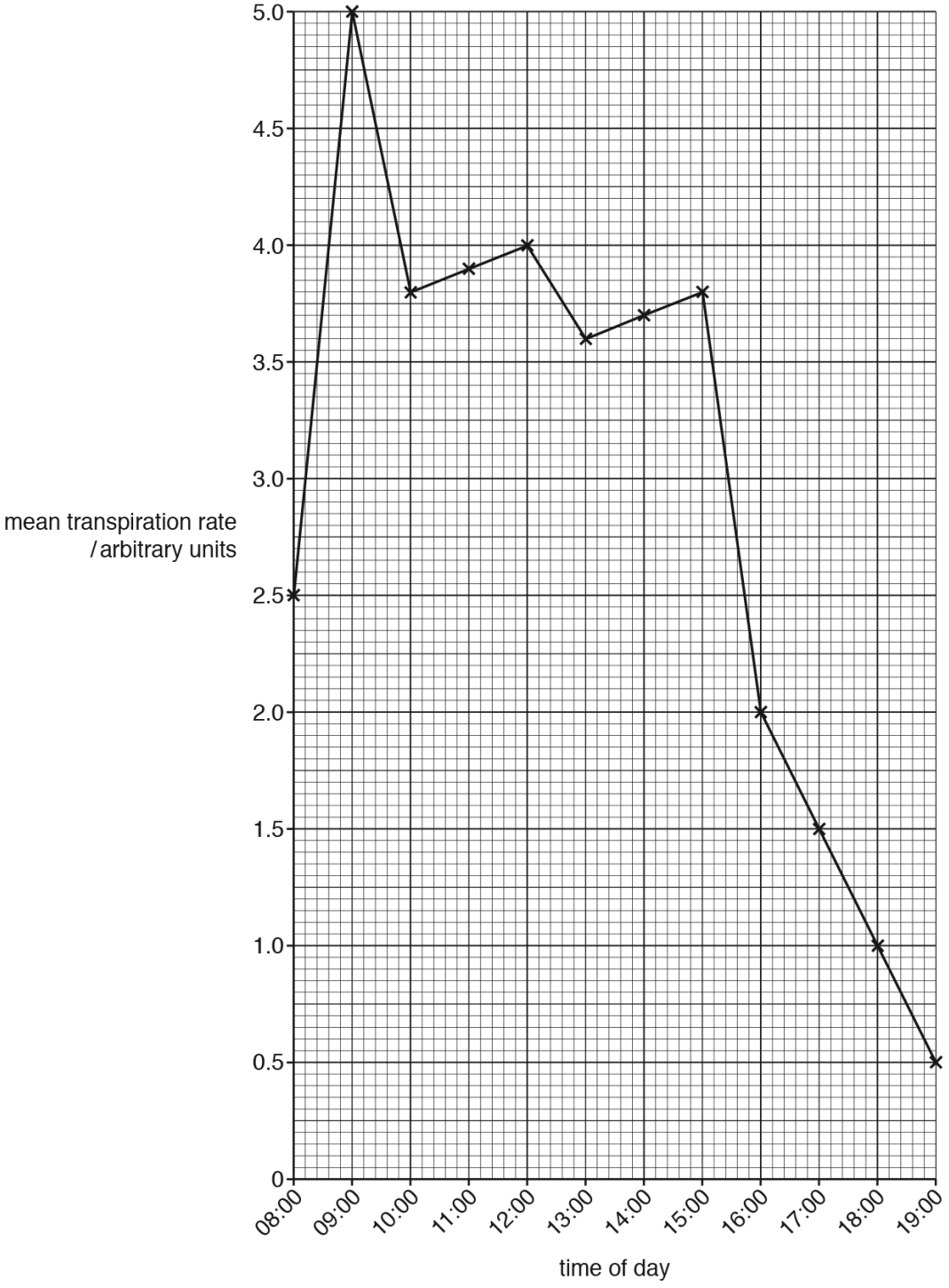


Fig. 2.2

(i) Describe the data shown in Fig. 2.2.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Suggest why the transpiration rate changed between 09:00 and 10:00.

.....

.....

.....

.....

.....

..... [2]

[Total: 13]

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168. 9700_w18_qp_22 Q: 1

Fig. 1.1**A** is a photomicrograph of healthy lung tissue.

Fig. 1.1**B** is a photomicrograph of lung tissue from a person with emphysema, a chronic obstructive pulmonary disease (COPD). The images are both at magnification ×40.

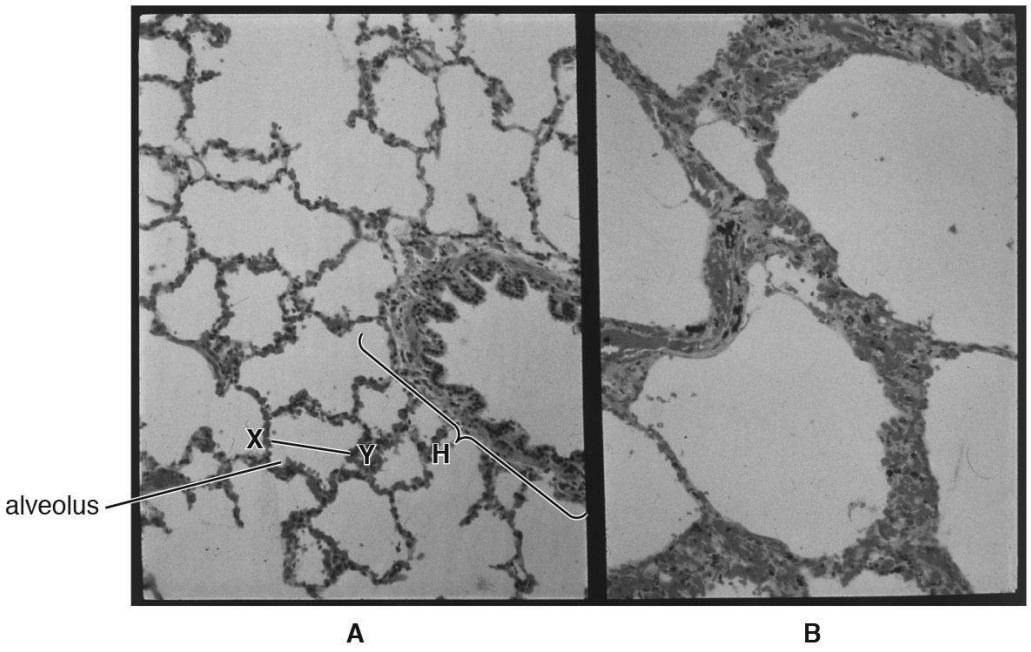


Fig. 1.1

(a) Name the structure labelled **H** in Fig. 1.1**A**.

..... [1]

(b) Calculate the actual diameter of the alveolus at **X**–**Y**.

Write down the formula and use it to make your calculation.

Give your answer to the nearest whole micrometre (μm).

formula

actual size ..... μm [2]

(c) Gas exchange in the lungs occurs in the alveoli.

Describe the process of gas exchange in healthy lungs **and** suggest how this compares with gas exchange in the diseased lung shown in Fig. 1.1**B**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

169. 9700_s16_qp_21 Q: 3

A student studied a transverse section of the trachea of a small mammal. The student drew a plan diagram of the section as shown in Fig. 3.1.

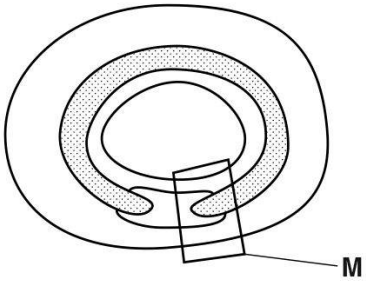


Fig. 3.1

Fig. 3.2 is a photomicrograph of the area labelled **M** in Fig. 3.1.



Fig. 3.2

(a) Name:

(i) the type of epithelium at **N**

.....[1]

(ii) the structures at **O**

.....[1]

(iii) the tissue at **P**.

.....[1]

(b) Smooth muscle in the trachea and in the bronchi relaxes during strenuous exercise.

Suggest the advantages of relaxing this smooth muscle during periods of strenuous exercise.

.....

.....

.....

.....

.....

.....[2]

(c) The walls of the trachea and bronchi contain elastic fibres.

Elastic fibres are made of bundles of the fibrous protein elastin.

- Each molecule of elastin is a single polypeptide.
- The primary structure contains a large proportion of the amino acid glycine.
- Glycine has a hydrophobic R group.
- Glycine does not occur at regular intervals in the polypeptide.
- The polypeptide forms random coils that change shape as the elastic fibres are stretched and recoil.
- Elastin molecules are joined to each other by many covalent bonds to form a cross-linked network.

Describe two ways in which the structure of a collagen molecule **differs** from the structure of an elastin molecule described above.

1 .....

.....

2 .....

.....[2]

[Total: 7]

170. 9700_s16_qp_22 Q: 4

Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

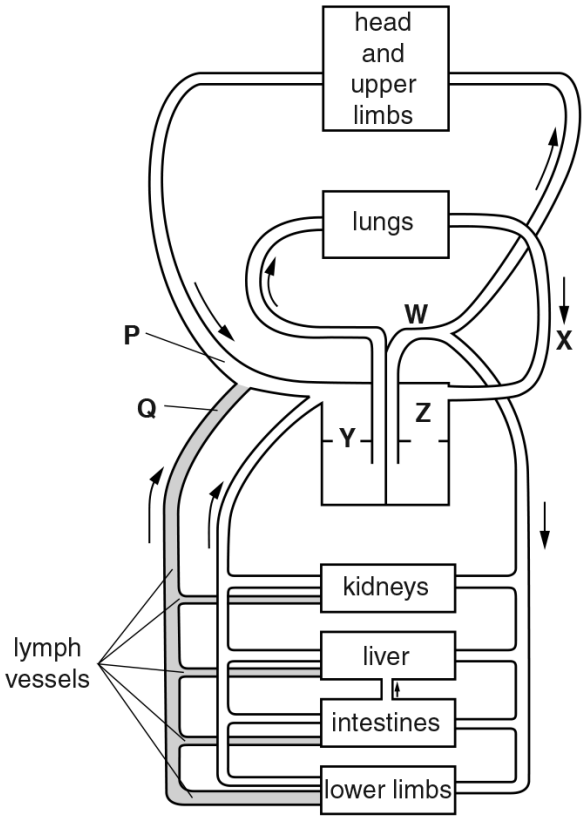


Fig. 4.1

(a) The type of circulatory system shown in Fig. 4.1 is a closed double circulation.

Explain what is meant by a *closed double circulation*.

.....

.....

.....

.....

.....[2]

(b) With reference to Fig. 4.1, name:

blood vessel **W** .....

blood vessel **X** .....

valve **Y** .....

heart chamber **Z** ..... [4]

(c) State the component present in the blood at location **P** that is **not** present in the lymph at location **Q** in Fig. 4.1.

.....[1]

(d) As blood passes through the capillary network in the lungs, gas exchange occurs.

Describe the process of gas exchange between the alveolus and the blood.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(e) As blood passes through the small intestine, small soluble products of digestion such as glucose are absorbed into the capillaries to be transported to the liver.

Fig. 4.2 is a transmission electron micrograph of intestinal epithelial cells.

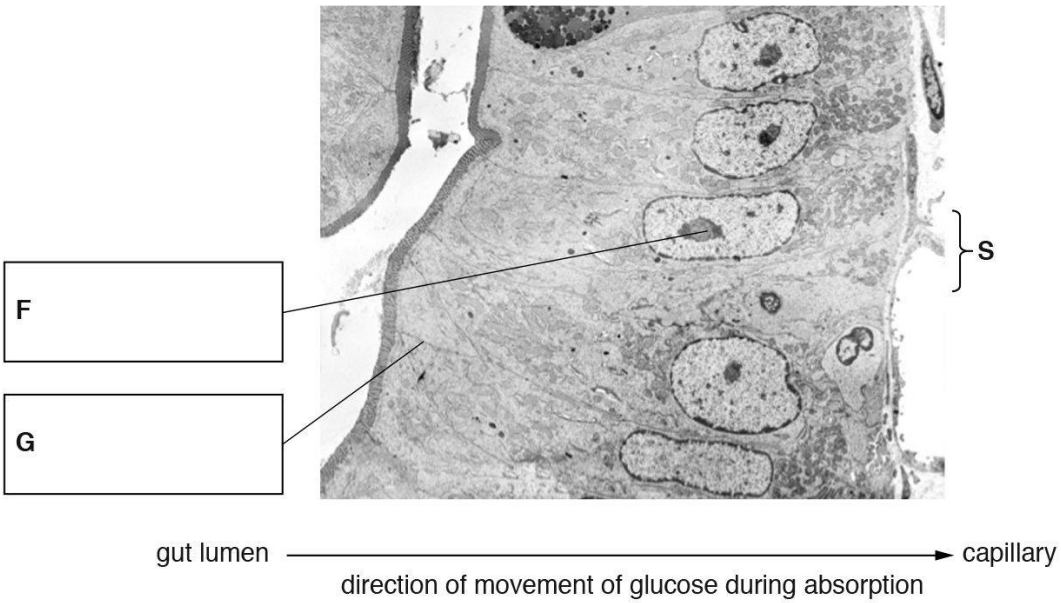


Fig 4.2

(i) Write the name of cell structures **F** and **G** in the boxes provided on Fig. 4.2. [2]

(ii) At the surface labelled **S**, movement of glucose molecules out of the intestinal epithelial cell occurs by facilitated diffusion.

Outline the features of facilitated diffusion of glucose molecules.

.....

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 16]

171. 9700_w15_qp_22 Q: 1

A student compared an image of a plant cell with an image of an animal cell. Both images were at the same magnification.

Parts **(a)** to **(c)** are four correct comparative statements about these images.

(a) Both cells contain large numbers of an organelle, bound by a double membrane. The inner membrane of these organelles is folded. These organelles all have a similar structure but do not always appear to have the same shape.

(i) State the name of the organelles described.

..... [1]

(ii) Suggest **one** reason why the organelles described do not always seem to have the same shape.

.....

.....

..... [1]

(b) Both cells contain cell structures that are approximately 25 nm in diameter and are **not** bound by a membrane.

(i) State the name of the cell structures described.

..... [1]

(ii) Draw a circle around the measurement that has the same value as 25 nm.

0.00025 μm **0.0025 μm** **0.025 μm** **0. 25 μm** **2.5 μm**

[1]

(c) There are strands of cytoplasm passing through channels in the cell wall of the plant cell. These are not visible in the animal cell.

(i) State the name of the cell structures described.

..... [1]

(ii) Explain **one** advantage to the plant cell of having these structures.

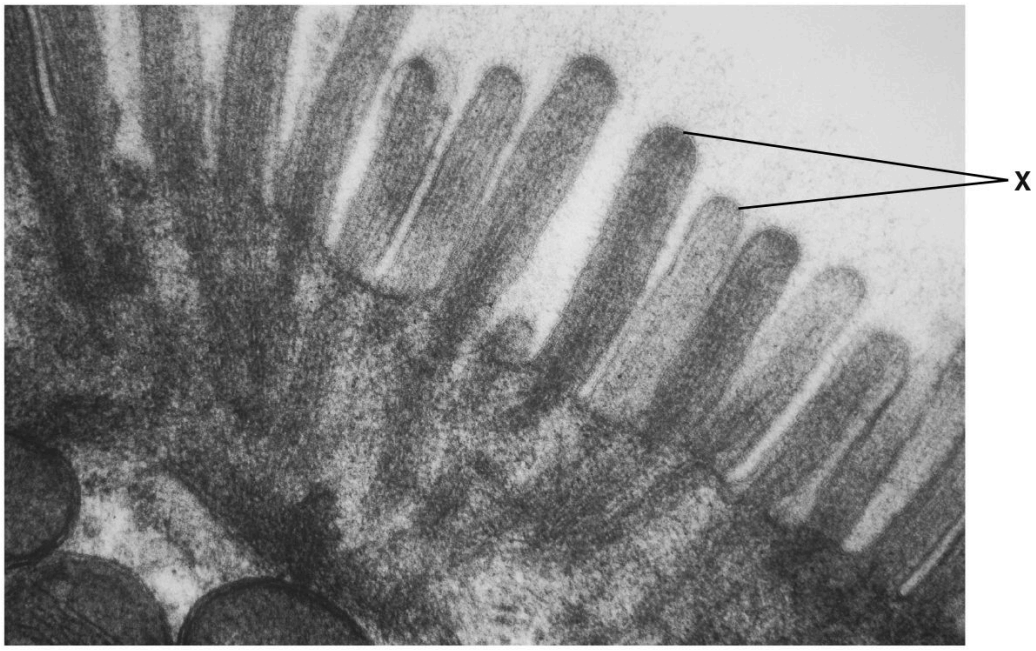
.....

.....

.....

..... [1]

(d) Fig. 1.1 is a transmission electron micrograph of part of an epithelial cell from the small intestine of a mammal.



magnification × 65000

Fig. 1.1

Name the cell structures labelled **X** in Fig. 1.1 **and** state their function.

.....

.....

.....

..... [1]

[Total: 7]

9.2 Smoking

172. 9700_w20_qp_23 Q: 1

Fig. 1.1 shows a section through the human chest. The gross structure of the human gas exchange system is shown.

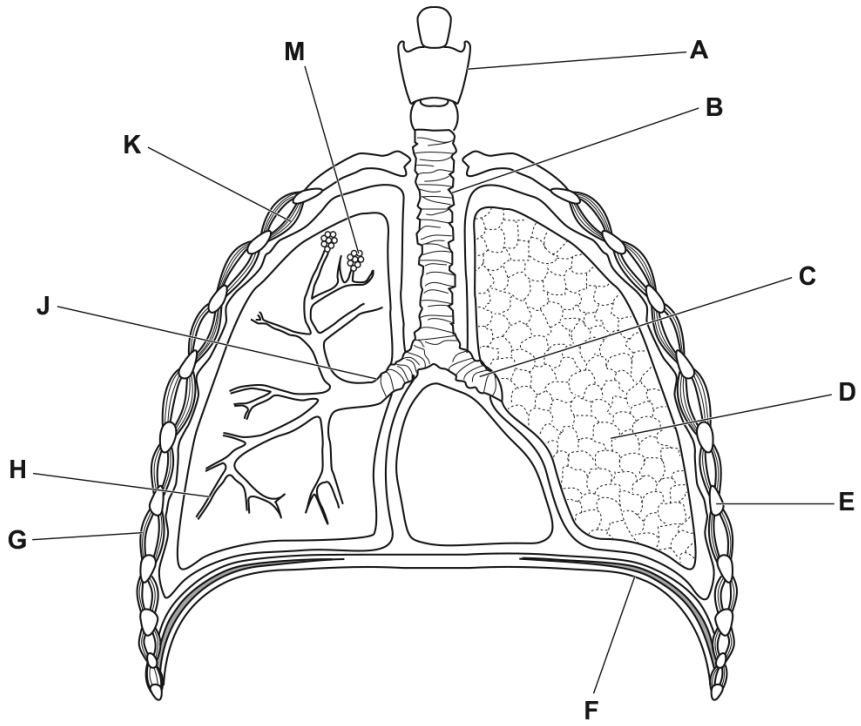


Fig. 1.1

(a) Descriptions of some parts of the gas exchange system are shown in Table 1.1.

Complete Table 1.1 to:

- state the name of the part described
- write a letter from Fig. 1.1 to identify each part.

Table 1.1

description	name of part of gas exchange system	letter from Fig. 1.1
supported by incomplete (C-shaped) rings of cartilage		
lined by ciliated epithelium and supported by blocks of cartilage		
lined by squamous epithelium		
lined by ciliated epithelium, but not supported by cartilage		

[4]

(b) Tobacco smoke contains a number of compounds which can affect the body.

State the appropriate term that matches each of the statements **A** to **E**.

A The type of chemical that causes mutation of genes that control the cell cycle.

.....

B A component that causes a short-term increase in blood pressure.

.....

C A component that reduces the carrying capacity of haemoglobin for oxygen.

.....

