



ANSWER BOOK

Three other answers: tracheae, gills and stomata

Exchange surfaces and gas exchange · Unit B07

AQA 3.3.2 · OCR A 3.1.1, 3.1.3 · CAIE 7.2

6 questions · 20 marks

NAVY EDITION

SECTION A · Short, 1 to 2 marks

- A1** **B1** each lamella is covered by a single layer of cells, so the diffusion pathway is very short. **B1** the lamellae are stacked in large numbers along each filament, giving a very large surface area; accept a capillary network inside each lamella that carries oxygen away and maintains the gradient. [2]
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SECTION B · Standard, 3 to 5 marks

- B1** **B1** in counter-current flow the water and the blood travel in opposite directions along the lamella. **B1** the water alongside any point on the lamella therefore always holds more oxygen than the blood beneath it. **B1** a concentration gradient is maintained along the whole length of the lamella, so oxygen diffuses into the blood across the entire exchange surface. **A1** in parallel flow the two fluids converge part-way along, and once they reach the same concentration diffusion stops and the rest of the surface is wasted, so at best both leave at about half the starting value. [4]
- B2** **B1** the muscle cells respire anaerobically in part, so lactate accumulates in their cytoplasm. **B1** the water potential of the muscle cells falls below that of the tracheal fluid. **B1** water therefore moves out of the end of the tracheole into the muscle cell by osmosis, and air is drawn further along the tracheole to fill the space. **A1** more of the final stretch of the pathway is now gas rather than liquid, and gases diffuse far faster through air than through water, so oxygen reaches the cell sooner. [4]
- B3** **B1** gas enters through the stomata into the large air spaces of the spongy mesophyll, so it diffuses freely through the interior of the leaf. **B1** no cell is more than a fraction of a millimetre from an air space, so the diffusion distance is short enough for diffusion alone to be fast enough. **B1** the moist walls of the mesophyll cells act as the exchange surface, and together they come to several times the area of the leaf itself. **A1** the leaf interior is saturated with water vapour while the air outside rarely is, so a pore open enough to admit carbon dioxide also lets water vapour diffuse out. [4]
- B4** **B1** in water the lamellae are supported and held apart, but in air they stick together and collapse into a wet mass. **B1** the surface area available for gas exchange therefore falls sharply. **A1** rate of diffusion is proportional to surface area, so too little oxygen crosses into the blood however much is present in the air around the fish. [3]
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B5 **B1** the insect pipes oxygen as a gas along tracheae and tracheoles directly to the cells, whereas the fish takes oxygen up at the gill and carries it in the blood. **B1** the insect's blood plays little or no part in oxygen transport, whereas the fish depends on haemoglobin to raise the amount of oxygen each volume of blood can carry. **A1** the insect's diffusion distance from air to cytoplasm is under a micrometre, whereas the fish's gill may be many centimetres from a working muscle, so a mass transport system is unavoidable. [3]
