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.

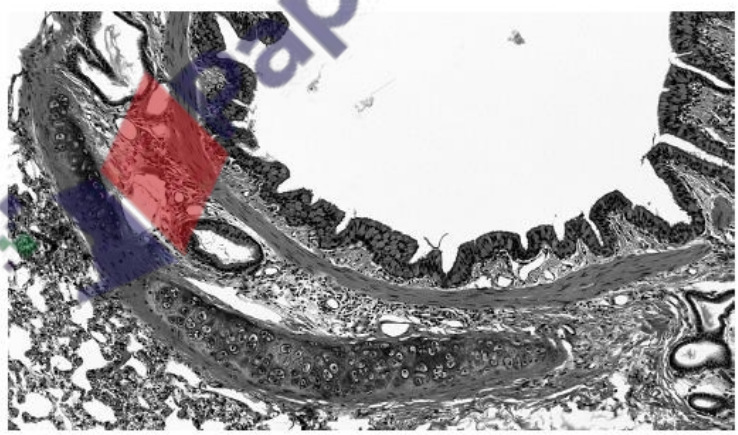
2 A decrease in blood pH will cause oxyhaemoglobin to dissociate.

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

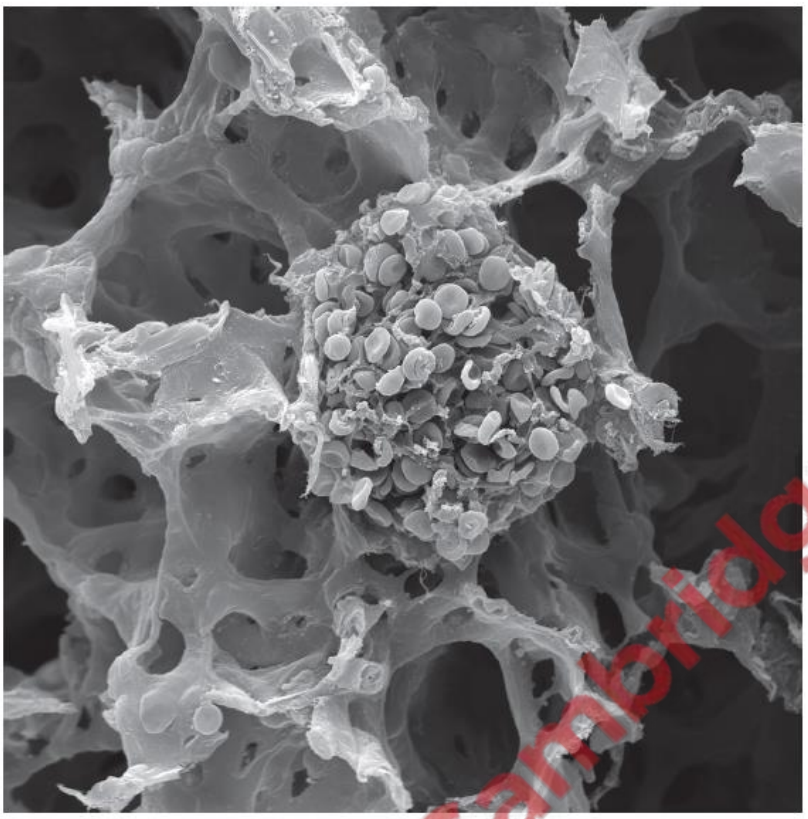
B bronchiole

C bronchus

D trachea

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

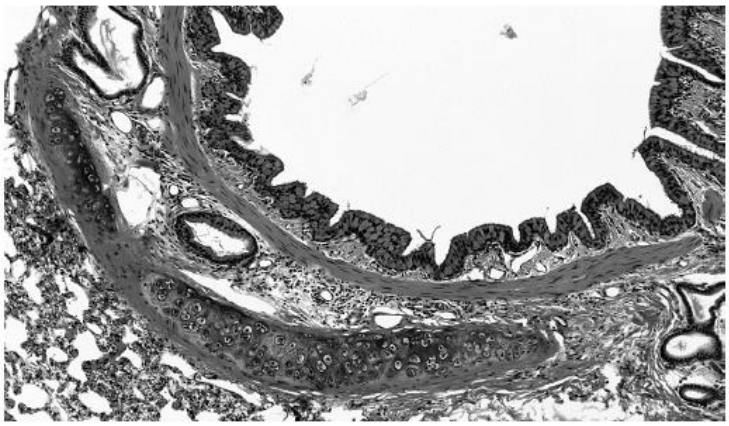
B ciliated epithelium

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

7. Nov/2023/Paper_ 9700/21/No.5

Fig. 5.1 is a photomicrograph of a transverse section of a bronchus in the lungs.