D A component that increases the production and secretion of mucus from goblet cells.

.....

E A component that causes a short-term increase in heart rate.

.....

[5]

[Total: 9]

173. 9700_m19_qp_22 Q: 4

In a double circulatory system, blood passes through the heart twice in one complete circuit of the body. The complete circuit consists of the pulmonary circulation and the systemic circulation.

(a) Fig. 4.1 is a diagram of a vertical section through the mammalian heart. The differences in the thickness of cardiac muscle in the walls of the four chambers of the heart are shown.

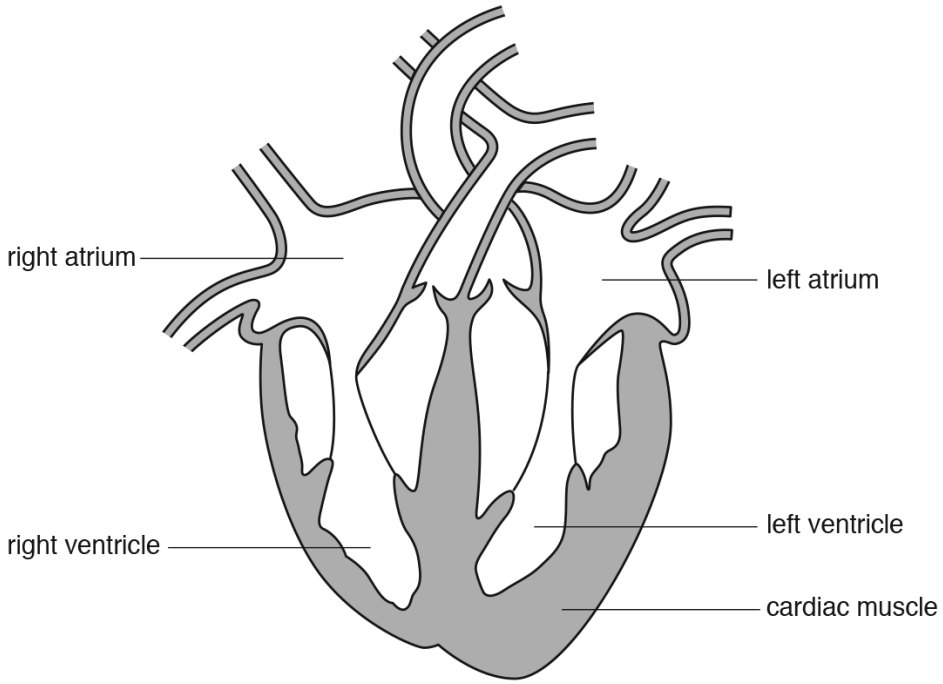


Fig. 4.1

Explain, with reference to their functions, the difference in the thickness of the walls of the left ventricle and right ventricle of the heart.

.....

.....

.....

.....

.....

.....

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.....

..... [3]

(b) The alveolus is the gas exchange surface in mammals. For efficient oxygen uptake, a steep diffusion gradient is maintained between the alveolar air and the blood.

Suggest how the steep diffusion gradient for oxygen is maintained at the gas exchange surface.

.....

.....

.....

.....

..... [2]

(c) Compared to when they were non-smokers, the ability of people who smoke tobacco to deliver oxygen to their body tissues is reduced. Two causes of this reduction include:

- a decrease in the volume of air per breath moving towards the alveoli
- a decrease in the ability of red blood cells to carry oxygen.

(i) Suggest **one** reason why smoking tobacco, even after only a short time, may cause a decrease in the volume of air per breath moving towards the alveoli.

.....

..... [1]

(ii) Explain why smoking tobacco causes a decrease in the ability of red blood cells to carry oxygen.

.....

.....

.....

.....

..... [2]

[Total: 8]

174. 9700_w19_qp_21 Q: 6

(a) Outline the role of DNA polymerase in the replication of DNA.

.....

.....

.....

.....

.....

..... [3]

(b) Floxuridine is a drug used to treat cancer.

(i) Floxuridine inhibits DNA replication.

Suggest why the inhibition of DNA replication is an effective treatment for cancer.

.....

.....

..... [1]

(ii) Floxuridine prevents thymine nucleotides being produced.

Explain why floxuridine does **not** affect transcription.

.....

.....

..... [1]

(c) Fig. 6.1 is a scanning electron micrograph of a lung cancer cell in a stage of the cell cycle.

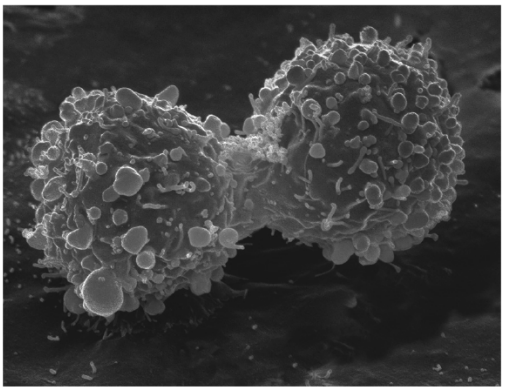


Fig. 6.1

(i) Name the stage of the cell cycle occurring in Fig. 6.1.

..... [1]

(ii) Explain why smoking tobacco increases the risk of developing lung cancer.

.....

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.....

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.....

..... [3]

[Total: 9]

175. 9700_w19_qp_22 Q: 2

People who smoke tobacco are at an increased risk of developing non-infectious diseases of the gas exchange system and the cardiovascular system.

In 2004, a study was carried out on the most popular brands of filter cigarettes from each of the six World Health Organization (WHO) regions.

In this study, the smoke passing through the filter was analysed for the tar, nicotine and carbon monoxide (CO) content for each brand of cigarette. For each WHO region, the mean content of tar, nicotine and carbon monoxide of the different brands of cigarette was calculated.

The results are shown in Fig. 2.1.

Key to WHO regions

AFRO = African Region
AMRO = Region of the Americas
EMRO = Eastern Mediterranean Region
EURO = European Region
SEARO = South-East Asia Region
WRPO = Western Pacific Region

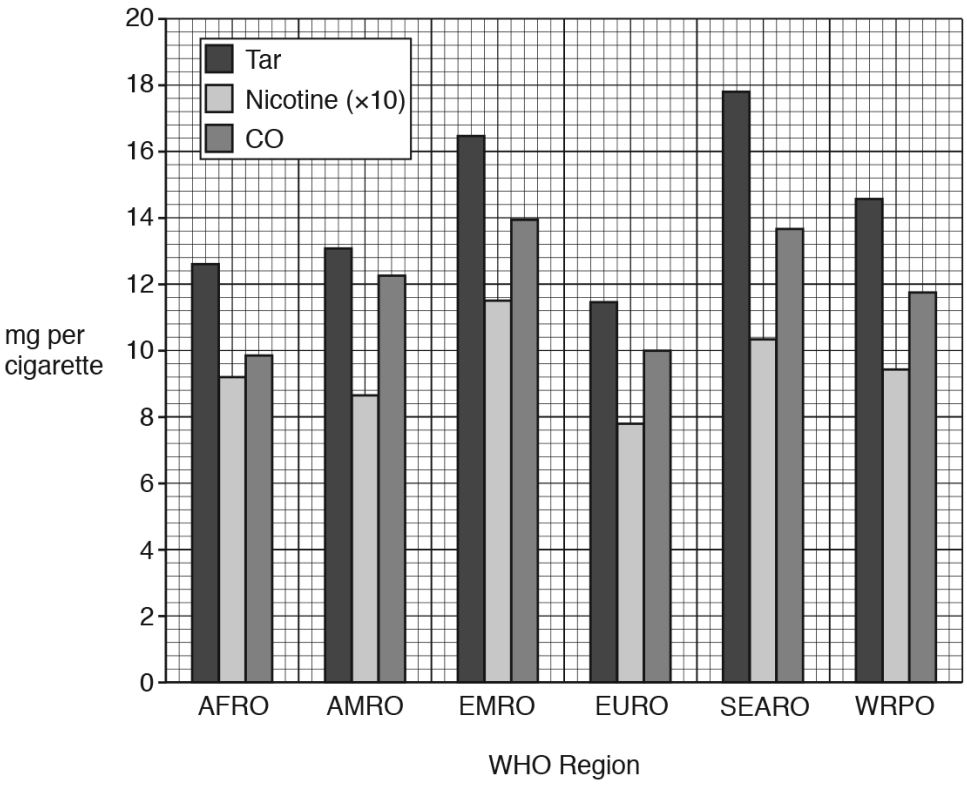


Fig. 2.1

(a) With reference to Fig. 2.1, list the **two** WHO regions where smokers are at the highest risk of developing diseases of the gas exchange or cardiovascular systems.

.....

.....

..... [1]

(b) With reference to Fig. 2.1, explain why smoking a popular brand of cigarette from the AFRO region is more likely to increase the risk of blood clots forming than smoking a popular brand of cigarette from the EURO region.

.....

.....

.....

.....

..... [2]

(c) One short-term effect of cigarette smoking is a decrease in the supply of oxygen to body tissues.

Describe **and** explain why cigarette smoking leads to a decrease in the supply of oxygen to body tissues.

.....

.....

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.....

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.....

.....

..... [4]

[Total: 7]

176. 9700_m17_qp_22 Q: 5

(a) Smooth muscle and cartilage are two of the tissues found in the walls of structures of the gas exchange system of mammals.

Complete Fig. 5.1 to show the distribution of these tissues in the gas exchange system of mammals.

Choose from the four structures listed below.

alveolus **trachea** **bronchus** **bronchiole**

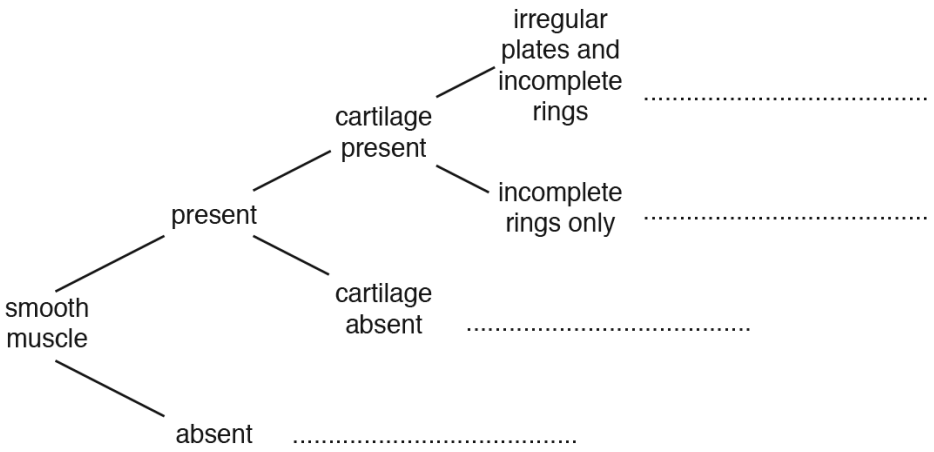


Fig. 5.1

[3]

Tobacco smoke is known to be one of the causes of lung cancer and chronic obstructive pulmonary disease (COPD).

(b) Outline how tobacco smoke may cause lung cancer.

.....

.....

.....

.....

.....

..... [2]

(c) Fig. 5.2 shows a section through the wall of one part of the gas exchange system in a person with COPD.

The tissue in the section of the wall labelled **X** is the result of changes to the original healthy tissue lining the lumen of the gas exchange system. The tissue shown is **not** scar tissue and is **not** a tumour.

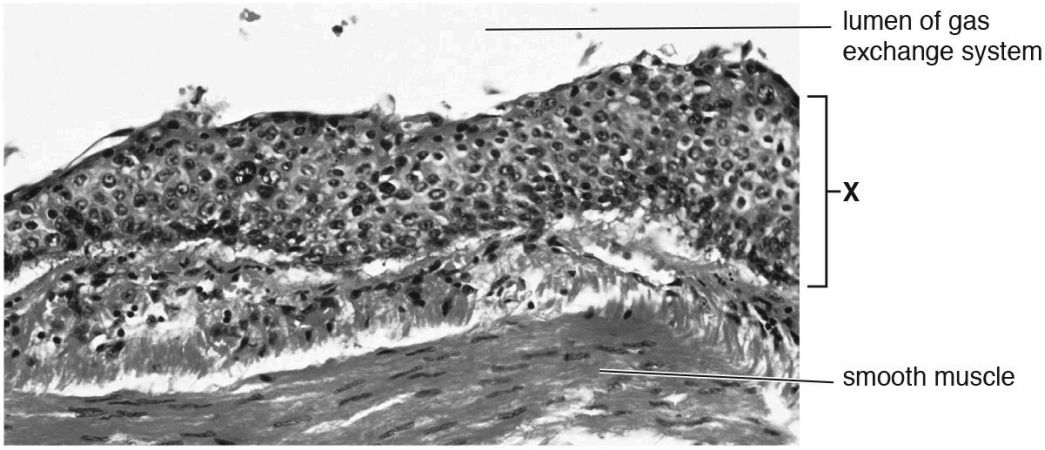


Fig. 5.2

The area labelled **X** on Fig. 5.2 is different in appearance to the original healthy tissue in the same part of the gas exchange system.

Describe these differences.

.....

.....

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.....

.....

.....

.....

.....

..... [3]

[Total: 8]

177. 9700_s17_qp_22 Q: 5

Some pathogens can enter the human body through the gas exchange system.

(a) The epithelial lining of the gas exchange system is adapted for defence against pathogens.

(i) List the structures in the gas exchange system that have a ciliated epithelial lining.

.....

.....[1]

(ii) Name the cells in the ciliated epithelium that synthesise and secrete mucus.

.....[1]

Alveolar macrophages are cells of the immune system. They have an important role in defence against respiratory infections.

(b) The infectious lung disease, pneumonia, can be caused by *Streptococcus pneumoniae*.

Most healthy people inhaling air containing these bacteria do **not** become ill because of the action of the alveolar macrophages.

Outline the mode of action of an alveolar macrophage in response to the presence of *S. pneumoniae*.

You may use diagrams with notes to help your answer.

.....

.....

.....

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.....[3]

Irritants in tobacco smoke can contribute to emphysema, one of the chronic obstructive pulmonary disorders (COPD). In emphysema, the alveoli lose their ability to recoil on expiration and can burst.

(c) Suggest how the structure of the alveolar wall changes so that an alveolus bursts.

.....

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.....

.....[2]

(d) Some alveolar cells produce a surfactant that helps to prevent the collapse of alveoli on exhalation. Too much surfactant decreases the efficiency of gas exchange in the alveoli.

A glycoprotein known as GM-CSF is released by some cells of the immune system when there is too much surfactant in the alveoli. Excess surfactant is then broken down by alveolar macrophages.

Receptors for GM-CSF are on the cell surface membranes of alveolar macrophages.

Explain how maintaining the correct quantity of surfactant in the alveoli is the result of a cell signalling mechanism.

.....

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.....

.....

.....[4]

[Total: 11]

178. 9700_s17_qp_23 Q: 1

Mammals have a closed double circulation system.

(a) Explain what is meant by a *closed double circulation*.

.....

.....

.....

.....

.....[2]

(b) Table 1.1 shows some structures in the mammalian circulatory system.

Complete Table 1.1 to show the sequence of structures through which blood flows, starting with the pulmonary vein.

Use the numbers 2 to 5 to indicate the correct sequence.

Table 1.1

structure	sequence of blood flow
left ventricle	
vena cava	
pulmonary vein	**1**
aorta	
right atrium	

[2]

(c) (i) Explain why arteries have thicker walls than veins.

.....

.....

.....

.....

.....[2]

(ii) Smoking causes carbon monoxide and nicotine to enter the blood.

Describe the short-term effects of each of these substances on the cardiovascular system.

carbon monoxide

.....

.....

.....

nicotine

.....

.....

.....[4]

[Total: 10]

---

179. 9700_M16_qp_22 Q: 6

(a) Fig. 6.1 shows the first three structures of the human gas exchange system through which air from the external atmosphere passes during inhalation.

Complete Fig. 6.1 to show the pathway that air takes during inhalation.

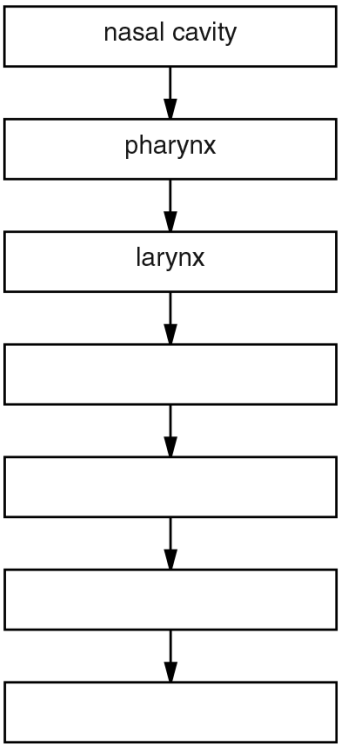


Fig. 6.1

[2]

(b) The inhalation of tobacco smoke can lead to chronic obstructive pulmonary disease (COPD). COPD is a term used to describe a collection of lung diseases.

Name two smoking-related diseases associated with COPD.

1 .....

2 .....[2]

[Total: 4]

180. 9700_s16_qp_23 Q: 1

Fig. 1.1 is a photomicrograph of epithelial cells in the bronchus.

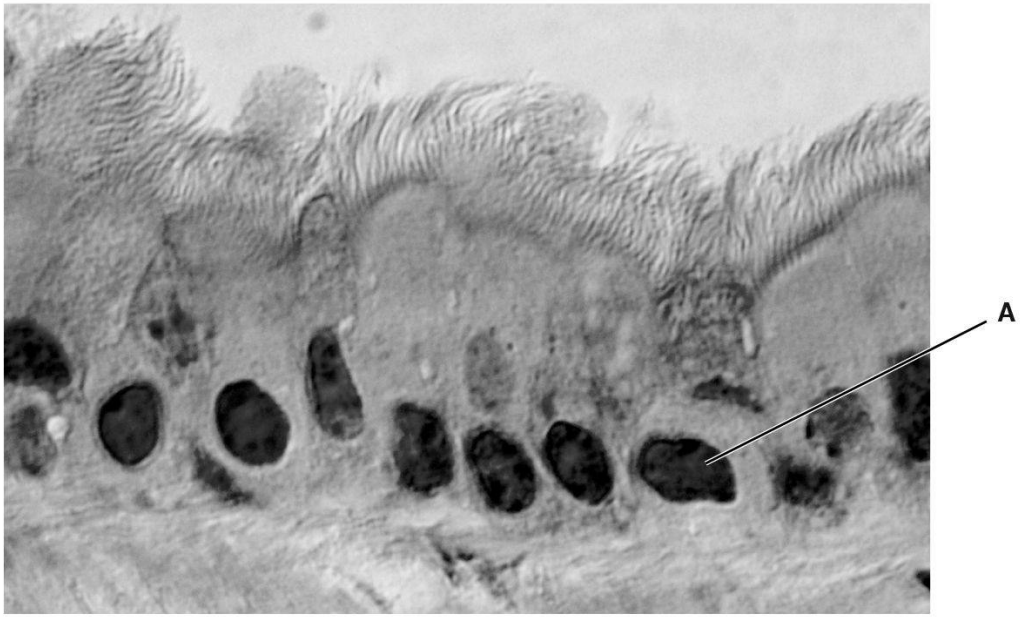


Fig. 1.1

(a) (i) Write a letter **X** on Fig. 1.1 to show the lumen of the bronchus. [1]

(ii) Name the structure in Fig. 1.1 labelled **A**.

.....[1]

(iii) State **one** feature of the cells, **visible in Fig. 1.1**, which indicates that these are **not** epithelial cells from the alveolus.

.....[1]

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(b) Epithelial cells are replaced when they are damaged.

(i) Name the type of cell division used to replace damaged epithelial cells.

.....[1]

(ii) The cells shown in Fig. 1.1 are from a non-smoker.

Smoking causes damage to the epithelial cells of the lungs.

Describe the appearance of the lining of the bronchus in a long-term smoker.

