Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

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

2.1

$Q = 150 \times 120 = 18\,000$ ml min^{-1} = **18** L min^{-1}

2.2

the impulse starts at the SA node and spreads over the atria, which contract; it reaches the AV node, which delays it so the ventricles can fill; it passes down the bundle of His and through the Purkinje fibres, so the ventricles contract from the bottom up

2.3

the diaphragm contracts and flattens; the external intercostal muscles contract, moving the ribs up and out; chest volume rises so pressure in the lungs falls below air pressure, and air flows in

2.4

(a) rest $0.5 \times 12 =$ **6** L min^{-1}; exercise $2.5 \times 40 =$ **100** L min^{-1}

(b) $100 \div 6 \approx$ **17** times

(c) chemoreceptors

3.1

(a) by diffusion; from a higher partial pressure of O_2 in the alveolus to a lower partial pressure in the blood

(b) any two, explained: walls one cell thick, so a short diffusion distance; a huge surface area; dense capillary network keeps the gradient high; moist lining

3.2

(a) stroke volume rises at low to moderate intensity; then levels off (plateau) at about 40–60% of maximum

(b) anticipation of exercise activates the sympathetic system; adrenaline is released and raises heart rate (anticipatory rise)

(c) any two: muscle pump: contracting muscles squeeze veins, with valves stopping backflow; respiratory pump: pressure changes in the chest during deeper breathing; venoconstriction

3.3

(a) sea level $0.209 \times 101 =$ **21.1** kPa; altitude $0.209 \times 75 =$ **15.7** kPa

(b) the partial pressure of O_2 in the alveoli is lower; so the gradient between alveoli and blood is smaller and less O_2 diffuses in / haemoglobin is less saturated

(c) any two: more EPO, so more red blood cells and haemoglobin; more capillaries in muscle; higher breathing rate; more mitochondria / myoglobin

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(d) sweating starts earlier and more sweat is produced, so more heat is lost; plasma volume rises, so stroke volume stays higher and heart rate is lower at the same work