9.1 The gas exchange system

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS gas exchange • bronchi • alveoli • bronchiole • trachea

Objective

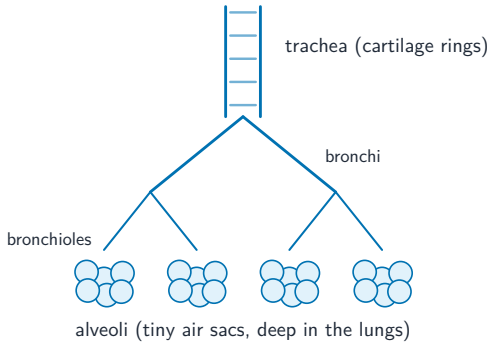
Build the skills to answer exam questions on **the gas exchange system** – its structure, the tissues of the airways, and **gas exchange** in the **alveoli** .

You must be able to:

- describe the structure of the gas exchange system and the distribution of its tissues
- describe the functions of cartilage, ciliated epithelium, goblet cells, smooth muscle and squamous epithelium
- explain how the alveoli are adapted for gas exchange

1 Key knowledge and worked examples

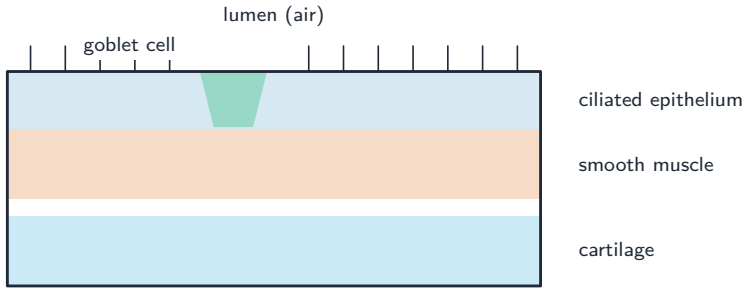
The airways



Air passes down the trachea, into the bronchi and bronchioles, to the alveoli

Air path: **trachea** → **bronchi** → **bronchioles** → **alveoli**, each wrapped in **capillaries** .

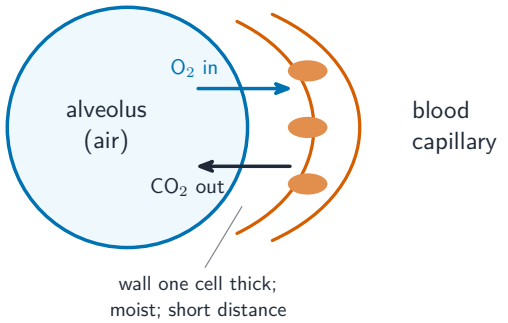
Tissues and their functions



Cilia and goblet cells line the lumen; smooth muscle and cartilage support the wall

- **cartilage** – holds the airway open.
- **ciliated epithelium** – cilia sweep **mucus** up to the throat.
- **goblet cells** – make mucus that traps dust and microbes.
- **smooth muscle** – narrows the airway; **elastic fibres** recoil to push air out.
- **squamous epithelium** – very thin alveolus lining → short diffusion distance.

Gas exchange in the alveoli



Across the thin, moist wall: oxygen diffuses into the blood, carbon dioxide diffuses out

Alveoli are adapted by: a **large surface area** (millions of sacs), a **thin wall** (one cell thick – short diffusion distance), a **rich blood supply**, and a **moist lining**. Breathing and blood flow keep the **concentration gradients** steep.

2 Practice

2.1 State the function of (a) cartilage and (b) goblet cells in the airways. [2]

2.2 State **three** features that make the alveoli good for gas exchange. [3]

3 Exam-style questions

3.1 Which tissue keeps the trachea open when air pressure inside falls? [1]

- **A** cartilage
- **B** ciliated epithelium
- **C** goblet cells
- **D** smooth muscle

3.2 Why do oxygen molecules diffuse from the alveolar air into the blood? [1]

- **A** the blood is warmer than the air
- **B** oxygen is at a higher concentration in the alveolar air than in the blood
- **C** the alveolus wall is thick
- **D** carbon dioxide pushes the oxygen across

3.3 Explain how the ciliated epithelium and goblet cells together keep the lungs healthy. [3]

3.4 An alveolus has a diameter of 250 µm. In a photomicrograph it measures 20 mm across.

(a) Calculate the magnification of the photomicrograph. [2]

(b) Explain why a one-cell-thick alveolus wall speeds up gas exchange. [2]

Solutions

Each answer shows the steps, then the **result**.

2.1

(a)

- cartilage holds the airway open / stops it collapsing

(b)

- goblet cells make mucus that traps dust and microbes

2.2

- any three: large surface area; thin (one-cell) walls / short diffusion distance; rich/good blood supply; moist surface

3.1 A

- Cartilage holds the trachea open

3.2 B

- Oxygen diffuses down its concentration gradient from high (air) to low (blood)

3.3

- goblet cells secrete mucus that traps dust and microbes; the cilia beat to sweep the mucus up towards the throat; it is swallowed, keeping the airways clear of pathogens

3.4

(a)

- 20 mm = 20 000 µm; magnification $= \dfrac{20\,000}{250} = \times 80$

(b)

- a thin wall gives a short diffusion distance, so gases cross faster