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 7]

181. 9700_w16_qp_21 Q: 6

(a) Complete Table 6.1 to show the features of the human gas exchange system.

Place a tick (✓) where a feature is present and a cross (✗) if a feature is absent.

Table 6.1

	cartilage	cilia	elastic fibres
trachea			
bronchioles			
alveoli			

[3]

(b) Smoking causes changes to the structure of the lining of the bronchi that make smokers more likely to be infected by bacteria.

Describe these changes and explain how this leads to an increased risk of bacterial infection.

.....

.....

.....

.....

.....

.....

.....[3]

(c) Haemoglobin binds oxygen in the lungs to form oxyhaemoglobin.

Describe what causes oxygen to be released from the oxyhaemoglobin as blood flows through respiring tissues.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(d) Explain why red blood cells are in blood but not in tissue fluid.

.....

.....

.....

.....[1]

[Total: 11]

---

182. 9700_w15_qp_23 Q: 5

Nicotine and carbon monoxide in tobacco smoke contribute to damage to the cardiovascular system.

(a) Explain how nicotine and carbon monoxide contribute to damage to the coronary arteries.

nicotine .....

.....

.....

.....

carbon monoxide .....

.....

.....

..... [3]

(b) One type of surgical treatment for coronary heart disease is to use arteries from the chest and veins from the leg to by-pass blockages as shown in Fig. 5.1.

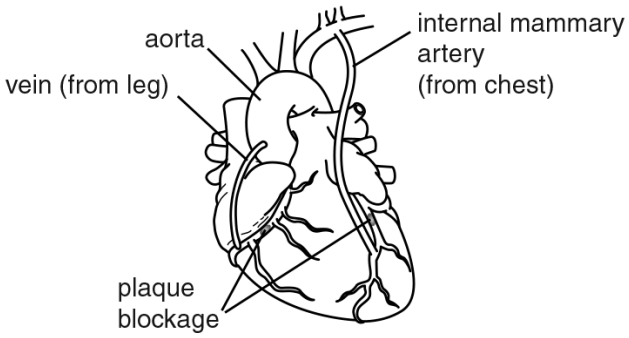


Fig. 5.1

(i) Explain how the two by-passes shown in Fig. 5.1 provide an effective treatment for coronary heart disease.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The cost of treating heart disease is very high.

Suggest the steps that governments could take to reduce heart disease in the population.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

Q.1.

6 The following statements apply to the effects of drugs on the body.

S acts as a stimulant
T increases the heart rate
U acts as a painkiller
V if taken in excess, may lead to cirrhosis
W mimics natural neurotransmitter chemicals in the nervous system
X leads to constriction of peripheral blood vessels
Y acts as a depressant
Z raises blood pressure

(a) Complete the table by putting **two** letters in each column of the table. Choose letters for the statements that most closely match each of the four drugs.

You may use each letter once, more than once or not at all.

alcohol	caffeine	nicotine	heroin
....	....	....	....

[4]

(b) Explain the term *drug tolerance*.

.....

.....

.....

.....

.....[2]

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(c) Some medicinal drugs act as non-competitive inhibitors of enzymes.

Explain how a non-competitive inhibitor acts on an enzyme to prevent it catalysing a reaction.

You may use an annotated diagram to illustrate your answer if you wish.

.....

.....

.....

.....

.....

[3]

[Total : 9]

Q.2.

(b) Nicotine is the drug in tobacco smoke.

State **two** effects of nicotine on the cardiovascular system.

.....

.....

.....

..... [2]

13

Table 6.1 shows information on smoking and lung cancer in six countries.

Table 6.1 shows:

- the percentage of male and female adults who smoke regularly in each country;
- the death rates from lung cancer expressed as deaths per 100 000 of the population of each country.

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Table 6.1

country	percentage of the population who smoke		deaths from lung cancer / deaths per 100 000	
	males	females	males	females
China	53.4	4.0	22.7	10.5
France	33.0	21.0	73.3	14.4
Malaysia	49.2	3.5	5.6	2.3
New Zealand	25.1	24.8	47.3	29.2
South Africa	43.8	11.7	13.8	5.4
Trinidad and Tobago	42.1	8.0	12.3	4.2

(c) Explain whether or not there is any evidence in Table 6.1 to support the following statements.
Use the data in the table to support your answer.

Men are more at risk of dying from lung cancer than women.

.....

.....

.....

Countries where a high percentage of the population smoke have high death rates from lung cancer.

.....

.....

..... [3]

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(d) Table 6.1 shows that a larger percentage of men in some countries, such as Malaysia, smoke compared with New Zealand. It also shows that the death rate from lung cancer for men in Malaysia is much lower.

Suggest **two other** pieces of information about men who smoke that would be useful in evaluating the risks of developing lung cancer.

1 .....

.....

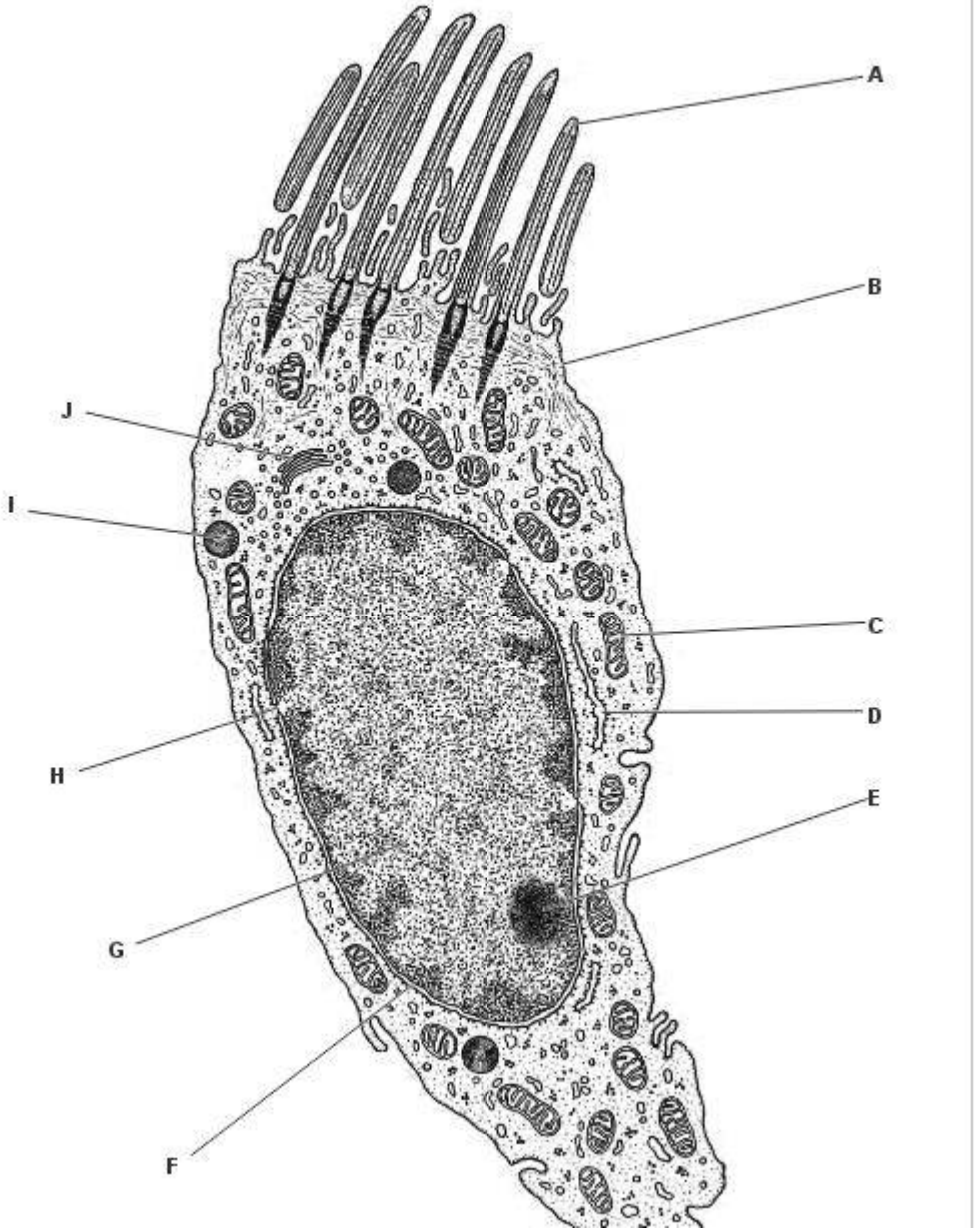
2 .....

..... [2]

Q.3.

1 Fig. 1.1 is a drawing made from an electron micrograph of a cell from the ciliated epithelium of the bronchus.

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A
B
J
I
C
D
H
E
G
F

(a) Complete the table below by writing the appropriate letter from Fig. 1.1 to indicate the structure that carries out each of the functions listed. The first one has been completed for you.

function	structure
facilitated diffusion of glucose	**B**
creates a current to move mucus	
aerobic respiration	
makes ribosomes	
a site of transcription	
packages proteins into lysosomes	

[5]

(b) The alveoli in the lungs are lined by a squamous epithelium.

Explain why gas exchange occurs in alveoli and not in the bronchus.

.....

.....

.....

.....

.....

.....[3]

(c) Describe the likely appearance of the lining of the bronchus in a person who has been a heavy smoker for many years.

.....

.....

.....

.....

.....

.....[3]

[Total: 11]

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Q.4.

(c) Some components of tobacco smoke are absorbed into the blood stream and affect the cardiovascular system.

Describe the effects of nicotine and carbon monoxide on the cardiovascular system.

nicotine .....

.....

.....

.....

carbon monoxide .....

.....

.....

..... [4]

Q.5.

4 Scientists at the Tibet Institute of Medical Sciences in Lhasa investigated differences between adult Tibetans who had lived in Lhasa (altitude 3658 m) all their lives and adult Han Chinese residents who had lived there for about 8 years. The Tibetans and the Han Chinese exercised at maximum effort and various aspects of their breathing were measured.

Some of the results are shown in Table 4.1.

Table 4.1

feature	Tibetans	Han Chinese
minute volume / $dm^3\ min^{-1}$	149	126
oxygen uptake / $cm^3\ kg^{-1}\ min^{-1}$	51.0	46.0

- Minute volume. This is the volume of air breathed in during one minute.
- Oxygen uptake. This is the volume of oxygen absorbed into the blood during one minute. It is expressed per kg of body mass.

The researchers observed that

- the greater minute volume of the native Tibetans resulted from a greater tidal volume
- the tidal volumes of the Tibetans showed a positive correlation with their vital capacity measurements
- the Han Chinese had lower values for both tidal volume and vital capacity.

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(a) State what is meant by the term *tidal volume*.

.....

..... [1]

(b) Suggest why the researchers also measured the *vital capacity* of the people in the study.

.....

.....

.....

..... [2]

(c) Explain how the minute volume **at rest** would be determined.

.....

.....

.....

..... [2]

(d) Suggest two differences in the **structure** of the lungs that may account for the greater oxygen uptake by the Tibetans shown in Table 4.1.

1 .....

.....

2 .....

..... [2]

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(e) When people who have lived all their lives at low altitude go to a place at high altitude, such as Lhasa, they are often breathless, lack energy and suffer from altitude sickness. However, with time, they often acclimatise to the high altitude.

In another study, researchers found that the red blood cell count increases in such people by about 30% over several weeks.

Explain why the red blood cell count increases so much when people visit places at high altitude.

.....

.....

.....

..... [2]

[Total: 9]

Q.6.

(b) People who have smoked cigarettes for many years are at risk of developing lung cancer.

Describe how cigarette smoke is responsible for the development of lung cancer.

.....

.....

.....

.....

.....

.....

.....

.....[4]

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(c) Fig. 6.2 shows the change in the percentage of smokers in the male population of the UK between 1950 and 2005.

Fig. 6.3 shows the change in mortality rate in the UK in men aged 75 to 84 between 1950 and 2005.

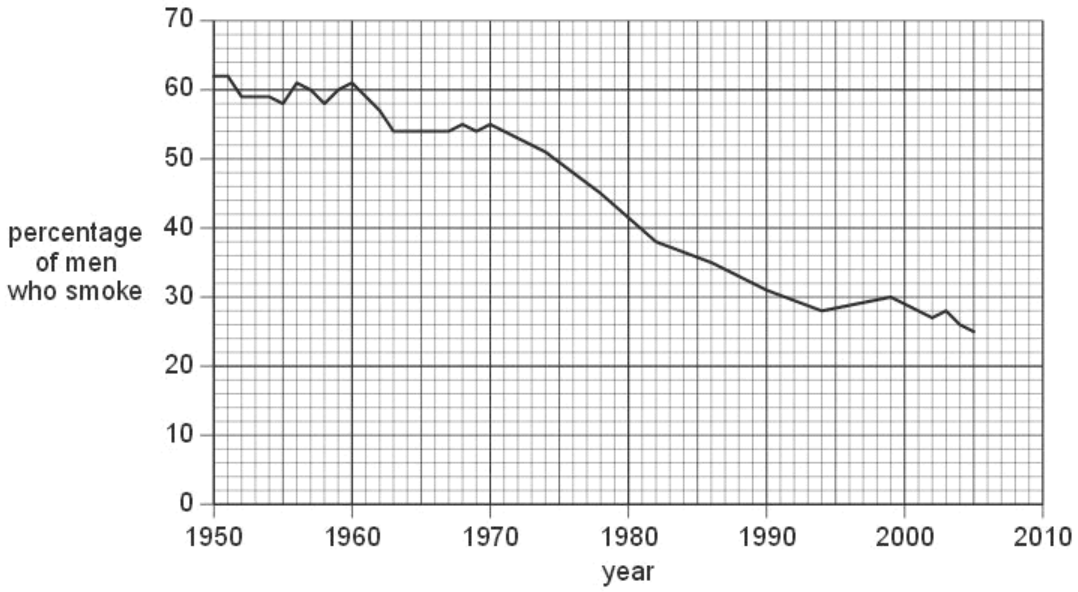


Fig. 6.2

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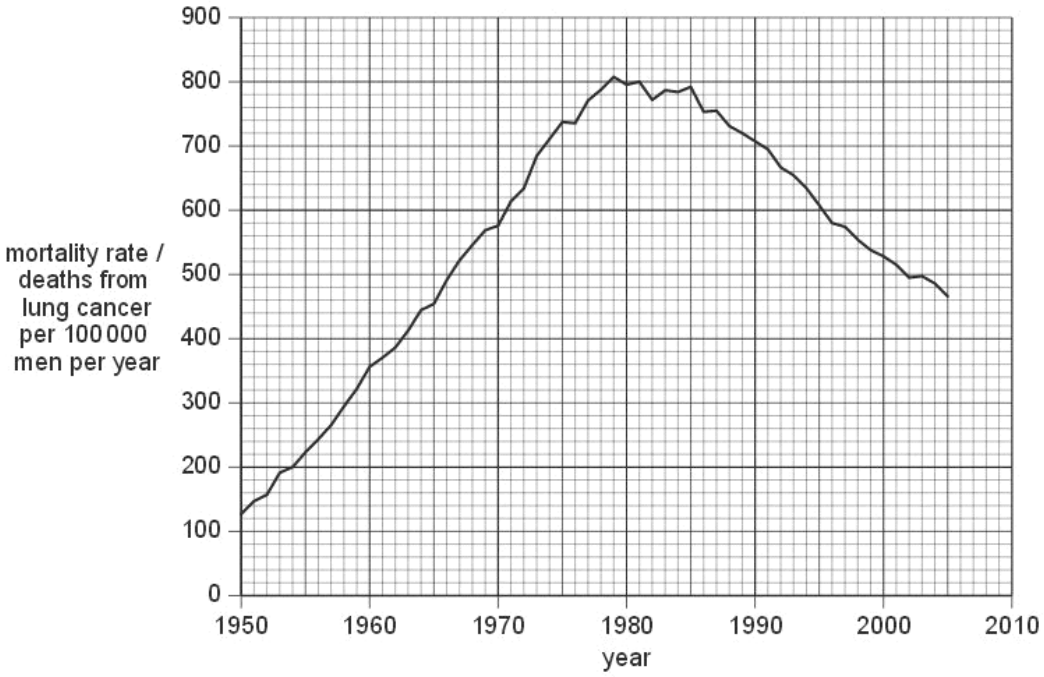


Fig. 6.3

Fig. 6.2 and Fig. 6.3 appear to show that there is no link between the percentage of the population that smoke and the death rate from lung cancer.

Explain why the mortality rate from lung cancer among men increased and then decreased over the period shown in Fig. 6.3, even though the percentage of smokers decreased over the same period of time.

.....

.....

.....

.....

.....

.....

.....

.....[3]

Q.7.

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2 Fig. 2.1 is a section of an alveolus and surrounding tissue.

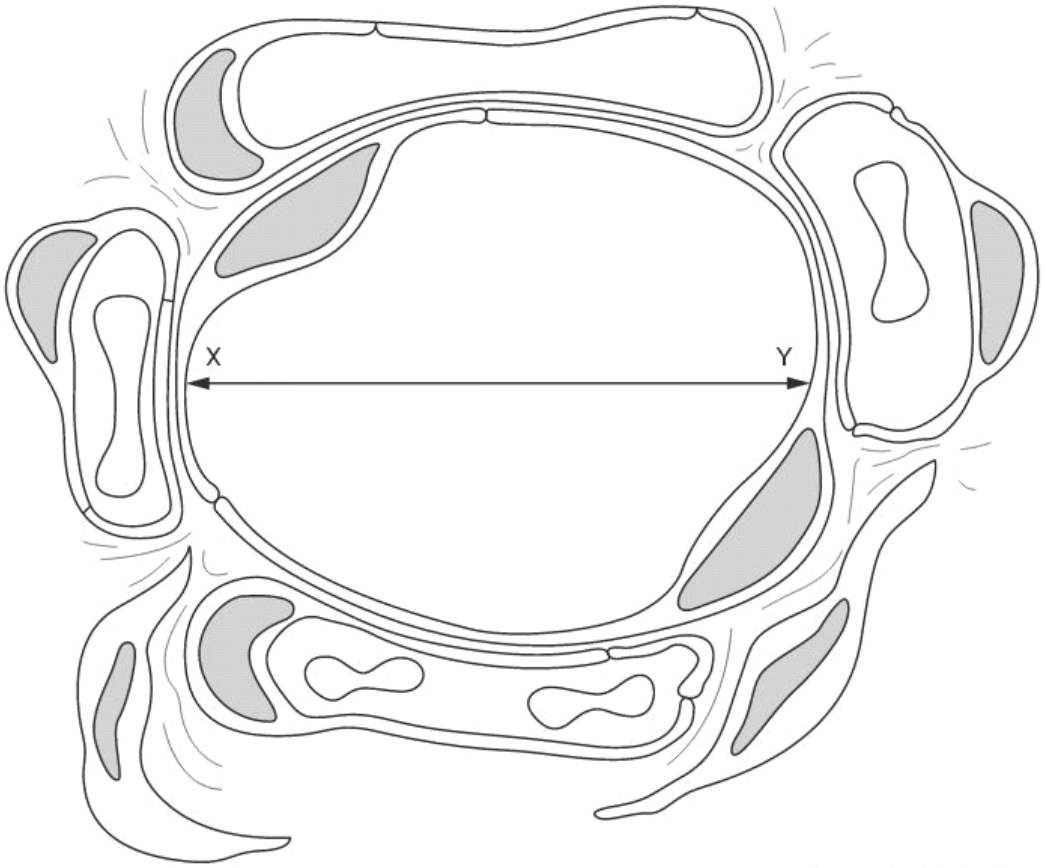


Fig. 2.1

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(a) Calculate the actual diameter of the alveolus along the line **X–Y**.

Show your working and give your answer to the nearest micrometre.

Answer = ... µm [2]

(b) **(i)** Describe the role of elastic fibres in the wall of the alveolus.

.....

.....

.....

.....[2]

(ii) With reference to Fig. 2.1, explain how alveoli are adapted for gas exchange.

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.....

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.....

.....

.....

.....