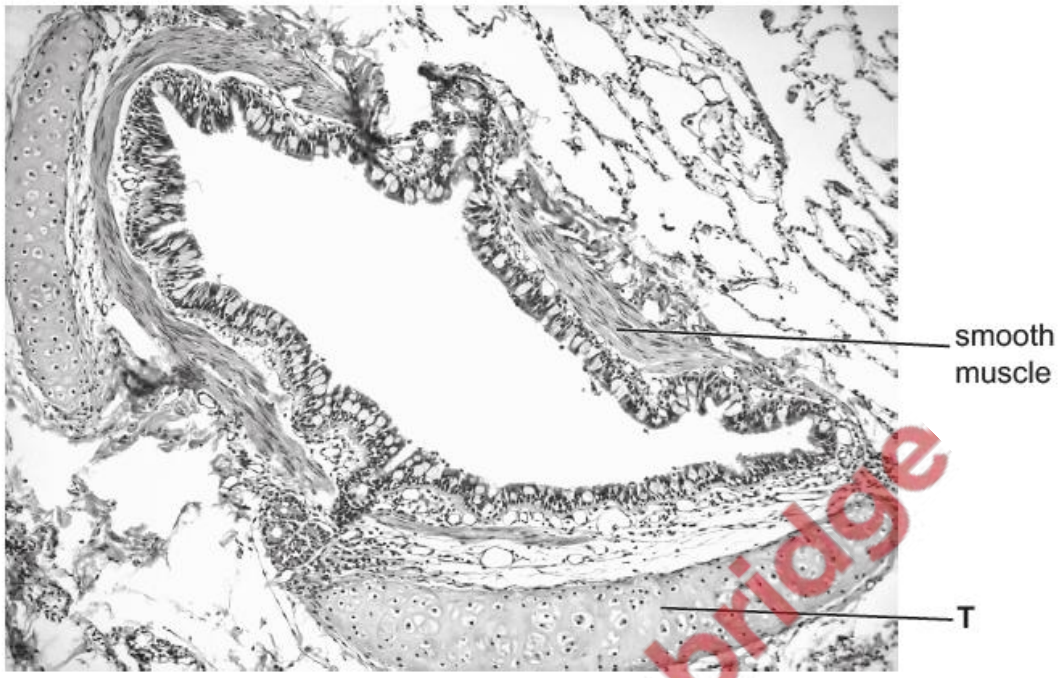


Fig. 5.1

(a) (i) Identify the tissue labelled **T** in Fig. 5.1.

..... [1]

(ii) Describe the function of smooth muscle in the bronchus.

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..... [2]

(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.

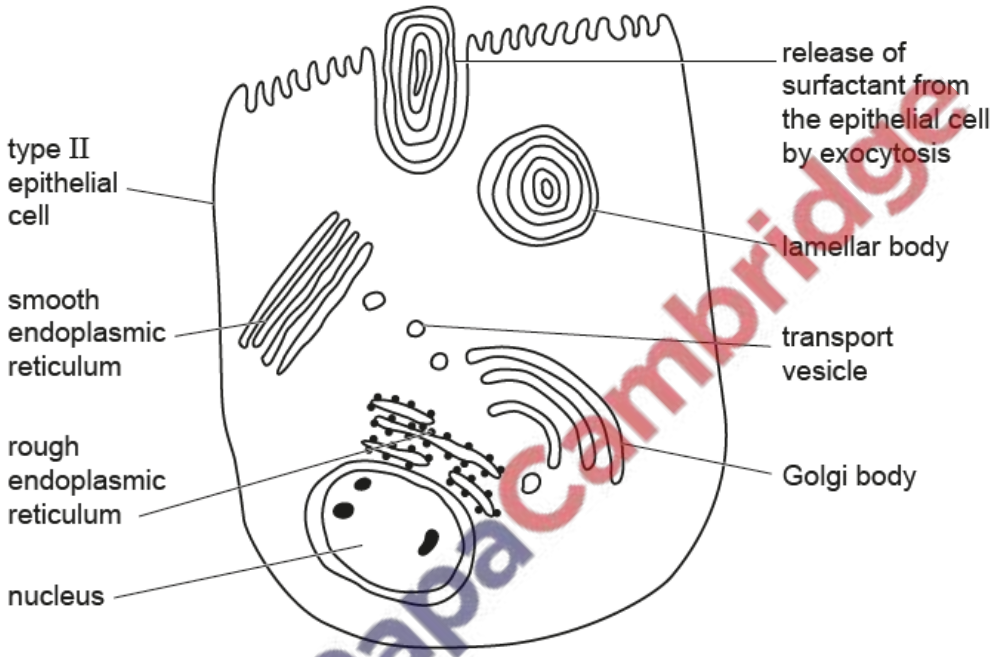

Fig. 5.2

(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]

(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.

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..... [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]

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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(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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(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]

(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.

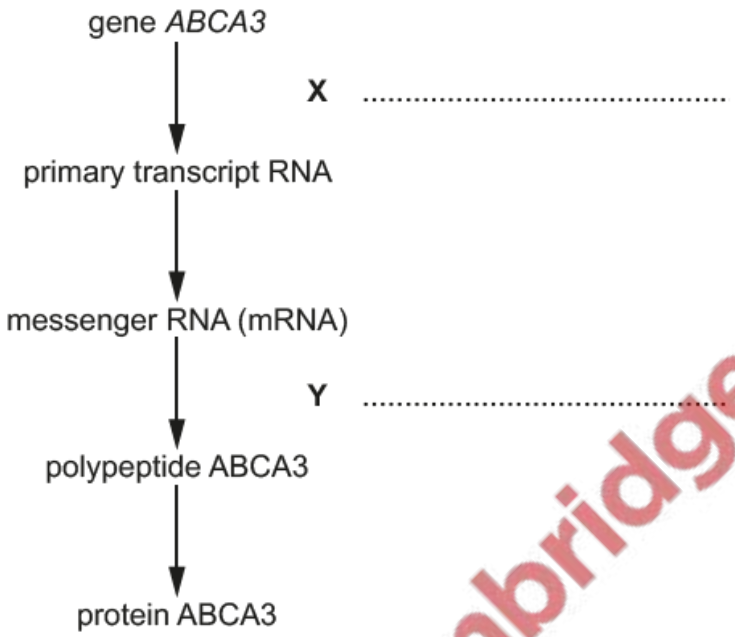

Fig. 4.1

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]