9. Gas exchange

1.

Which statement helps to explain why there is no cartilage in the walls of the bronchioles?

A Cartilage would make the bronchioles too narrow.

B Gases must diffuse across the walls of the bronchioles.

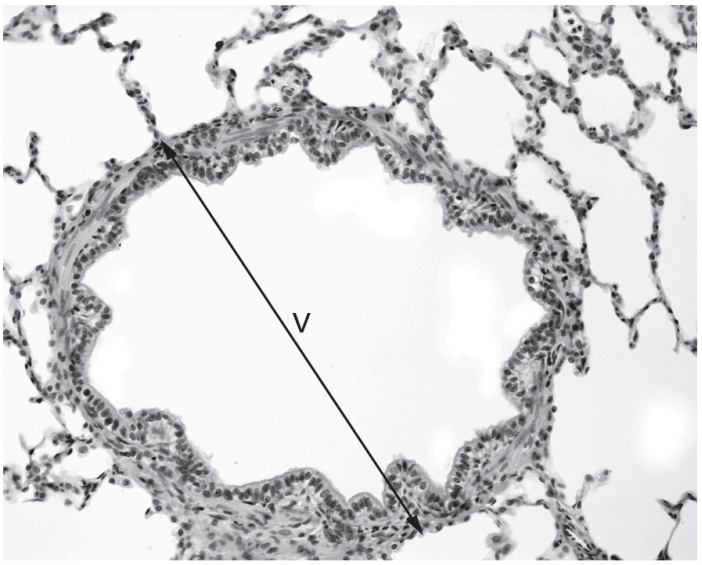
C Smooth muscle is sufficient to support the walls of the bronchioles.

D The bronchiole walls do not need to change shape.

Ans: C

2.

The photomicrograph shows a cross-section of part of the gas exchange system of a mammal.



What is shown by the line labelled V?

A the diameter of an alveolus

B the diameter of a bronchiole

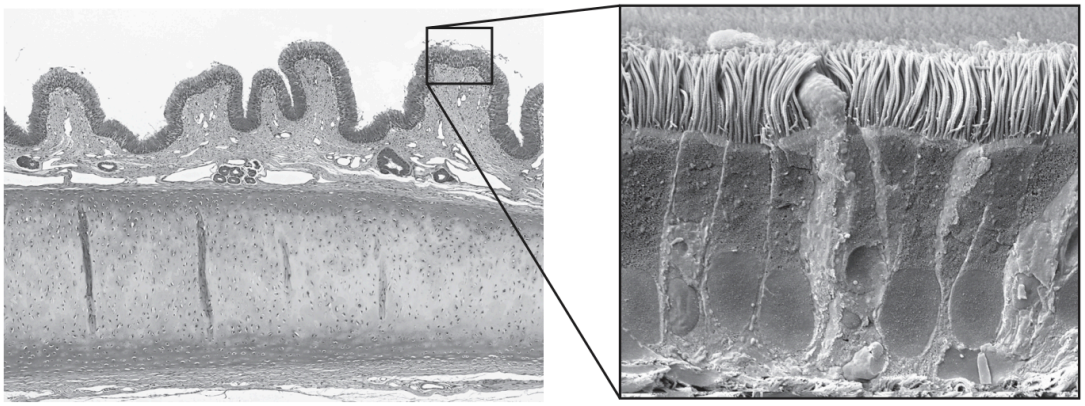
C the diameter of a capillary

D the diameter of a trachea

Ans: B

3.

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

Ans: D

4.

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

Ans: D

Surfactant is the liquid which prevents alveoli from collapsing. This is the only factor!

5.

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

Ans: B
NOTE: bronchi are NOT supported by rings of cartilage, rather by blocks of cartilage!

6.

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

Ans: C

7.

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.