.....[4]

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(c) Chronic obstructive pulmonary disease (COPD) is a progressive disease that develops in many smokers. COPD refers to two conditions:

- chronic bronchitis
- emphysema.

(i) State two ways in which the lung tissue of someone with emphysema differs from the lung tissue of someone with healthy lungs.

1. .....

2. .....[2]

(ii) State two symptoms of emphysema.

1. .....

.....

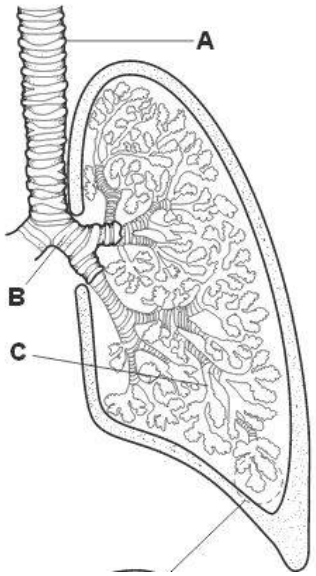
2. .....

.....[2]

[Total: 12]

Q.8.

5 **Fig. 5.1 is a diagram of part of the human gas exchange system.**



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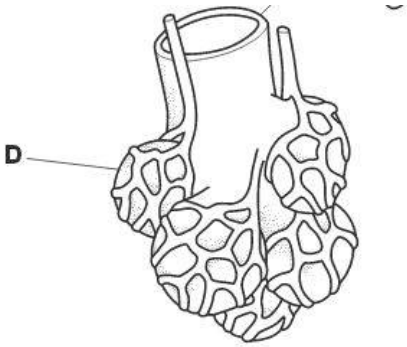


Fig. 5.1

(a) Complete the table to show the distribution of the structural features within the parts of the gas exchange system, **A** to **D**, shown in Fig. 5.1.

Use a tick (✓) if the feature is present and a cross (✗) if the feature is absent. Some of the boxes have been completed for you.

structure	features				
	cartilage	ciliated epithelium	elastic fibres	goblet cells	smooth muscle
A		✓		✓	
B			✓		
C				✓	✓
D	✗				✗

[4]

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(b) Explain the role of goblet cells and cilia in the maintenance of a healthy gas exchange system.

goblet cells .....

.....

.....

.....

.....

cilia .....

.....

.....

.....

.....[4]

[Total: 8]

Q.9.

6 Various structures in the human gas exchange system are adapted in different ways to perform their specific functions.

(a) Complete the table below using a tick ✓ or cross ✗ in each box to show whether or not the structure shows the particular feature.

Two boxes have been completed for you.

	lined with cilia	reinforced with cartilage	site of gas exchange	contains smooth muscle
trachea			✗	
bronchus				
bronchiole				✓
alveolus				

[4]

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(b) State the two ways in which the concentration gradients of oxygen and carbon dioxide are maintained for efficient gas exchange.

1. .....

.....

2. .....

.....[2]

(c) The alveoli in the lungs have elastic fibres in their walls.

(i) State **one** function of the elastic fibres.

.....

.....[1]

(ii) Name the medical condition caused by breakdown of the elastic fibres.

.....[1]

(d) Cigarette smoke contains tar, a substance which has several harmful effects on **the cells** lining the gas exchange system.

Outline three of these effects.

1. .....

.....

2. .....

.....

3. .....

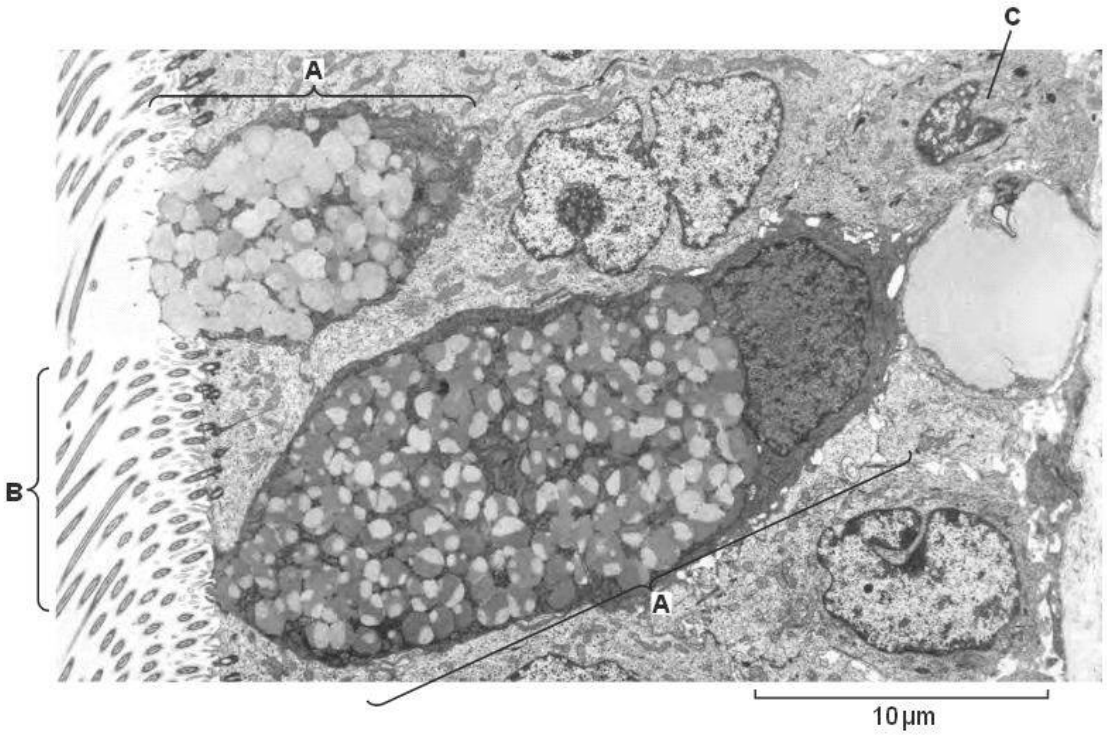
.....[3]

[Total: 11]

Q.10.

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1 Fig. 1.1 is an electron micrograph of cells from the ciliated epithelium of the trachea.



(a) Calculate the magnification of the electron micrograph in Fig. 1.1.

Show your working and express your answer to the nearest whole number.

magnification × .....[2]

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(b) Explain how the cells labelled **A** and the structures labelled **B** in Fig. 1.1 protect the lining of the trachea.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Cells, such as **C**, at the base of the epithelium of the trachea divide by mitosis.

Describe the changes that occur within the cell between the beginning of prophase and the end of metaphase.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total: 11]

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Q.11.

6 Leaves of tobacco plants, *Nicotiana spp*, have a high concentration of nicotine, the addictive component of tobacco smoke. Scientists are continually seeking ways to produce tobacco plants that have reduced nicotine content.

(a) Describe **and** explain the effects of nicotine on the cardiovascular system that can contribute to a person developing **coronary heart disease**.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) The production of low-nicotine cigarettes and cigars is considered a strategy that may reduce the harmful effects of smoking.

Explain whether or not you agree with this statement.

.....

.....

.....[1]

[Total: 5]

Q.12.

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(b) Describe the experimental evidence that shows that smoking causes lung cancer.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Fig. 6.1 shows the changes in mortality rates for lung cancer in five countries between 1950 and 2006 for males.

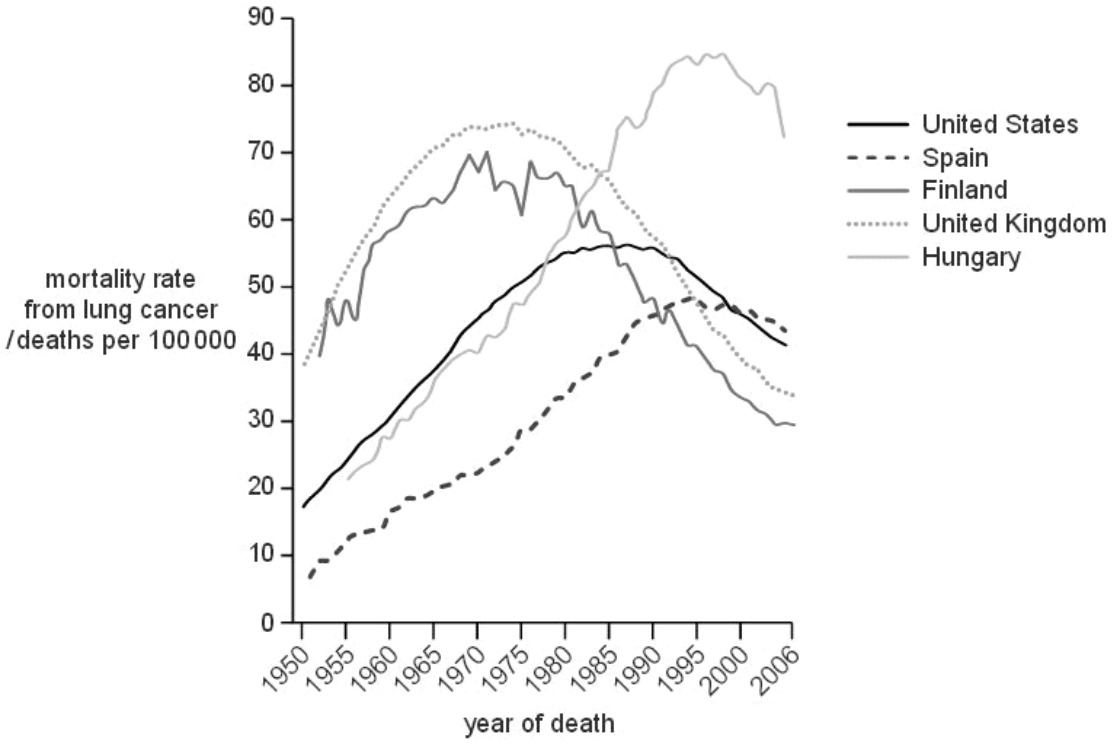


Fig. 6.1

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With reference to Fig. 6.1, describe the similarities **and** differences in the trends in mortality rates in the countries shown.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

Q.13.

1 Fig. 1.1 is a drawing made from an electron micrograph showing a cross-section of an alveolus and two adjacent capillaries.

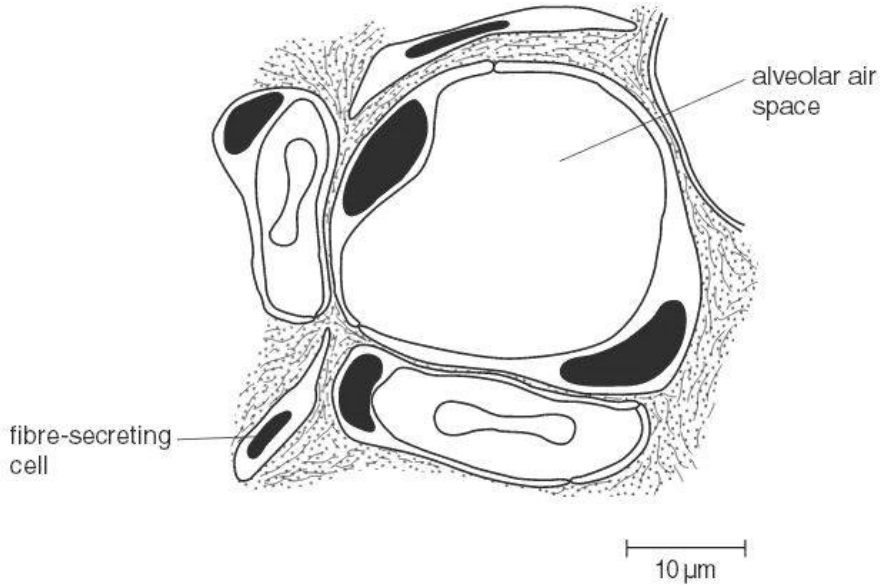


Fig. 1.1

STEMUP.CO.UK

(a) Calculate the magnification of Fig. 1.1. Show your working and express your answer to the nearest whole number.

.....

.....[2]

(b) With reference to Fig. 1.1, describe the process of gaseous exchange in the alveolus.

.....

.....

.....

.....

.....[4]

Allergies, such as asthma, are the result of an over reaction by the immune system to a harmless antigen. When people suffer from an asthma attack, their immune systems respond to the presence of a specific antigen by producing antibodies. These antibodies attach to the surface of mast cells in the airways causing these cells to release histamine. This hormone-like chemical stimulates inflammation in the lining of the airways, which then makes breathing very difficult.

(c) State the name of the cells of the immune system that secrete antibodies.

.....[1]

(d) Describe the changes that occur in airways, such as the bronchioles, during an asthma attack that make breathing difficult.

.....

.....

.....

.....

.....[3]

[Total : 10]

Q.14.

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6 Complete the following passage.

During strenuous exercise, muscles often do not receive sufficient oxygen to support aerobic respiration. As a result, muscles carry out ..... respiration and produce ..... , which diffuses into the blood. Most is then absorbed by the ..... , which respires it to form carbon dioxide and water or uses it to form glucose. The volume of oxygen absorbed by the lungs does not return to normal immediately after strenuous exercise because the body has to repay an oxygen ..... .

Exercise that uses the cardiovascular and gaseous exchange systems is termed ..... exercise. Improvements in fitness of the cardiovascular system can be followed by measuring the decrease in the ..... pulse rate. [6]

[Total : 6]

Q.15.

(c) Describe the effect of tar from cigarettes on the lining of the gaseous exchange system.

.....

.....

.....

.....

.....

.....[3]

Q.16.

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6 An athlete exercised for eight minutes. The athlete's oxygen consumption was measured before, during and after the exercise. The results are shown in Fig. 6.1.

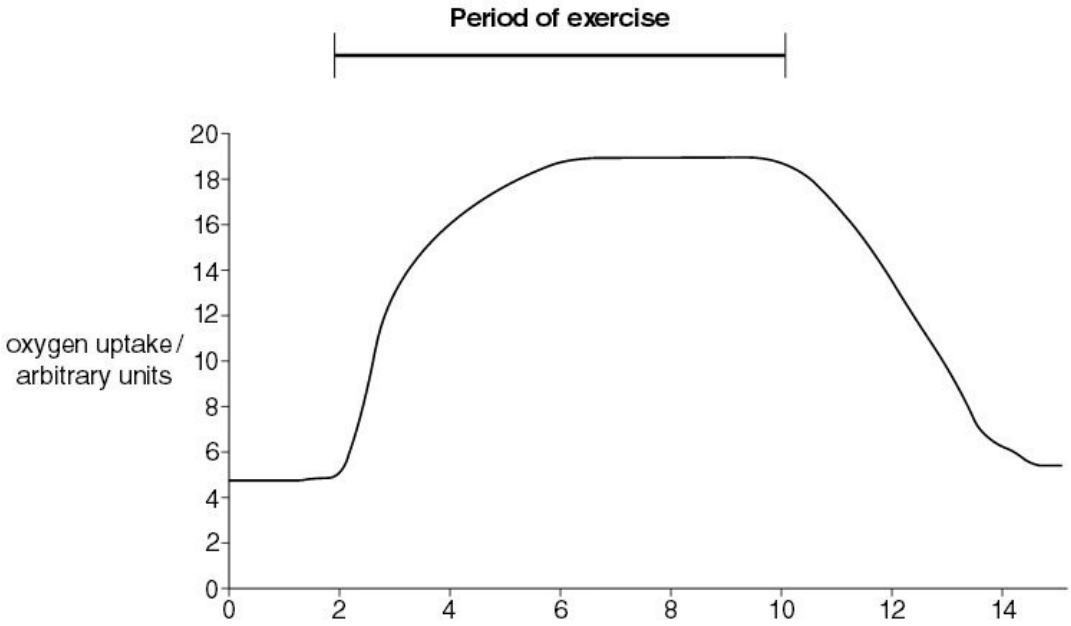


Fig. 6.1

(a) Explain why the athlete's oxygen consumption increased between two minutes and six minutes.

.....

.....

.....

.....[2]

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(b) Explain why the athlete's oxygen consumption took more than four minutes to decrease to resting values after the end of exercise.

.....

.....

.....

.....

.....

.....[4]

(c) Heart transplants and coronary by-pass surgery are used in the treatment of heart disease.

State two reasons why heart transplants are much less common than coronary by-pass surgery in the treatment of heart disease.

1 .....

.....

2 .....

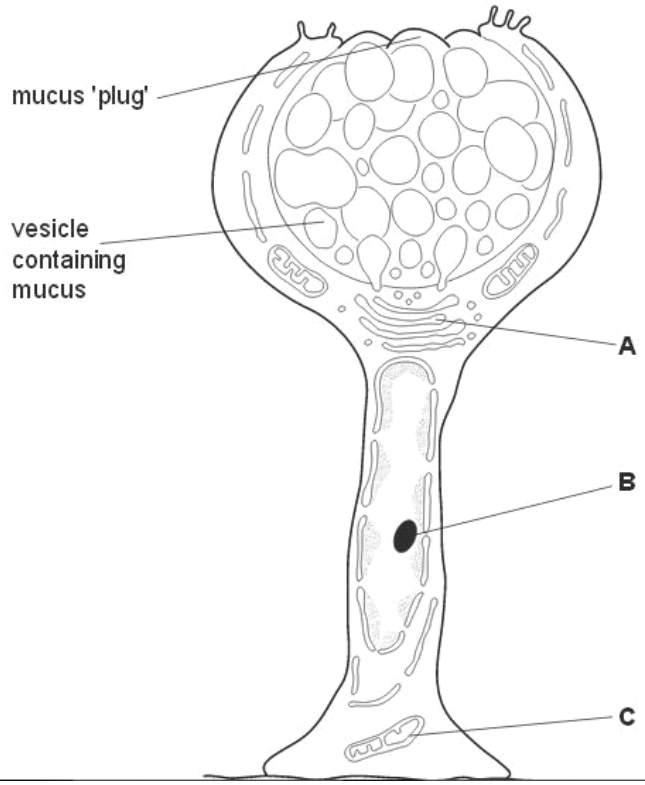
.....[2]

[Total: 8]

Q.17.

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1 Fig. 1.1 is a drawing made from an electron micrograph of a goblet cell from the epithelium of the gas exchange system.



(a) Name **A** to **C**.

A .....

B .....

C .....[3]

(b) State two places in the gas exchange system where goblet cells are found.

1. .....

2. .....[1]

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Mucus contains a number of different glycoproteins, called mucins. These have a protein 'core' that is formed by repeated sequences of amino acids, some of which have carbohydrates attached to their side chains (R groups). A part of one of these repeated units is shown diagrammatically in Fig. 1.2.

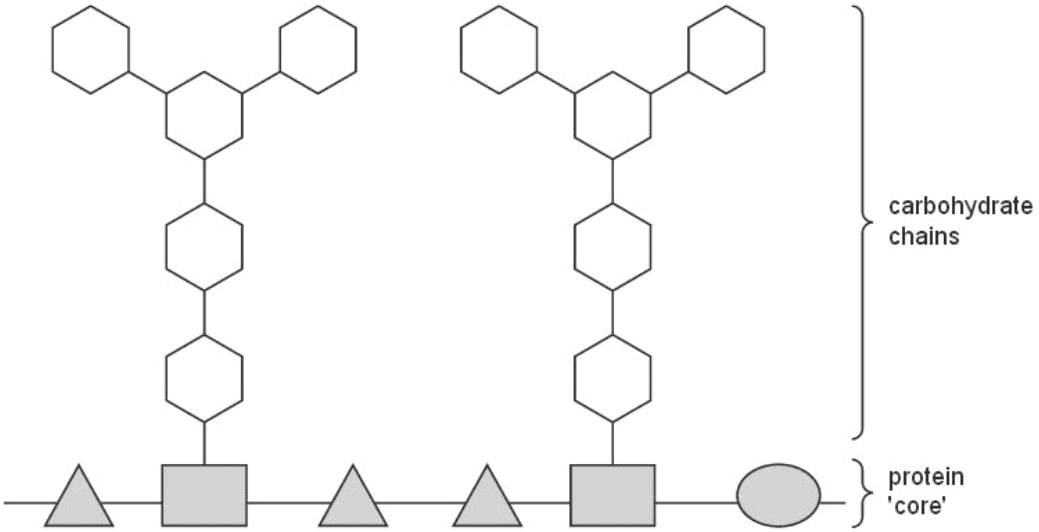


Fig. 1.2

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(c) Use label lines and the letters **P** and **G** to indicate on Fig. 1.2 the positions of:
P – a peptide bond;
G – a glycosidic bond. [2]

(d) Describe the role of mucus in the gas exchange system.

