

9.1 The gas exchange system

Name: _____ Class: _____ Date: _____

Total: 14 marks

KEY WORDS gas exchange 气体交换 • bronchi 支气管 • alveoli 肺泡 • bronchiole 细支气管 • trachea 气管

Objective

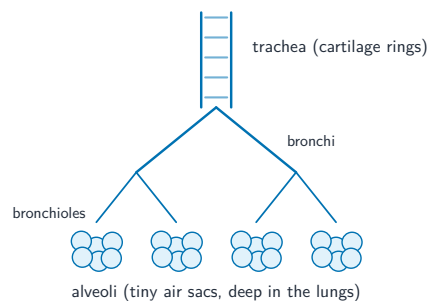
Build the skills to answer exam questions on **the gas exchange system** — its structure, the tissues of the airways, and **gas exchange** 气体交换 in the **alveoli** 肺泡.

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 Worked examples

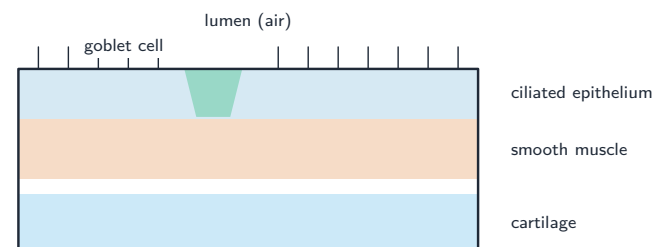
■ The airways



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

Air path: **trachea** 气管 → **bronchi** 支气管 → **bronchioles** 细支气管 → **alveoli**, each wrapped in **capillaries** 毛细血管.

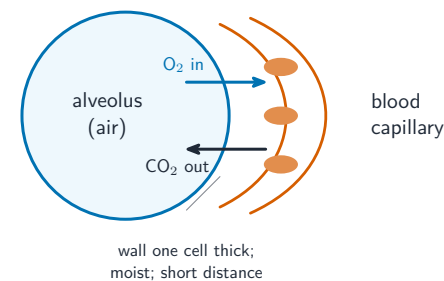
■ Tissues and their functions



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

- **cartilage** 软骨 — holds the airway open.
- **ciliated epithelium** 纤毛上皮 — cilia sweep **mucus** 黏液 up to the throat.
- **goblet cells** 杯状细胞 — make mucus that traps dust and microbes.
- **smooth muscle** 平滑肌 — narrows the airway; **elastic fibres** recoil to push air out.
- **squamous epithelium** 扁平上皮 — 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** 浓度梯度 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

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) $20\text{ mm} = 20\,000\text{ }\mu\text{m}$; magnification = $\frac{20\,000}{250} = \times 80$.

(b) a thin wall gives a short diffusion distance, so gases cross faster.