Solutions

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

2.1

- the **trachea**
- the cartilage holds the trachea **open**, so air can always pass through it

2.2

- any **two** features, each with its reason:
- **large surface area** – so more gas can diffuse at the same time
- **thin, one cell thick** – so the diffusion distance is short
- other acceptable pairs: a **good blood supply**, or **good ventilation**, each because it keeps a steep concentration gradient

2.3

- the **external intercostal muscles contract**
- so the ribs move **up and out**
- the **diaphragm contracts** and **flattens**, moving down

2.4

- the volume of the thorax **increases**
- so the pressure inside it **decreases**, and becomes lower than the air pressure outside
- air therefore moves **from the higher pressure outside to the lower pressure inside**, and enters the lungs

2.5

- the limewater turns **milky** (cloudy white) quickly
- the control is a second tube of limewater through which **inspired air** is drawn; it goes milky only slowly, showing the difference is caused by the expired air

2.6

- goblet cells make **mucus**, which traps particles and pathogens
- ciliated cells have **cilia** that sweep the mucus up to the throat, where it is swallowed

3.1 A

- breathing in: the external intercostals contract and the diaphragm contracts and flattens, so the thorax gets **bigger** and the pressure inside gets **lower**
- **B** has the diaphragm doing the opposite; **C** and **D** describe breathing out

3.2

(a)

- oxygen **diffuses** from the air in the alveoli into the blood

- because it is used by the body cells in **respiration**, which keeps its concentration in the blood low

(b)

- the alveoli and the airways have **moist** surfaces
- water **evaporates** from them into the air, so the air breathed out carries much more water vapour

(c)

- 16% is still a high enough concentration of oxygen for it to **diffuse into the casualty's blood** in the alveoli
- so their cells can still respire, which keeps them alive until help arrives

3.3

(a)

- multiply the rate by the volume of each breath

at rest: $14 \times 0.5 = \mathbf{7}$ $\mathbf{dm^3}$ per minute during: $30 \times 1.8 = \mathbf{54}$ $\mathbf{dm^3}$ per minute

(b)

- the breathing **rate** rose, from 14 to 30 breaths per minute
- the **depth** of each breath rose too, from 0.5 to 1.8 dm^3

(c)

- her muscles **respired faster** during the exercise, to release more energy
- so they produced more **carbon dioxide**, which entered the blood
- the **brain** detected the increased carbon dioxide concentration in the blood
- and increased the **rate and depth** of breathing, so that more carbon dioxide is removed and more oxygen taken in

(d)

- the carbon dioxide concentration in her blood has **not yet returned** to its resting level
- so the brain is still stimulating faster, deeper breathing until the extra carbon dioxide has been removed

(e)

- any **two** of: the **type** of exercise; how **long** the exercise lasts; how **hard** the exercise is; the time after exercise at which the measurements are taken