.....

.....

.....

.....

.....

.....[3]

(e) Glycoproteins are found in cell surface membranes.

State **one** function of these glycoproteins.

.....

.....[1]

[Total: 10]

Q.18.

3 Fig. 3.1 shows some cells from the lining of the bronchus from a person who has never smoked.
Fig. 3.2 shows cells from the same area in a heavy smoker who suffers from chronic bronchitis.

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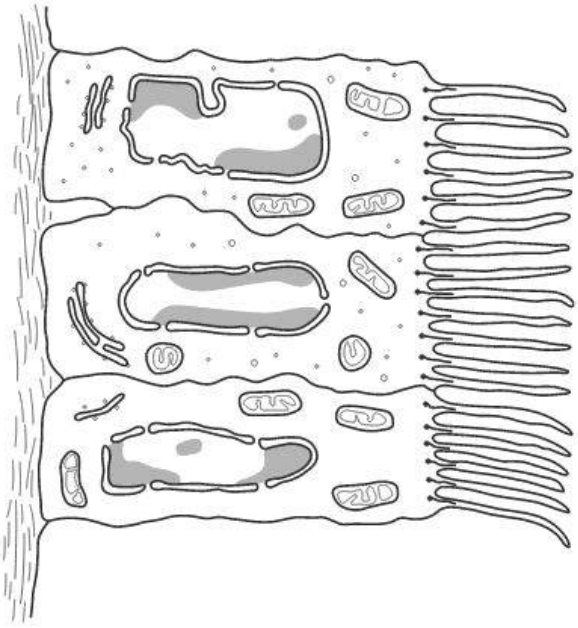


Fig. 3.1



Fig. 3.2

(a) Using label lines and the following letters, label the structures **A** to **C** on Fig. 3.1.

A cilia
B nuclear membrane (nuclear envelope)
C endoplasmic reticulum [3]

(b) Explain why the lungs are at an increased risk of infection when the bronchial epithelium is damaged as is shown in Fig. 3.2.

.....

.....

.....

.....

.....

.....[3]

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(c) Chronic obstructive pulmonary disease (COPD) includes chronic bronchitis and emphysema.

A student used the World Health Organisation database to investigate the link between cigarette smoking and deaths from COPD. Fig. 3.3 shows deaths from COPD plotted against the mean annual consumption of cigarettes in 20 countries for the period 1997 to 2002.

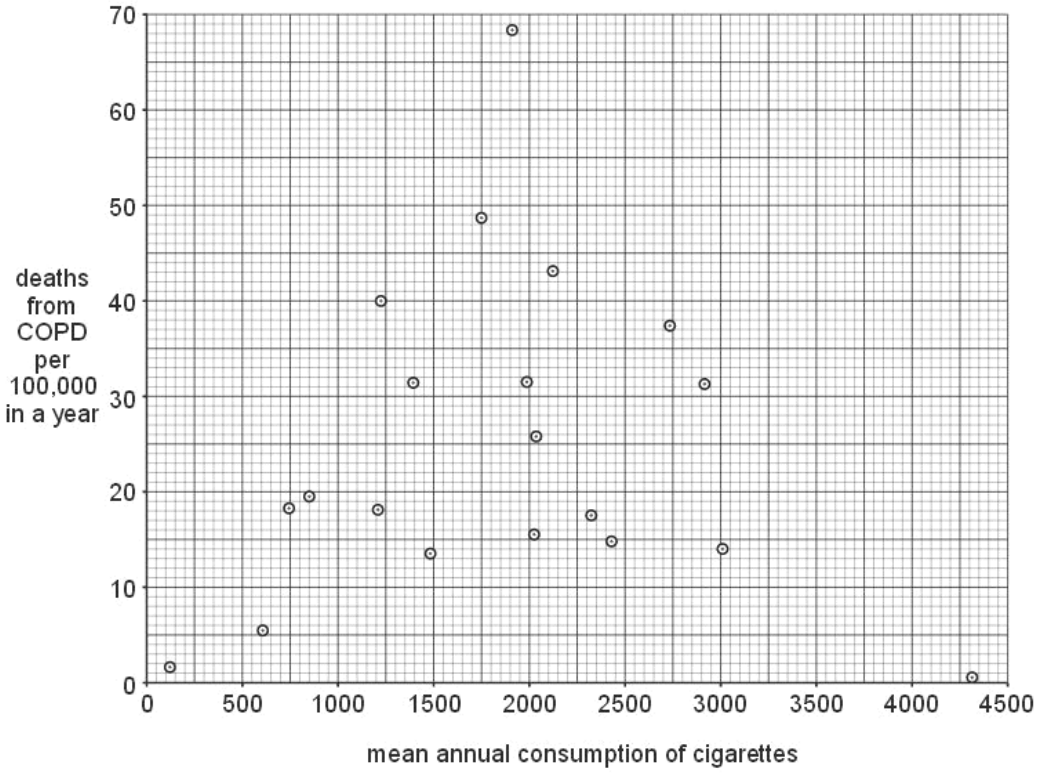


Fig. 3.3

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The student concluded that there was no link between cigarette consumption and deaths from COPD.

Use the information in Fig. 3.3 to discuss the student's conclusion.

.....

.....

.....

.....

.....

.....[3]

[Total: 9]

Q.19.

(b) When tobacco leaf fragments in cigarettes are burnt, substances that are hazardous to health are released.

Name three of these hazardous substances and for each describe **one** effect on the body.

substance .....

effect .....

.....

substance .....

effect .....

.....

substance .....

effect .....

.....[3]

Q.20.

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2 **(a)** Table 2.1 shows some of the structures in different parts of the gas exchange system.

Complete Table 2.1 by indicating with a tick (✓) if the structure is present in each part of the gas exchange system or a cross (✗) if it is not.

Table 2.1

structure	trachea	bronchus	bronchiole	alveolus
ciliated epithelium				
goblet cells				
cartilage				
smooth muscle				

[4]

(b) An exercise physiologist investigated aspects of breathing in an athlete.

The minute volume is the volume of air breathed in during one minute.

The data recorded is in Table 2.2.

Table 2.2

vital capacity /dm^3	breathing rate at rest /breaths min^{-1}	minute volume /dm^3
5.8	11	5.5

(i) Explain how the physiologist would determine the vital capacity of the athlete.

.....

.....

.....

.....

.....[2]

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(ii) Calculate the athlete's tidal volume.

Answer = ...[1]

(c) Fig. 2.1 shows a cross section of a coronary artery partially blocked by plaque causing atherosclerosis.

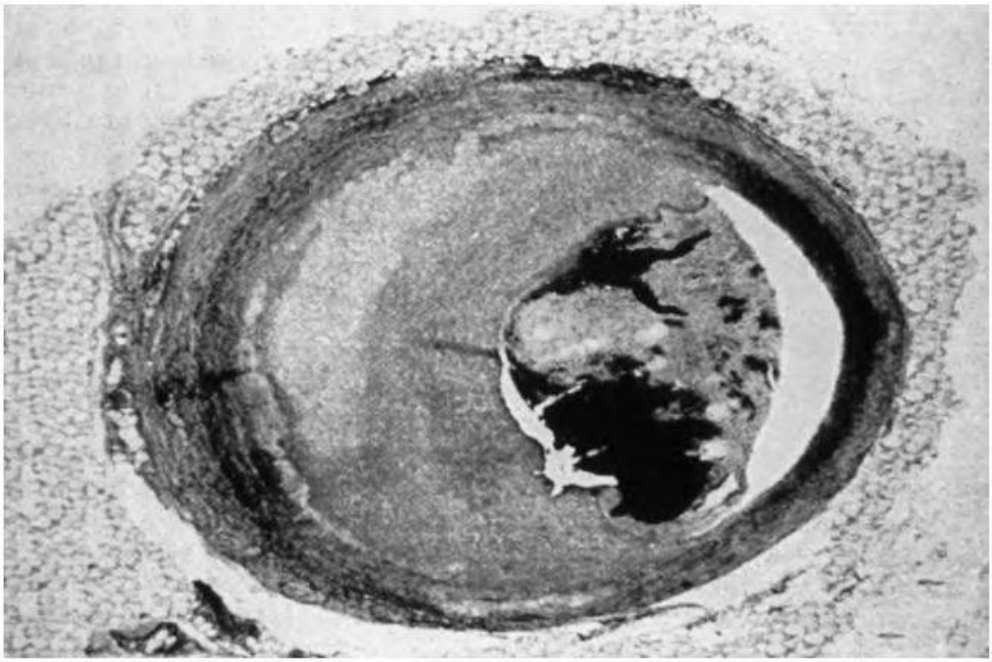


Fig. 2.1

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Explain why atherosclerosis in coronary arteries may limit the ability of people to take vigorous exercise.

.....

.....

.....

.....

.....

.....[3]

(d) Describe the effects of nicotine and carbon monoxide in cigarette smoke on the cardiovascular system.

nicotine .....

.....

.....

.....

.....

.....

carbon monoxide .....

.....

.....

.....

.....

.....[3]

[Total: 13]

Q.21.

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6 Fig. 6.1 is a section through lung tissue showing an alveolus and its blood supply.

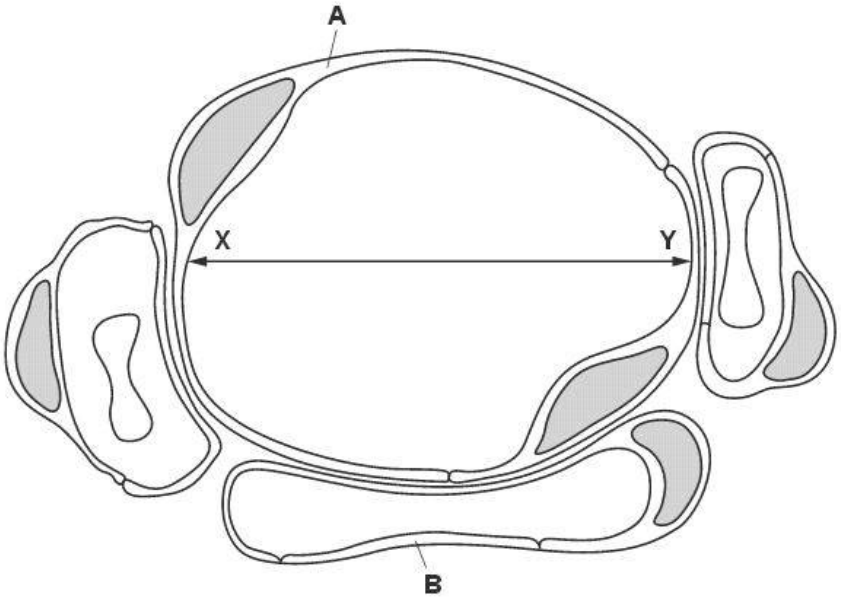


Fig. 6.1

(a) (i) Name the type of epithelial cell shown by label lines **A** and **B**.

..... [1]

(ii) Describe how the elastic fibres of the alveoli contribute to the healthy functioning of the lungs.

.....

.....

.....

..... [2]

(b) The actual diameter of the alveolus along the line **X–Y** is 220 micrometres (μm). Calculate the magnification of Fig. 6.1.

Show your working and give your answer to the nearest whole number.

answer × ..... [2]

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(c) Outline two features of a gas exchange surface **that are shown on Fig. 6.1**.

1. .....

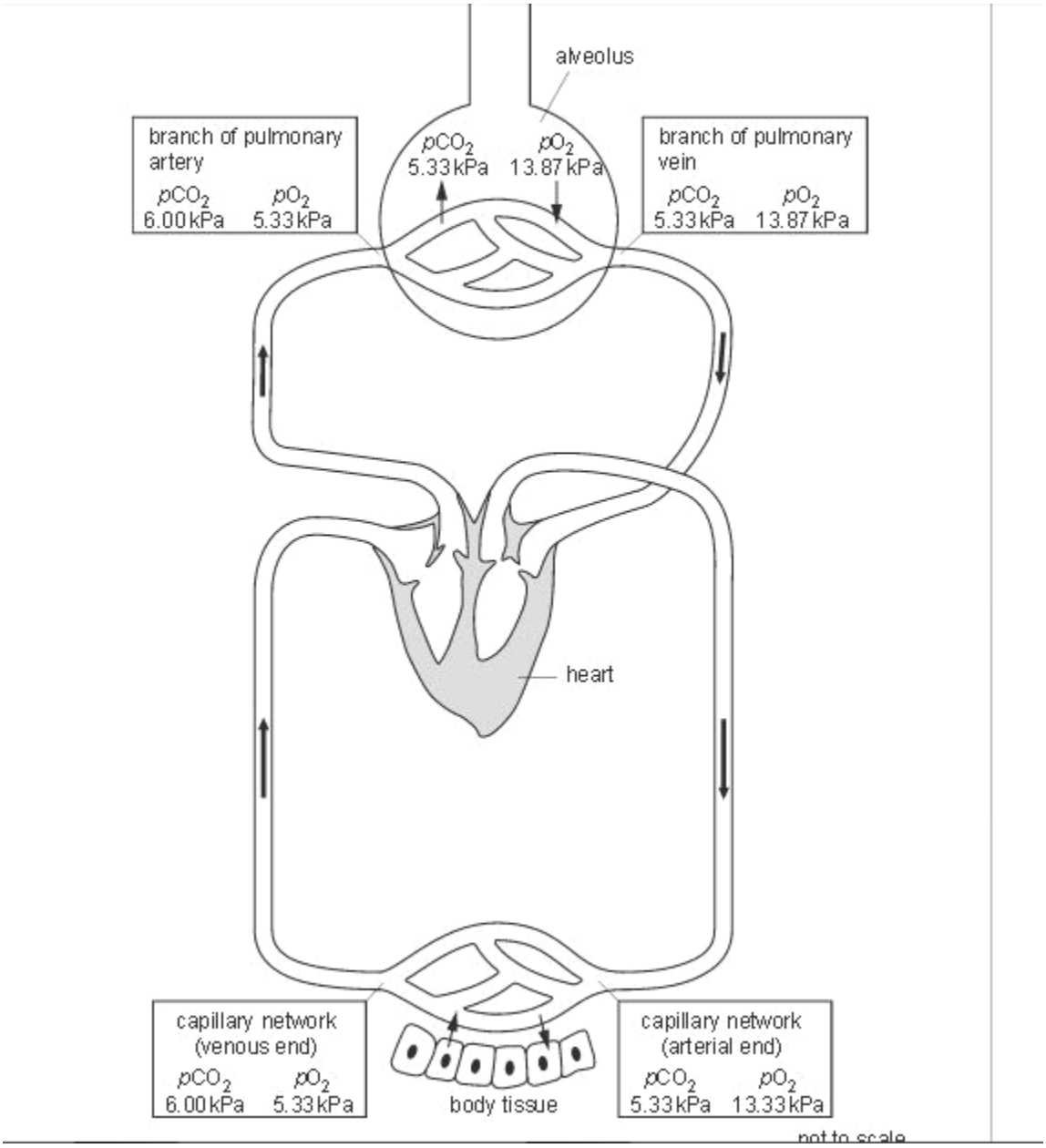
.....

2. .....

..... [2]

(d) Fig. 6.2 is a simplified diagram of the circulatory system of a human, showing gas exchange in the lungs and in respiring tissue. The partial pressures of oxygen (pO_2) and carbon dioxide (pCO_2) at four locations are also shown.

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alveolus
branch of pulmonary artery
pCO_2 6.00 kPa
pO_2 5.33 kPa
pCO_2 5.33 kPa
pO_2 13.87 kPa
branch of pulmonary vein
pCO_2 5.33 kPa
pO_2 13.87 kPa
heart
capillary network (venous end)
pCO_2 6.00 kPa
pO_2 5.33 kPa
body tissue
capillary network (arterial end)
pCO_2 5.33 kPa
pO_2 13.33 kPa
not to scale

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With reference to Fig. 6.2, explain how the differences in *p*O2 and pCO_2 in the alveolus and in blood enable gas exchange in the lungs **and** respiring tissue.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 11]

Q.22.

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5 **(a)** Describe and explain how the structure of alveoli is adapted for efficient gas exchange.

.....

.....

.....

.....

.....[3]

Fig. 5.1 shows a cross-section of normal human alveoli and Fig. 5.2 shows a cross-section of alveoli from a person suffering from emphysema.

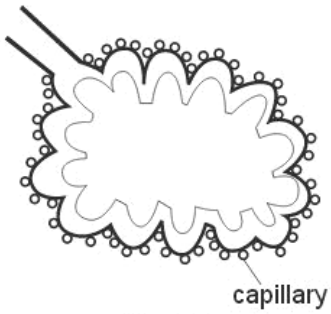


Fig. 5.1

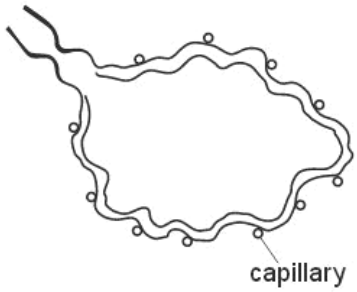


Fig. 5.2

(b) (i) State the most common cause of emphysema.

.....[1]

(ii) With reference to changes visible in Fig. 5.1 and Fig. 5.2, state and explain the effect of emphysema on the alveoli and on gas exchange.

.....

.....

.....

.....[2]

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(c) State three symptoms of emphysema.

1. .....

.....

2. .....

.....

3. .....

.....[3]

[Total: 9]

Q.23.

1 Fig. 1.1 is a scanning electron micrograph of part of the wall of the bronchus of a healthy human.

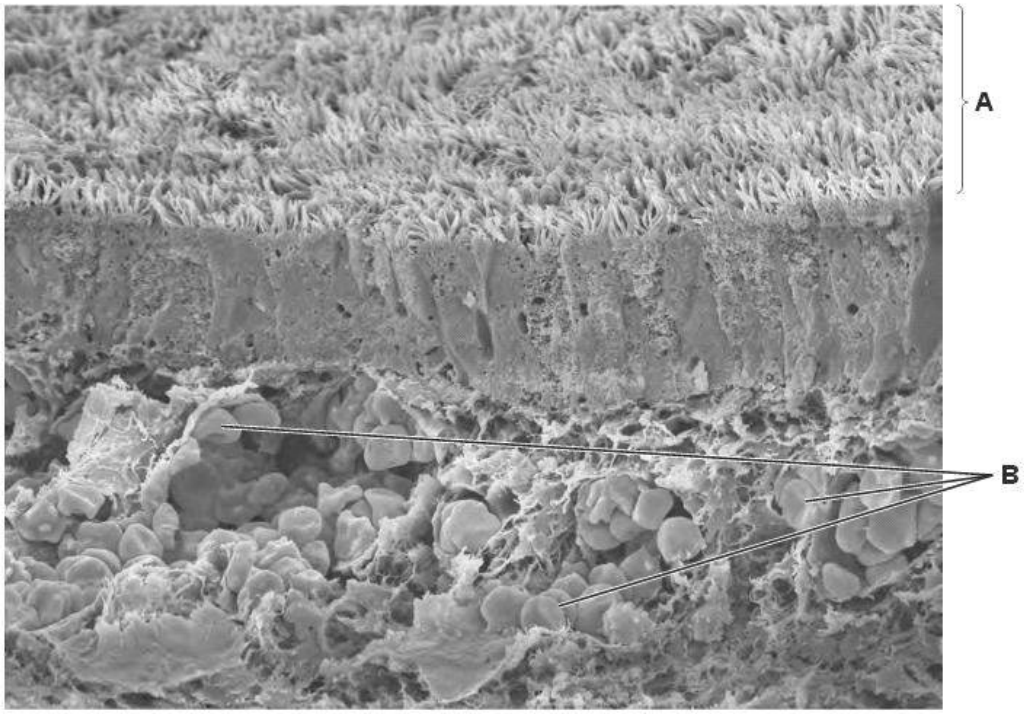


Fig. 1.1

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(a) **(i)** Name the structures labelled **A**.