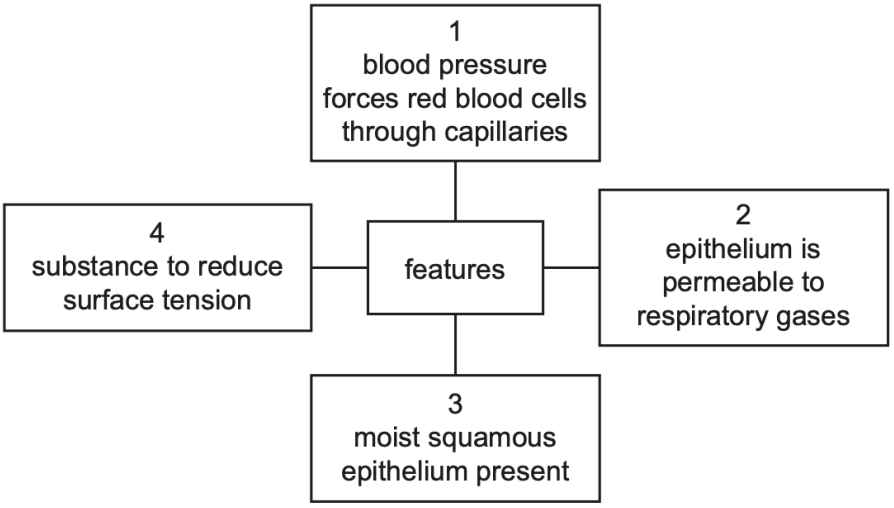
4 Carbon dioxide and water are formed from hydrogencarbonate ions and hydrogen ions.

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

Ans: D

8.

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

Ans: A

NOTE: surfactant reduces surface tension, thus preventing collapse of alveoli. It is not needed for diffusion of O2.

9.

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

Ans: A

NOTE:

Feature	**Trachea**	**Bronchus**	**Bronchiole**
Cartilage	✓ regular C-shaped ring arrangement	✓ irregular arrangement	X
Ciliated epithelium	✓	✓	✓
Goblet cells	✓	✓	X
Smooth muscle	✓	✓	✓ terminal X respiratory

10.

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

Ans: C

11.

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.

Ans: D

12.

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

Ans: B

13.

Which statements about the function of tissues found in the human gas exchange system are correct?

1 Collagen in the bronchi prevents them collapsing.

2 Smooth muscle in the bronchioles can contract to increase the flow of air into the alveoli.

3 Elastic fibres in the alveoli stretch and recoil during breathing.

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

Ans: D

- Statement 1: cartilage prevents collapsing of bronchi
- Statement 2: Contraction of smooth muscle would decrease the flow of air

NOTE:

- Smooth muscle contraction narrows the airway lumen
- Smooth muscle relaxation widens airway lumen

14.

Steep concentration gradients must be maintained for efficient gaseous exchange to occur in the human lungs.

Which row correctly describes how steep concentration gradients can be maintained?

	elastic fibres in the walls of the alveoli recoil when breathing out	continual supply of deoxygenated blood by the pulmonary artery
A	✓	✓
B	✗	✓
C	✓	✗
D	✗	✗