.....[1]

(ii) State the function of the cells labelled **B**.

.....[1]

(b) Name two tissues found in the wall of the bronchus that are not visible in Fig. 1.1.

1. .....

2. .....[2]

Chronic bronchitis is one of the conditions that contributes to chronic obstructive pulmonary disease (COPD).

(c) State the name of the other condition that contributes to COPD.

.....[1]

(d) Describe the appearance of a section through the **wall** of a bronchus in a person with chronic bronchitis.

.....

.....

.....

.....

.....

.....

.....

.....[4]

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(e) Suggest why a person with chronic bronchitis is more likely than a healthy person to suffer from infectious diseases of the gas exchange system.

.....

.....

.....

.....[2]

[Total: 11]

Q.24.

5 In 1954, an article was published in the British Medical Journal entitled, *The mortality of doctors in relation to their smoking habits*.

One aspect of the investigation studied a very large number of male doctors in the UK aged 35 years and older. A survey established the quantity of tobacco smoked per day.

Twenty-nine months later, the cause of any deaths in the study group was recorded.

Table 5.1 summarises the results obtained.

Table 5.1

cause of death	number of deaths	death rate per year per 1000 men in the study			
		non-smokers	smokers, tobacco smoked / g day^{-1}		
			1–14	15–24	25 and above
coronary thrombosis (heart attack)	235	3.89	3.91	4.71	5.15
other cardiovascular diseases	126	2.23	2.07	1.58	2.78
lung cancer	36	0.00	0.48	0.67	1.14
other diseases of the gas exchange system	54	0.86	0.88	1.01	0.77

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(a) State which group in the study is most at risk from dying of lung cancer.

.....[1]

(b) Using information from Table 5.1 to support your answer, discuss the evidence linking tobacco smoking to disease and early death.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 5]

Q.25.

3 A study was carried out on a large number of people, some of whom were smokers. The study investigated the link between percentage of deaths due to lung cancer in smokers and their smoking habits. The age at which they started smoking and the number of cigarettes smoked per day were recorded. The results of the study are shown in Fig. 3.1.

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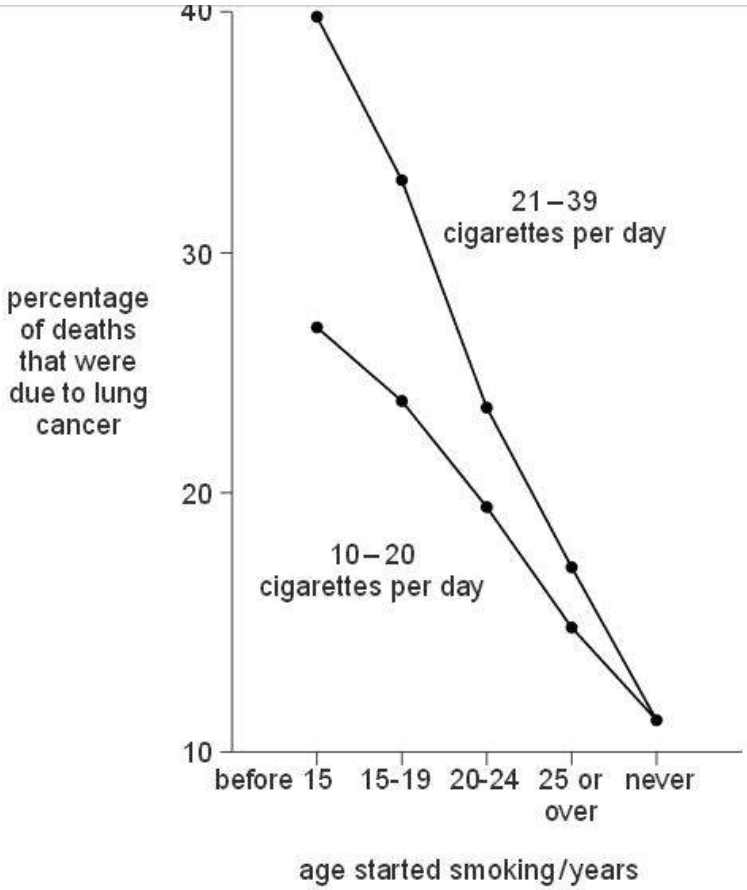


Fig. 3.1

(a) Explain what the results in Fig. 3.1 show about the link between cigarette smoking and percentage of deaths due to lung cancer.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

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(b) Tobacco smoke contains many substances which are harmful to the body.

Outline the harmful effects on the cardiovascular system of:

(i) carbon monoxide

.....

.....

.....

.....[2]

(ii) nicotine.

.....

.....

.....

.....[2]

(iii) Describe briefly the effects of tar on the goblet cells and cilia of the trachea.

goblet cells .....

.....

.....

.....

cilia .....

.....

.....

.....[4]

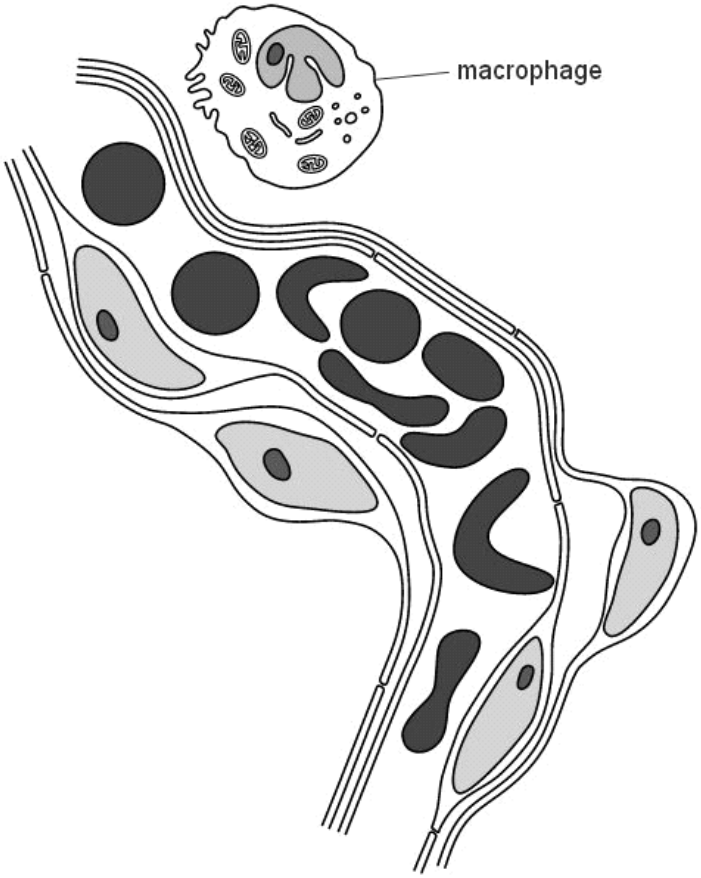
[Total: 12]

Q.26.

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Macrophages are large phagocytic cells that are found in many tissues including alveolar tissue in the lungs. They provide the main means of defence against pathogens in this tissue.

Fig. 3.1 is a drawing made from an electron micrograph showing part of a capillary and two alveoli, with a macrophage.



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(b) With reference to Fig. 3.1, explain:

(i) how alveoli are adapted for gaseous exchange

.....

.....

.....

.....

.....

.....[3]

(ii) how macrophages function to protect the lungs from becoming infected.

.....

.....

.....

.....

.....

.....

.....

.....[4]

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(c) Phagocytes release enzymes that digest proteins. In smokers, this may lead to the large-scale destruction of alveolar walls.

Outline the effects of this destruction on a person's health.

.....

.....

.....

.....

.....

.....[3]

Q.27.

(c) Describe **and** explain how the structure of the human **gas exchange surface** is adapted for maximum efficiency.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

Q.28.

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(b) Nicotine has an effect on the cardiovascular system, such as making platelets sticky, so causing blood to clot. This increases the risk of thrombosis and reduces blood flow.

Outline **other** effects of nicotine on the cardiovascular system.

.....

.....

.....

.....

.....

.....[3]

Q.29.

1 Name as precisely as you can the structure described in each of the following statements.

(a) The blood vessel that transports deoxygenated blood from the heart.

.....[1]

(b) The cell that ingests and digests cell debris and bacteria in the lungs.

.....[1]

(c) The cell that secretes antibodies.

.....[1]

(d) The epithelial cell that secretes mucus in the trachea.

.....[1]

(e) The tissue that prevents the collapse of the trachea during inhalation.

.....[1]

[Total: 5]

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Gas exchange – AS 9700 Biology June 2022

1. June/2022/Paper_11/No.33

Which reactions take place in the capillaries surrounding an alveolus?

1 carbon dioxide + water → carbonic acid

2 carbon dioxide + haemoglobin → carbaminohaemoglobin

3 haemoglobinic acid → haemoglobin + hydrogen ions

4 hydrogencarbonate ions + hydrogen ions → carbonic acid → carbon dioxide + water

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

2. June/2022/Paper_11/No.34

Which statement explains the importance of the chloride shift in red blood cells (RBC)?

A Carbon dioxide diffuses from blood plasma into RBC and chloride ions diffuse out of RBC to maintain a balance of positive and negative ions.

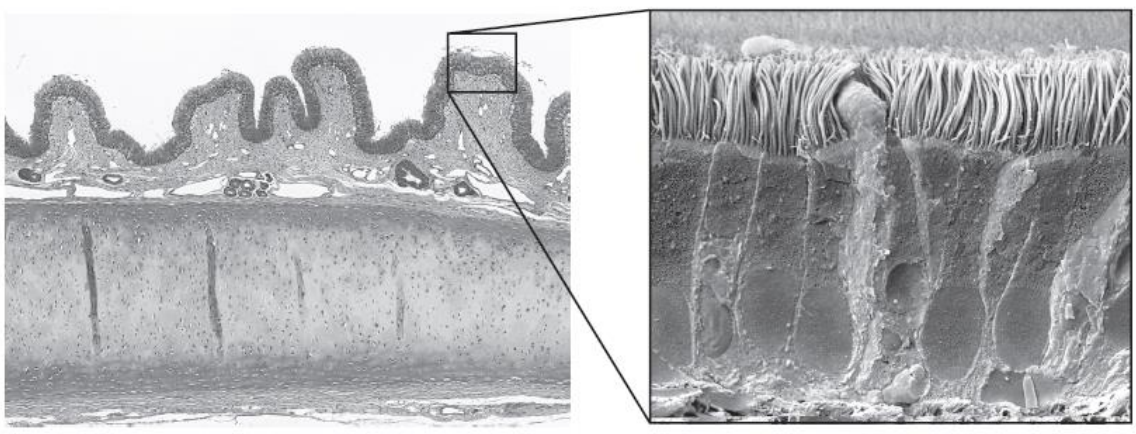
B Hydrogencarbonate ions diffuse into plasma from RBC and chloride ions diffuse into RBC to maintain a balance of positive and negative ions.

C Carbon dioxide in RBC together with chloride ions stimulate the release of oxygen from haemoglobin to allow increased levels of respiration.

D Hydrogencarbonate ions diffuse into RBC from plasma and chloride ions diffuse into plasma to maintain a balance of positive and negative ions.

3. June/2022/Paper_11/No.35

The photomicrographs show a cross-section through the lining of part of the respiratory system.



Which statements about the photomicrographs are correct?

1 Goblet cells are visible between squamous epithelium cells.

2 Smooth muscle is visible.

3 The section cannot be from a bronchiole as cartilage is visible.

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

4. June/2022/Paper_11/No.36

The surface tension of the layer of liquid lining the alveoli tends to pull the walls inwards so alveoli could collapse.

Which statements could explain how this is prevented?

1 Alveolar fluid is moved around by cilia.

2 Elastic fibres keep the alveoli open.

3 Epithelial cells secrete a chemical that reduces the cohesion in water.

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

5. June/2022/Paper_12/No.35

Which statements about the human gas exchange system are correct?

1 The absence of cartilage in small bronchioles allows them to expand.

2 The walls of the alveoli are made of cuboidal epithelium.

3 Alveoli secrete a substance which reduces surface tension.

4 The trachea and bronchi are supported by rings of cartilage.

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

6. June/2022/Paper_12/No.36

Four types of cell in the gas exchange system are listed.

J alveolus epithelium cell

K ciliated cell

L goblet cell

M smooth muscle cell

The ticks (✓) in the table show specialised features of three of these types of cell.

	many mitochondria	lots of endoplasmic reticulum	many Golgi bodies
1	✓		
2	✓		
3	✓	✓	✓

Which row correctly matches the specialised feature with the correct cell?

	1	2	3
A	J	M	K
B	K	J	M
C	K	M	L
D	M	L	J

7. June/2022/Paper_13/No.34

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.

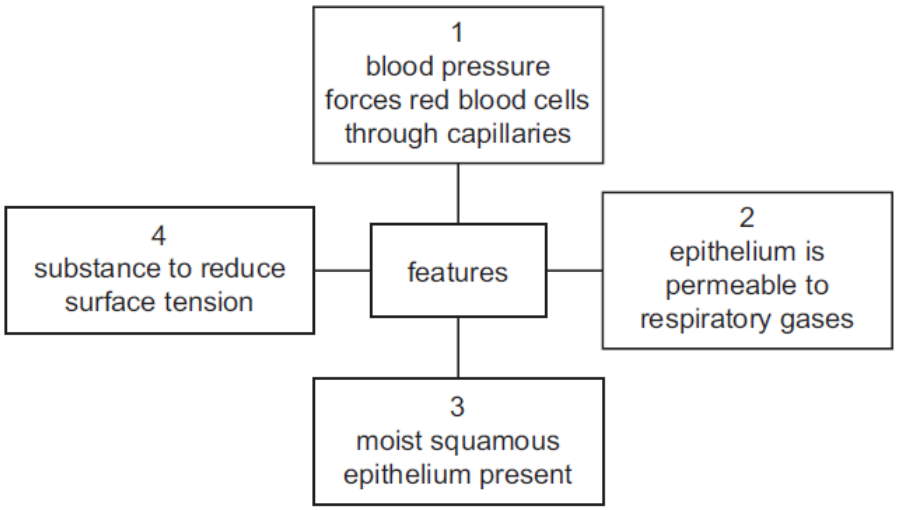
4 Carbon dioxide and water are formed from hydrogencarbonate ions and hydrogen ions.

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

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8. June/2022/Paper_13/No.35

Which features are important for the process of diffusion of oxygen out of an alveolus?



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

9. June/2022/Paper_13/No.36

A student viewed three slides at both low magnification and high magnification. Each slide was a section through a different airway of the gas exchange system.

The student observed three features in each slide.

slide	three features observed by student
1	irregular arrangement of cartilage highly folded inner layer cilia on epithelial cells
2	very few goblet cells cilia on epithelial cells thick layer of smooth muscle relative to wall thickness
3	smooth muscle tissue blood vessels many goblet cells

Which row correctly identifies the three slides?

	slide 1	slide 2	slide 3
A	bronchus	bronchiole	trachea
B	bronchus	trachea	bronchiole
C	trachea	bronchiole	bronchus
D	trachea	bronchus	bronchiole

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10. June/2022/Paper_21/No.1

Fig. 1.1 and Fig. 1.2 are photomicrographs showing the distribution of tissues in the lungs.

Fig. 1.1 is a photomicrograph of a section through part of the lungs.

Fig. 1.2 is a high-power view of the area indicated on Fig. 1.1.

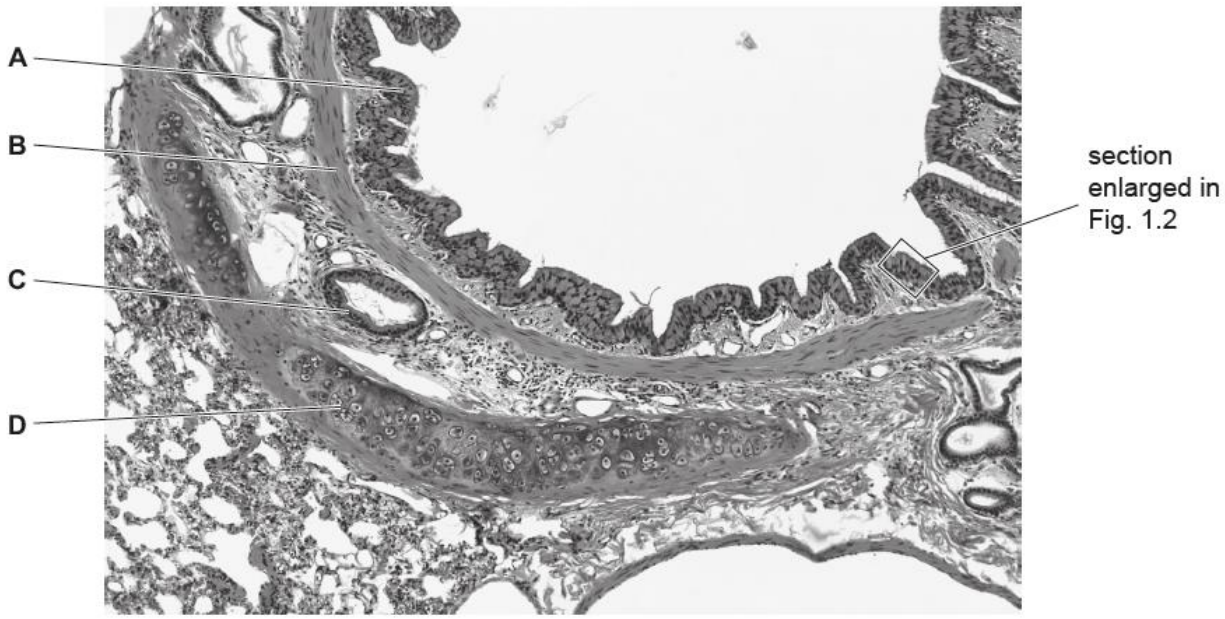


Fig. 1.1

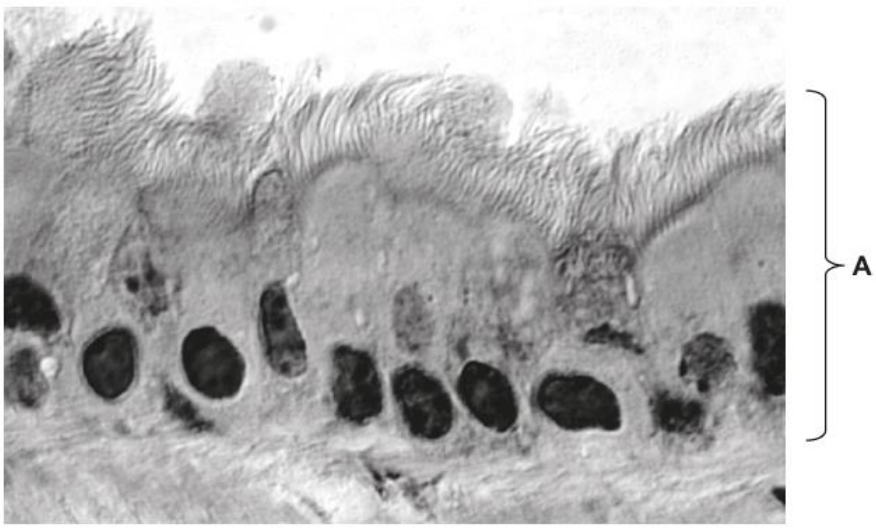


Fig. 1.2

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(a) State the names of the tissues **A**, **B** and **D**.

A .....

B .....

D .....

[3]

(b) Describe the role of the glands labelled **C** in Fig. 1.1 in maintaining the health of the gas exchange system.

.....

.....

.....

.....

.....

.....

..... [3]

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(c) Hyperventilation occurs when a person breathes too fast or too deeply.

The effects of hyperventilation are:

- a decrease in the partial pressure of carbon dioxide in alveolar air
- an increase in the pH of the blood.

Fig. 1.3 shows the change in the oxygen dissociation curve as a result of hyperventilation.

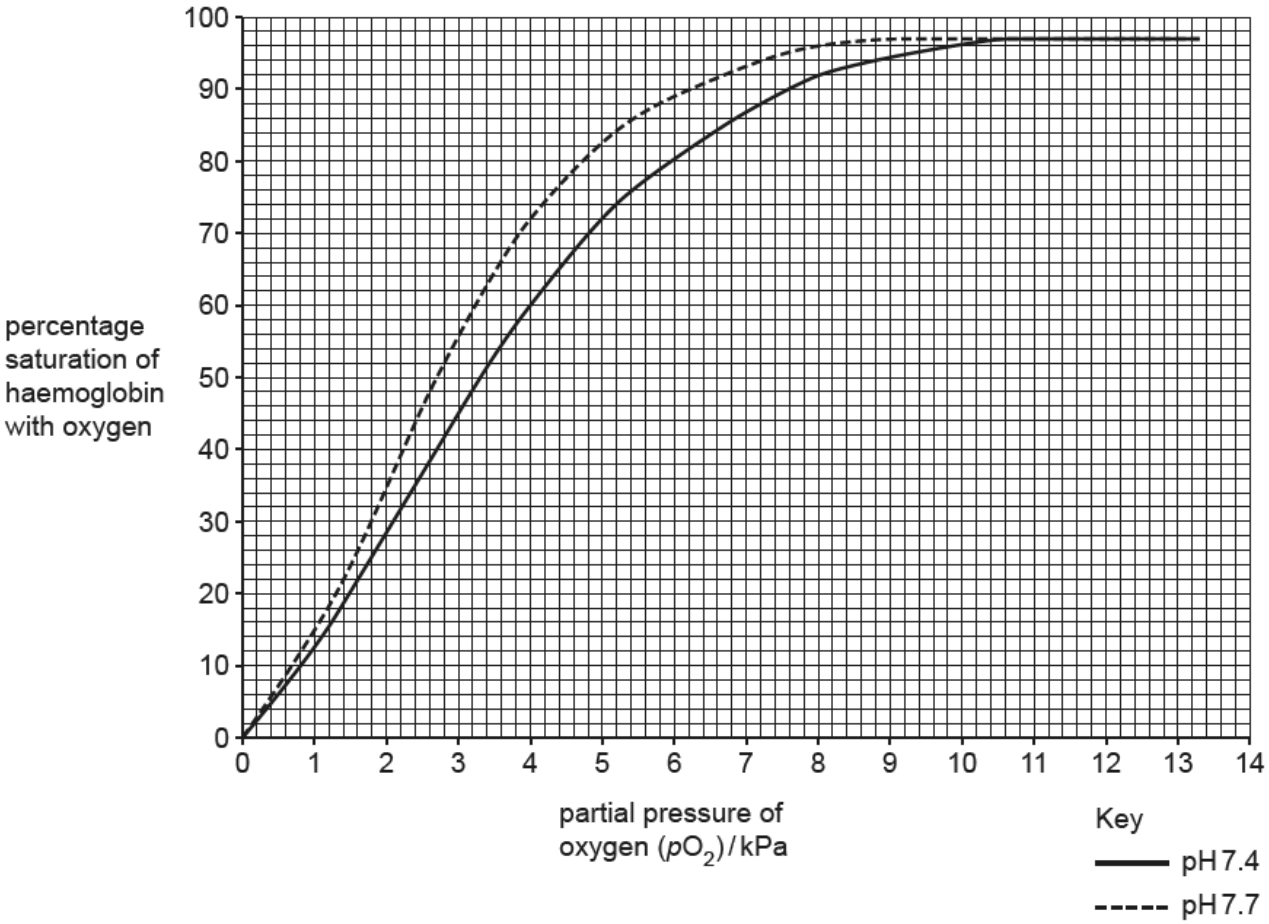


Fig. 1.3

(i) State the percentage saturation of haemoglobin at a pO_2 of 4.0 kPa.

pH = 7.7 ..... kPa

pH = 7.4 ..... kPa [1]

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(ii) Use the information in Fig. 1.3 to state **and** explain the effect of hyperventilation on the supply of oxygen to the respiring tissues.

.....

.....

.....

.....

..... [2]

[Total: 9]

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11. June/2022/Paper_21/No.5

The enzyme carbonic anhydrase has been found in a wide range of organisms and acts as a catalyst in many tissues.

Studies have shown that there are differences in the protein structure of the enzyme and differences in the number and organisation of introns and exons of the gene coding for the enzyme.

All carbonic anhydrase enzymes catalyse the same reversible reaction, shown in Fig. 4.1.

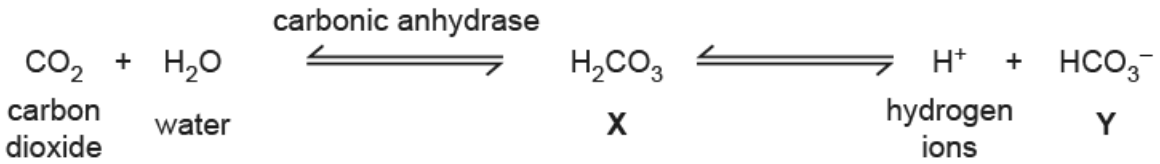


Fig. 4.1

(a) With reference to Fig. 4.1, name **X** and **Y**.

X .....

Y .....

[2]

(b) Carbonic anhydrase enzymes can have different primary structures.

Suggest how all carbonic anhydrase enzymes can catalyse the same reaction, even though they have different primary structures.

.....

.....

..... [1]

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(c) Genes coding for proteins in eukaryotes consist of introns and exons.

Outline the similarities and differences between the introns and the exons of genes coding for proteins such as carbonic anhydrase.

.....

.....

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..... [3]

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All mammals have the same type of carbonic anhydrase, known as α-carbonic anhydrase. Many different forms, or isoforms, of α-carbonic anhydrase have been identified in mammals.

There are 15 isoforms of α-carbonic anhydrase (CA) in humans. Cells of different tissues have one or more isoforms. Within cells the isoforms may be in different locations.

(d) Red blood cells contain two isoforms, CA1 and CA2.

Suggest the location of CA1 and CA2 in red blood cells **and** give a reason for your answer.

.....

.....

.....

.....

..... [2]

(e) Isoform CA6 forms part of human breast milk. Mammary gland cells package CA6 in Golgi vesicles for release from the cells.

Name the transport mechanism associated with CA6 secretion.

..... [1]

(f) Human CA isoforms in some epithelial cells in the eye have a role in the formation of the clear fluid of the eye known as aqueous humour. Overactivity of the enzyme may lead to a harmful increase of pressure within the eye and cause a condition known as glaucoma.

Acetazolamide is a therapeutic drug that can be used in the treatment of glaucoma. It acts as a reversible non-competitive inhibitor.

Describe the mechanism of action of acetazolamide as a reversible non-competitive inhibitor of carbonic anhydrase.

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.....

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..... [3]

[Total: 12]

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Gas exchange – AS 9700 Biology Nov 2022

1. Nov/2022/Paper_11/No.35

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 not present, oxyhaemoglobin is less likely to unload oxygen.

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

2. Nov/2022/Paper_11/No.36

Carbon dioxide is continually produced by respiring cells. It diffuses into red blood cells and dissociates into hydrogen ions (H^+) and hydrogen carbonate ions (HCO_3^-). HCO_3^- then diffuses out of the cell in exchange for chloride ions (Cl^-) in the chloride shift.

What is the importance of the chloride shift?

A It helps to maintain a neutral pH in the red blood cell by acting as a buffer.

B It maintains a balance of positive and negative charge between the cell and the plasma.

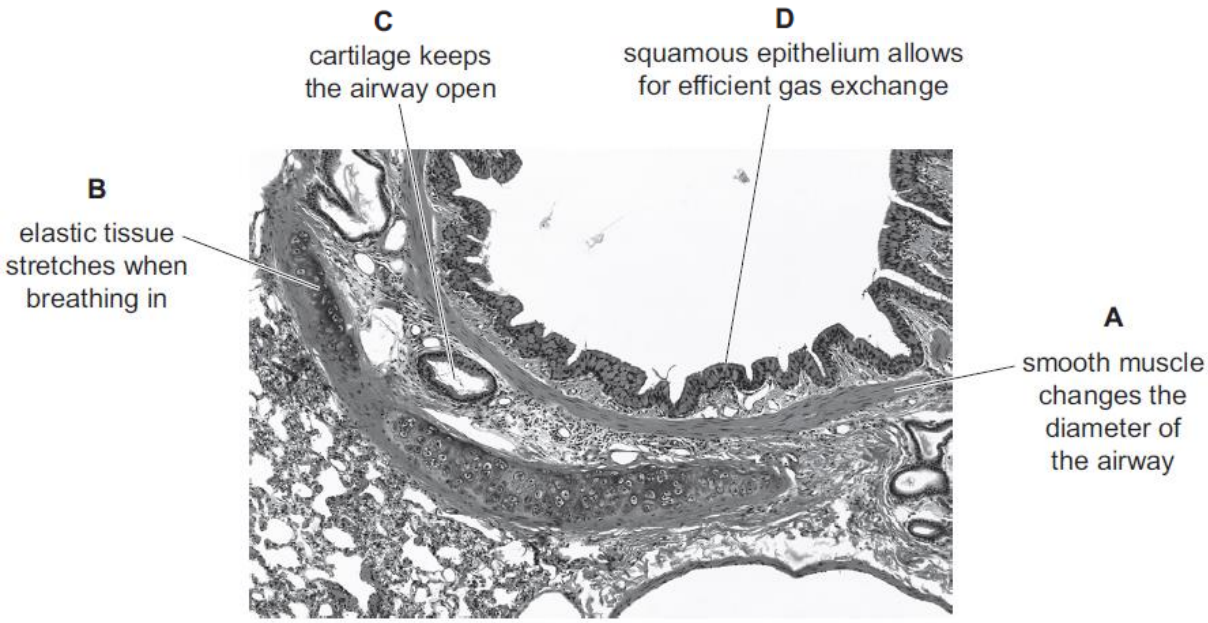
C It causes the oxygen dissociation curve to shift to the left, releasing more oxygen.

D It prevents carbon dioxide combining with haemoglobin, allowing haemoglobin to combine with oxygen.

3. Nov/2022/Paper_11/No.37

The photomicrograph shows a section through a bronchus.

Which annotated label is correct?



4. Nov/2022/Paper_12/No.36

What can be found in the wall of an alveolus in the lungs of a human?

	cartilage	cilia	elastic fibres
A	✓	✓	✗
B	✗	✗	✓
C	✓	✗	✗
D	✗	✓	✓

key

✓ = present

✗ = not present

5. Nov/2022/Paper_12/No.37

What are the functions of cilia in the gas exchange system?

1 to move mucus

2 to trap pathogens and dust

3 to increase the surface area

	1	2	3
A	✓	✗	✗
B	✓	✓	✗
C	✗	✓	✓
D	✗	✗	✓

key

✓ = a function

✗ = not a function

6. Nov/2022/Paper_13/No.35

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

7. Nov/2022/Paper_13/No.30

What would be changed if mitochondrial activity was inhibited by a metabolic poison acting on cells in the phloem tissue?

1 concentration of hydrogen ions in the cell wall of companion cells

2 concentration of sucrose in the cytoplasm of cells in a leaf

3 hydrostatic pressure gradient in the phloem sieve tube

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

8. Nov/2022/Paper_21/No.3(a)

Carbonic anhydrase is a globular protein found in red blood cells.

(a) (i) Explain why this protein is described as globular.

.....

.....

.....

.....

..... [2]

(ii) State the function of carbonic anhydrase in red blood cells.

.....

.....

.....

.....

..... [2]

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9. Nov/2022/Paper_22/No.1(d)

(d) The entry of carbon dioxide into red blood cells results in the production of hydrogencarbonate ions. This involves the enzyme carbonic anhydrase.

Complete the passage summarising the production of hydrogencarbonate ions by:

- writing the correct biological term in the spaces provided
- writing the molecular formula for **two** of the terms in the spaces in brackets.

Carbonic anhydrase has an overall spherical shape and is known as a ..... protein. The enzyme acts within the cell so can be described as an ..... enzyme. When blood passes into the capillary network through actively respiring tissues, carbon dioxide (CO_2) diffuses into red blood cells and carbonic anhydrase catalyses a reaction where ..... (.....) is combined with CO_2 to form ..... (H_2CO_3), which rapidly forms ..... ions (.....) and hydrogencarbonate ions (HCO_3^-). [5]

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10. Nov/2022/Paper_22/No.4(a, b)

The airways of the gas exchange system are lined with epithelium. Gradual changes in the structural features of this epithelium occur as the airways branch and become increasingly narrow.

(a) Table 4.1 shows the changes that occur in the number of goblet cells in the epithelium of the different structures of the gas exchange system.

Table 4.1

gas exchange structure	number of goblet cells in epithelium
trachea	many
bronchi	many
larger bronchioles	very few
smaller bronchioles	none
alveoli	none

Goblet cells produce mucus, which is important in maintaining the health of the airways.

The smallest bronchioles closest to the alveoli are known as respiratory bronchioles.

Suggest **and** explain why respiratory bronchioles do not have any goblet cells.

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.....

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..... [2]

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(b) Fig. 4.1 is a photomicrograph of a section through a bronchiole, which is surrounded by alveoli.

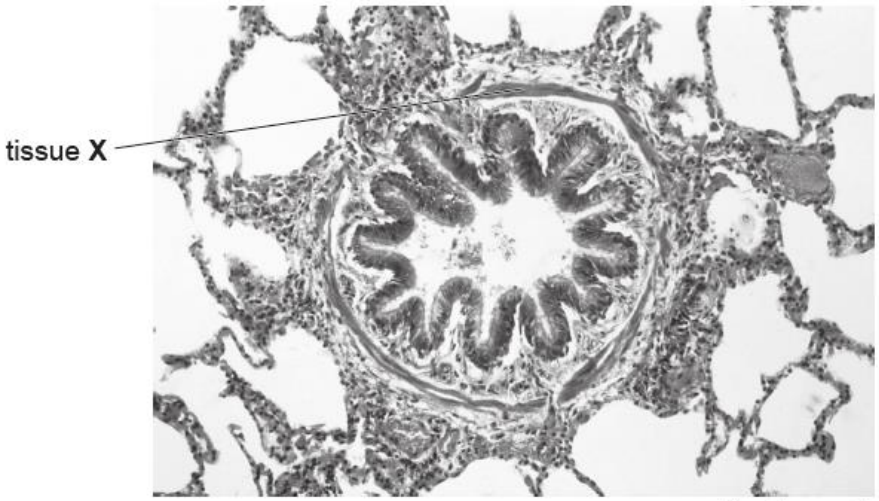


Fig. 4.1

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(i) There are structural differences between the epithelium of the bronchiole and the epithelium of an alveolus.

Describe the differences between the epithelium of bronchioles and the epithelium of alveoli, **other than** differences in the number of goblet cells.

.....

.....

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.....

.....

.....

.....

..... [3]

(ii) Tissue **X**, shown in Fig. 4.1, is located in the wall of the bronchiole.

Name tissue **X and** outline the function of tissue **X** in the bronchiole.

tissue **X** = ...

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

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11. Nov/2022/Paper_23/No.6

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

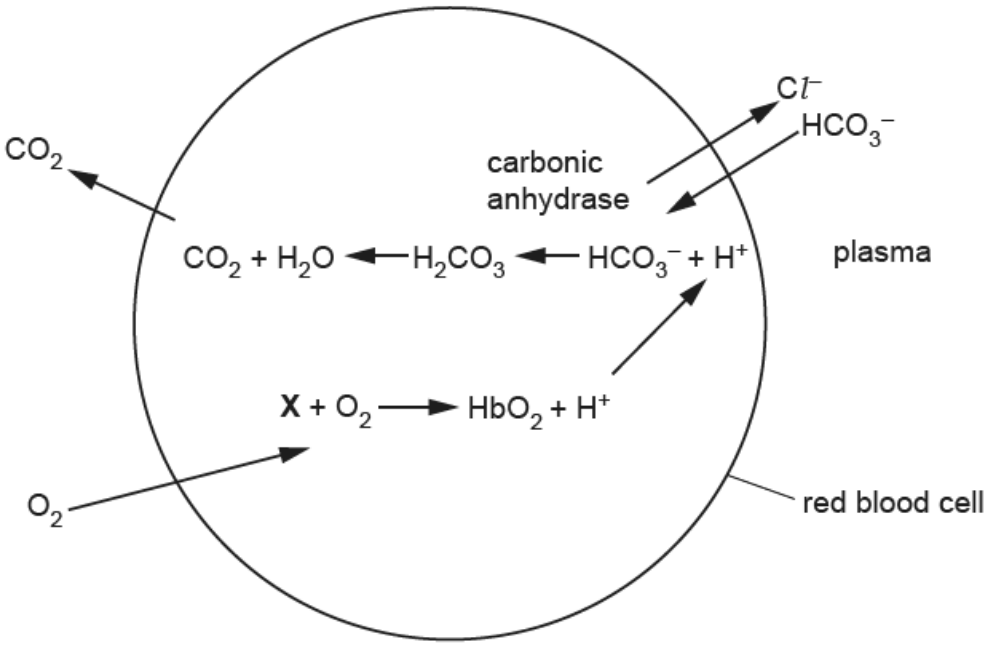


Fig. 6.1

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

.....

.....

..... [1]

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

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

.....

.....

..... [1]

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

.....

..... [1]

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

.....

..... [1]

[Total: 4]

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Gas exchange – AS 9700 June 2022

1. June/2023/Paper_9700/11/No.34

A person with no breathing conditions rests for an hour. Their breathing in this time is shallow and slow, so little air from outside the body reaches the alveoli. The person's heart rate remains constant.

Which statement is correct?

A The carbon dioxide concentration in the blood in the pulmonary vein will be higher than in the pulmonary artery.

B Carbon dioxide molecules in the air of the alveoli move out of the blood by active transport.

C The air in the alveoli has a lower concentration of oxygen than the blood in the pulmonary vein.

D Oxygen molecules diffuse from the air in the alveoli into the blood at a slower rate than when the person is active.

2. June/2023/Paper_9700/11/No.35

Which statements about **all** bronchioles are correct?

1 They have epithelium.

2 They have goblet cells.

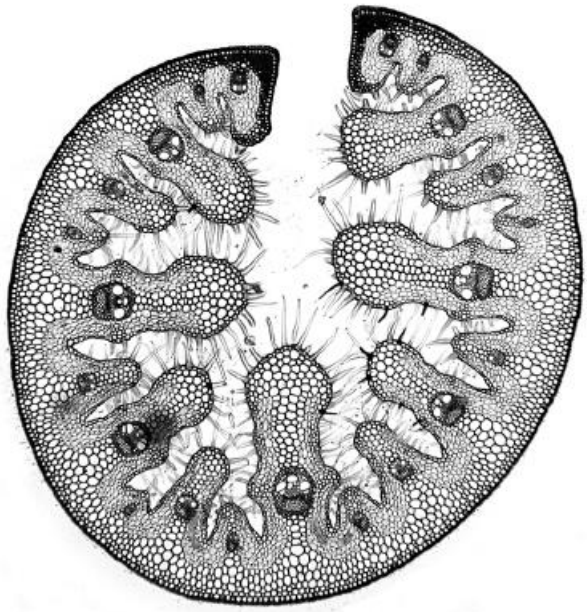
3 They have muscle tissue.

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

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3. June/2023/Paper_9700/12/No.30

The photomicrograph shows a transverse section of the leaf of a species of grass.



The grass is specially adapted to grow in a dry habitat.