key

✓ = helps maintain

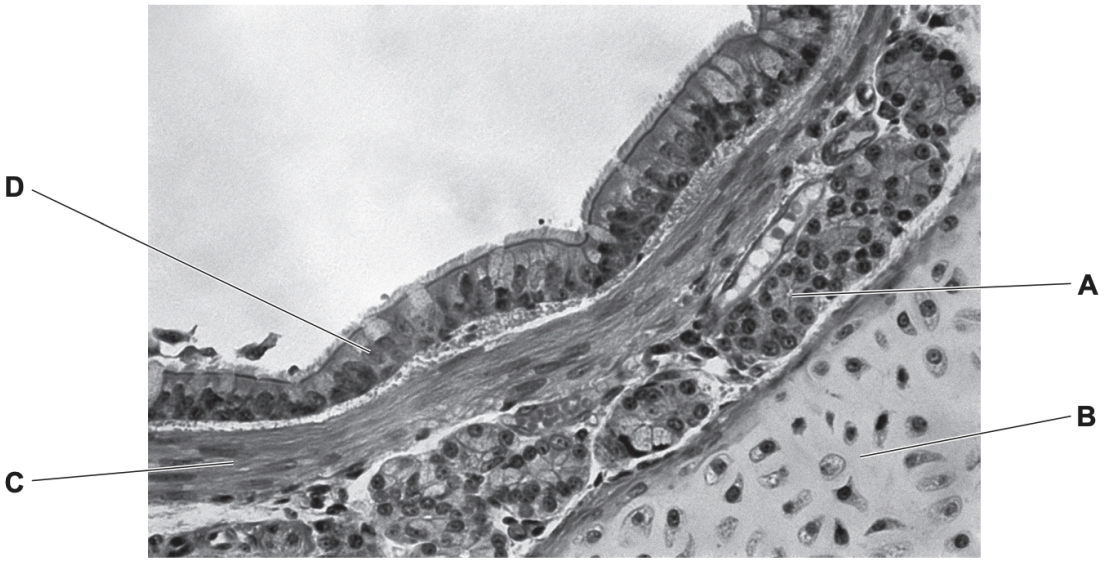
✗ = does not help maintain

Ans: A

15.

The photomicrograph shows part of a bronchus.

Which label identifies cartilage?

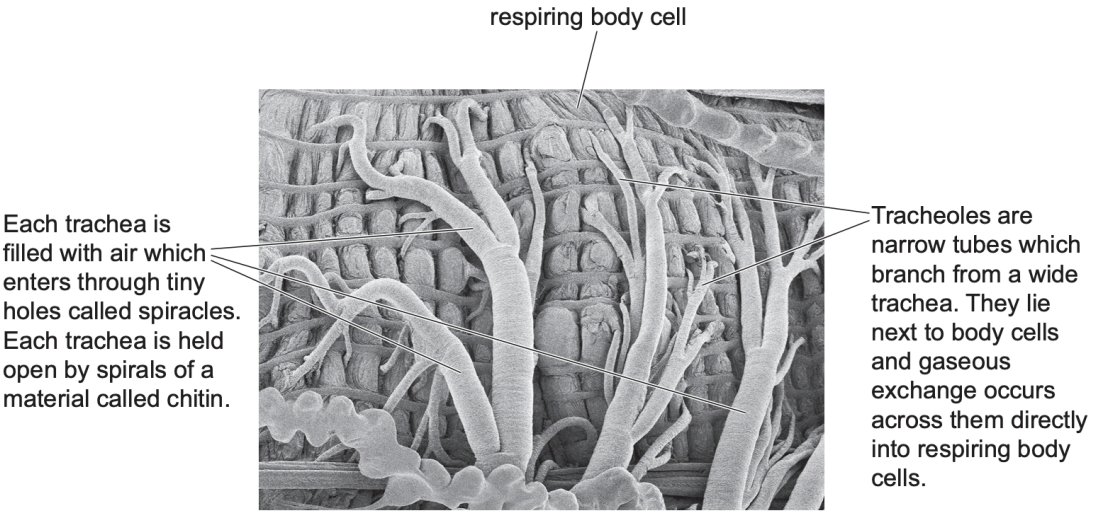


Ans: B

- A = glandular tissue (mucous glands)
- B = cartilage
- C = smooth muscle
- D = ciliated epithelium

16.

34 The electron micrograph shows some of the airways in the gaseous exchange system of an insect and the respiring body cells that surround them.



Which statements describe correct differences between the insect gas exchange system shown in the electron micrograph and the human gas exchange system?

1 Gas exchange occurs through the walls of the airways directly into respiring body cells in insects but this does **not** occur in humans.

2 There are spirals of chitin in the walls of a trachea in insects to hold it open but **not** in humans.

3 There is more than one trachea in the gas exchange system of the insect but only one in humans.

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

Ans: A

17.

Which structures are present in the trachea **and** also in all bronchioles?

1 cartilage

2 smooth muscle

3 epithelial cells

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

Ans: C

18.

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.

Ans: C

19.

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

Ans: C

- Wall of alveolus = 5+190+5 = 200
- Between alovlar wall and capillary wall = 300
- Wall of capillary = 5+90+5 = 100
- Wall of RBC = 5
- 200 + 300 + 100 + 5 = 605