Which row correctly explains how the features help the grass to grow in this habitat?

	hair-like structures	leaf shape
A	increase internal humidity	decrease external humidity
B	decrease external humidity	increase internal humidity
C	increase internal humidity	increase internal humidity
D	decrease external humidity	decrease external humidity

4. June/2023/Paper_9700/12/No.35

Where are squamous epithelial cells found in the human gas exchange system?

	trachea	bronchus	alveolus
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = found

✗ = not found

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5. June/2023/Paper_9700/12/No.36

Which statement about gas exchange between air in the alveoli and blood in the pulmonary capillaries is correct?

A The oxygen concentration in the capillaries leaving the pulmonary artery is higher than the oxygen concentration in the alveoli.

B Gases must diffuse across the endothelium of the pulmonary capillaries and the endothelium of the alveoli.

C The elastic fibres in the alveoli walls allow the alveoli to expand to increase the surface area available for diffusion into the pulmonary capillaries.

D Breathing out reduces the carbon dioxide concentration gradient between the blood in the pulmonary capillaries and the air in the alveoli.

6. June/2023/Paper_9700/12/No.37

The average thicknesses for some structures in the human respiratory system are shown.

structure	average thickness of structure / nm
human cell membrane	5
cytoplasm of alveolar wall cells	190
cytoplasm of capillary wall cells	90
tissues between alveolar wall and capillary wall	300

A molecule of oxygen is in the alveolar air space next to the wall of the alveolus.

What is the shortest distance that the molecule needs to diffuse from its current position to the haemoglobin that completely fills a red blood cell in the nearest capillary?

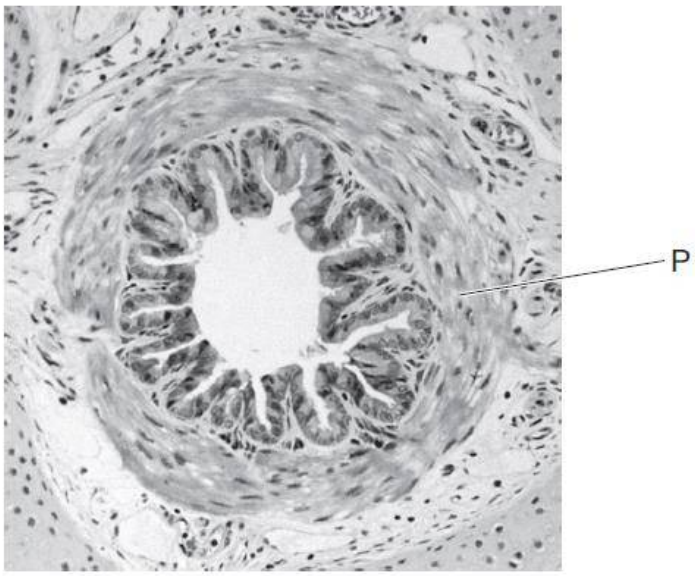
(Assume that the red blood cells touch the walls of a capillary.)

A 595 nm **B** 600 nm **C** 605 nm **D** 610 nm

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7. June/2023/Paper_9700/13/No.37

The photomicrograph shows a part of the human gas exchange system with one tissue labelled P.



Which row is correct?

	part of gas exchange system	function of tissue P
A	bronchus	regulates the amount of air reaching the lungs
B	bronchus	provides support and prevents collapse
C	bronchiole	regulates the amount of air reaching the lungs
D	bronchiole	provides support and prevents collapse

8. June/2023/Paper_9700/13/No.38

How many times must a molecule of oxygen pass through a cell surface membrane as it diffuses from the airspace inside an alveolus, through a cell in the capillary wall, to bind to a molecule of haemoglobin?

A 3 **B** 4 **C** 5 **D** 10

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9. March/2023/Paper_9700/12/No.34

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 At low partial pressures of oxygen, it binds to oxygen more strongly than the haemoglobin of larger mammals.

B It saturates with oxygen at lower partial pressures of oxygen than the haemoglobin of larger mammals.

C It releases oxygen more easily than the haemoglobin of larger mammals.

D When the partial pressure of oxygen is high, it carries more oxygen than the haemoglobin of larger mammals.

10. March/2023/Paper_9700/12/No.35

What is an effect of an increased concentration of carbon dioxide in the blood?

A increased movement of chloride ions out of red blood cells

B increased concentration of haemoglobinic acid

C decreased concentration of hydrogencarbonate ions in blood plasma

D decreased concentration of carbaminohaemoglobin

11. March/2023/Paper_9700/12/No.36

Two of the requirements of an efficient gas exchange system are a large surface area and a short diffusion distance.

Which row correctly describes how alveoli are adapted to meet these requirements?

	large surface area	short diffusion distance
A	elastin fibres prevent the alveolus wall from collapsing	an extracellular layer inside the alveolus wall contains blood capillaries
B	gases dissolve in a layer of liquid to speed up diffusion	alveolar walls are next to capillaries
C	alveoli are folded and interconnected	walls of alveoli are only one cell thick
D	walls of alveoli are formed of squamous epithelial cells	red blood cells are very close to capillary walls

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Gas exchange – AS 9700 November 2023

1. Nov/2023/Paper_ 9700/11/No.31

Sulthiame is a molecule that inhibits carbonic anhydrase.

Which effect would sulthiame have inside a red blood cell in muscle tissue that is respiring at a high rate?

A a decrease in the rate of formation of haemoglobinic acid

B a decrease in the pH

C an increase in the rate of the chloride shift

D an increase in the dissociation of oxyhaemoglobin

2. Nov/2023/Paper_ 9700/11/No.33

Which statements about the Bohr shift are correct?

1 The shift is accelerated by the action of carbonic anhydrase.

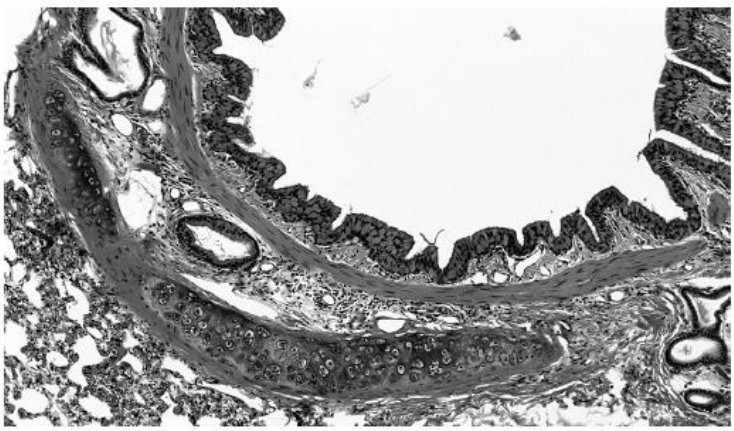
2 A decrease in blood pH will cause oxyhaemoglobin to dissociate.

3 A decrease in carbon dioxide concentration will cause more oxygen to bind to haemoglobin.

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

3. Nov/2023/Paper_ 9700/12/No.34

The photomicrograph shows a section through part of the human gas exchange system.



Which structure is shown?

A alveolus

B bronchiole

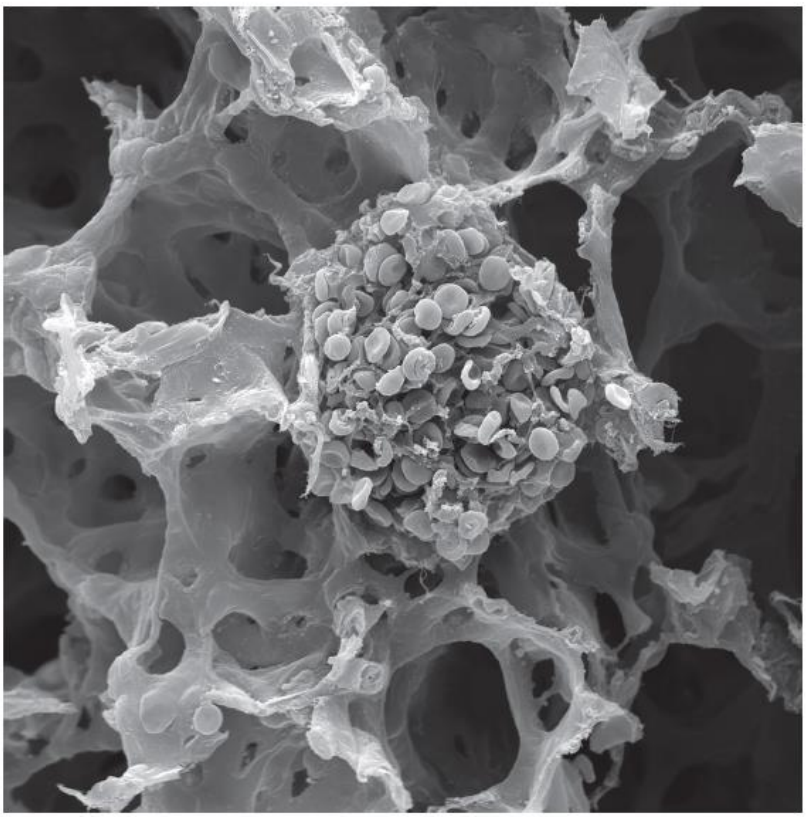
C bronchus

D trachea

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4. Nov/2023/Paper_ 9700/12/No.35

What is shown in the electron micrograph?



×850

A scanning electron micrograph of bronchial epithelium and lymphocytes

B scanning electron micrograph of lung squamous epithelium and red blood cells

C transmission electron micrograph of bronchial epithelium and lymphocytes

D transmission electron micrograph of lung squamous epithelium and red blood cells

5. Nov/2023/Paper_ 9700/13/No.33

What is typically found in the trachea, bronchi and bronchioles in the human gas exchange system?

A cartilage

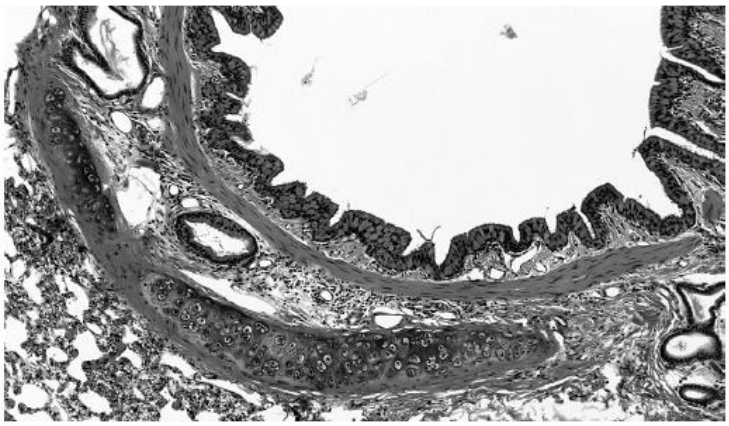
B ciliated epithelium

C squamous epithelium

D squamous endothelium

6. Nov/2023/Paper_ 9700/13/No.34

The photomicrograph shows a section through part of the human gas exchange system.



Which structure is shown?

A alveolus

B bronchiole

C bronchus

D trachea

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7. Nov/2023/Paper_ 9700/21/No.5

Fig. 5.1 is a photomicrograph of a transverse section of a bronchus in the lungs.

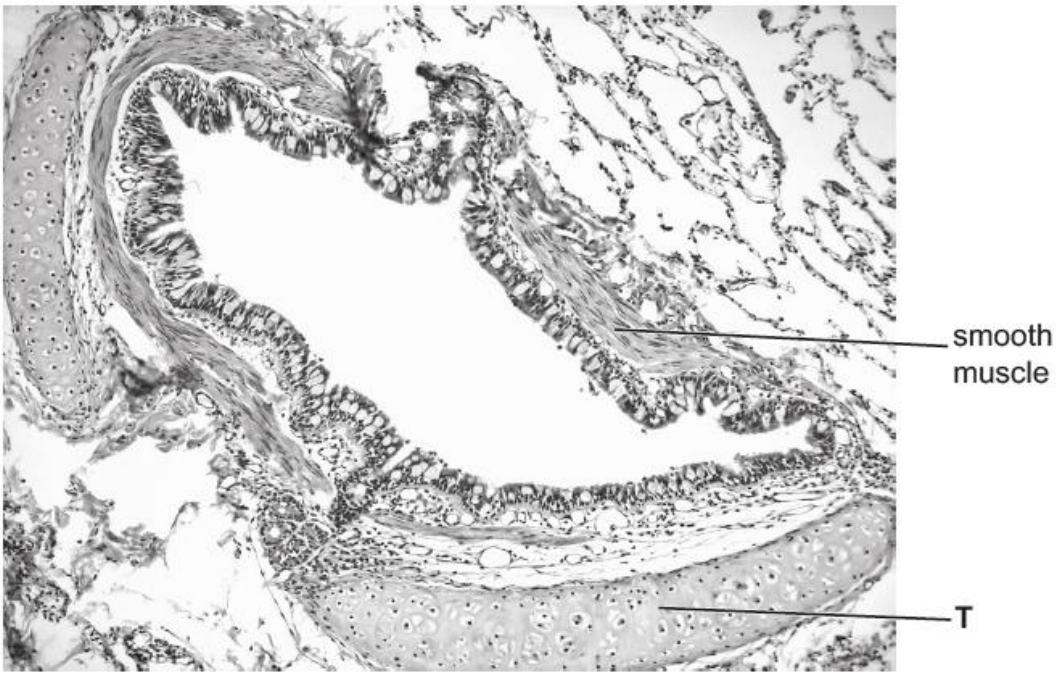


Fig. 5.1

(a) (i) Identify the tissue labelled **T** in Fig. 5.1.

..... [1]

(ii) Describe the function of smooth muscle in the bronchus.

.....

.....

.....

.....

..... [2]

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(b) The walls of alveoli contain some specialised epithelial cells called type II epithelial cells. These cells secrete surfactant. Surfactant helps to prevent the alveoli collapsing during breathing.

Surfactant contains phospholipid, cholesterol and protein.

The components of surfactant are synthesised in the rough endoplasmic reticulum and smooth endoplasmic reticulum and then passed to the Golgi body.

The surfactant that is produced is stored in secretory organelles called lamellar bodies.

The surfactant in the lamellar bodies is released onto the surface of the alveolar epithelium by exocytosis, as shown in Fig. 5.2.

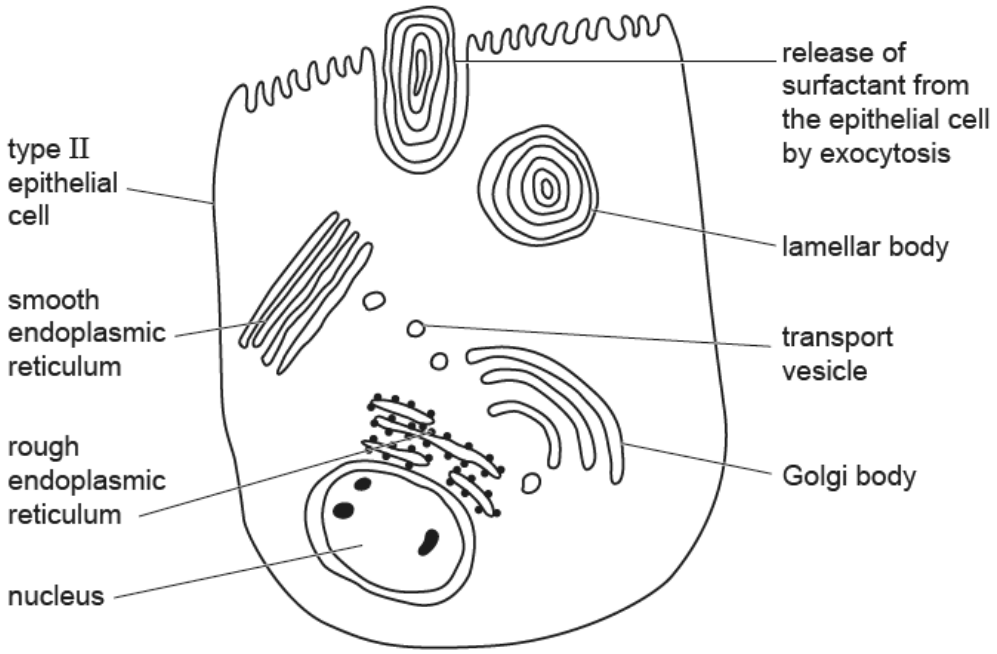


Fig. 5.2

(i) Each lamellar body is surrounded by a single membrane.

Draw a diagram to show the arrangement of phospholipid molecules in the membrane surrounding the lamellar body.

[2]

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(ii) Scientists studying the production and secretion of lung surfactant have discovered that a reduction in cholesterol in the cell surface membrane of type II epithelial cells reduces the secretion of surfactant.

Suggest why secretion of surfactant is affected by a reduction in cholesterol in the cell surface membranes of type II epithelial cells.

.....

.....

.....

.....

..... [2]

(iii) Lung surfactant is engulfed by macrophages that are in close contact with the type II epithelial cells.

Suggest why macrophages engulf surfactant.

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..... [1]

[Total: 8]

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8. Nov/2023/Paper_ 9700/22/No.4

The alveoli of the lungs are the main gas exchange surface in humans.

(a) Explain how blood flow through the alveolar capillaries helps to maintain steep diffusion gradients for gas exchange.

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..... [2]

(b) Ventilation of the lungs is the process of inhalation and exhalation. Ventilation helps to maintain steep diffusion gradients.

Explain the role of elastic fibres in the alveolar wall during ventilation.

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..... [2]

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(c) Some cells in the alveolar wall are specialised to secrete surfactant to prevent collapse of the alveoli at the end of exhalation. In these cells, surfactant is stored in membrane-bound organelles known as lamellar bodies. Surfactant is a mixture of lipids, mainly phospholipids, and some proteins.

A protein known as ATP-binding cassette transporter A3 (ABCA3) is needed to move surfactant phospholipids into lamellar bodies from the surrounding cytosol (fluid part of cytoplasm).

Suggest **and** explain the features of protein ABCA3 that make it suited to its function.

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..... [3]

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(d) The gene *ABCA3* codes for protein ABCA3. The gene is 80 kb (80 000 base pairs) long and is composed of introns and exons. Protein ABCA3 is composed of 1704 amino acids.

(i) Fig. 4.1 shows the flow of genetic information in the production of ABCA3.

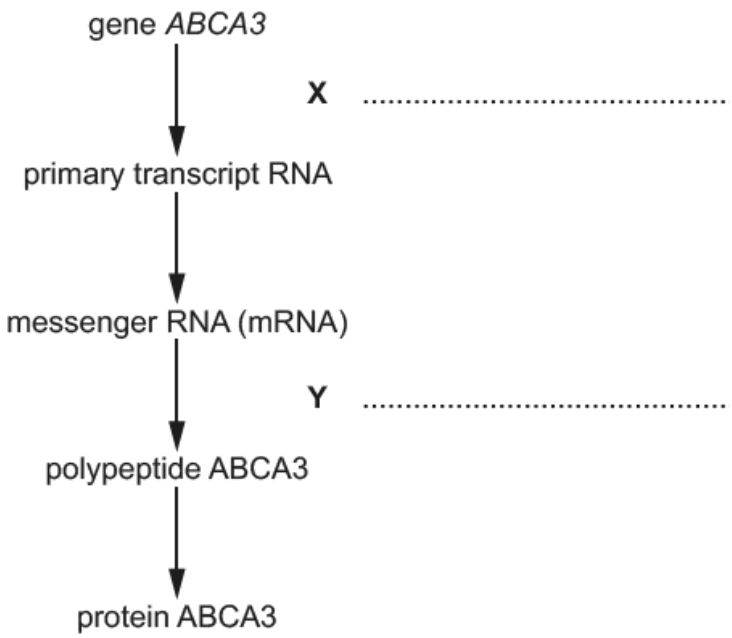


Fig. 4.1

Complete Fig. 4.1 to name the processes occurring at **X** and **Y**. [2]

(ii) A triplet of bases codes for one amino acid. This fact only partly explains how the activity of gene *ABCA3*, which is 80 kb long, can result in the protein ABCA3, which is only 1704 amino acids long.

Suggest **other** reasons to explain the difference in the number of base pairs in gene *ABCA3* compared with the number of amino acids in protein ABCA3.

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..... [3]

[Total: 12]

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