

Exchange of Substances - Mark Scheme

Q1.

| Question Number | Acceptable Answer | Additional Guidance | Mark |
|-----------------|--|---------------------|------------|
| | <p>An explanation that makes reference to five of the following:</p> <ul style="list-style-type: none"> • rate of diffusion is proportional to surface area - alveoli have large surface area (1) • rate of diffusion is proportional to difference in concentration – breathing maintains a difference in gas concentrations (1) • rate of diffusion is proportional to difference in concentration – blood flow maintains a difference in gas concentrations (1) • rate of diffusion is inversely proportional to diffusion distance – walls of alveoli and capillaries are one cell thick (1) • diffusion distance is reduced due to flattened cells forming alveoli and capillary walls (1) • rate of diffusion is proportional to diffusion constant – cell membranes are relatively permeable to non-polar gas molecules (1) | | (5) |

Q2.

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|-----------------|--|---|------|
| (a) | <ol style="list-style-type: none"> idea of large surface area to volume ratio or that it is thin (body) ; idea that this helps diffusion e.g. short diffusion distance, faster diffusion ; | <ol style="list-style-type: none"> IGNORE flat, small unqualified, thin membrane, thin skin etc NOT cell wall IGNORE gas exchange NOT osmosis | (2) |

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|-----------------|--|---|------|
| (b)(i) | <ol style="list-style-type: none"> solubility of oxygen decreases as temperature increases / eq ; credit correct manipulation of figures ; | <ol style="list-style-type: none"> ACCEPT converse, negative correlation units not required but if given then they must be correct e.g. 8.2 mg dm⁻³ difference in solubility between 0 and 40 °C, solubility halved between 5 °C and 40 °C | (2) |

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| (b)(ii) | <ol style="list-style-type: none"> idea that there is quite a lot of dissolved oxygen in the water at this temperature ; idea of oxygen concentration gradient (between water and flatworm's cells) ; idea of enzyme activity being temperature-dependent ; idea that water below 15°C would be too cold for {enzymes / metabolism / eq} to work effectively ; idea that it is a balance between oxygen availability and {enzyme activity / kinetic effects /eq} ; | <p>IGNORE there is most oxygen available</p> <ol style="list-style-type: none"> ACCEPT sufficient O₂, not enough O₂ at higher temps. Ref. to diffusion or gas exchange alone, not sufficient for the mark ACCEPT e.g. 15°C is optimum for their enzymes NB: This is for linking enzymes and temperature, Mp4 is a development of Mp3 stating something specific. IGNORE ref to effects above 15°C | (3) |

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| (c) | <ol style="list-style-type: none"> heart needed to {pump / move / eq} blood (around the body) ; reference to mass flow ; idea that many animals have a small surface area to volume ratio ; idea that a circulatory system is needed to overcome limitations of diffusion / eq ; credit correctly named molecule transported (in blood) ; idea that many animals have a high metabolic rate ; | <ol style="list-style-type: none"> ACCEPT idea that diffusion is not sufficient oxygenated blood not enough by itself ACCEPT any appropriate molecule in the blood ACCEPT idea of thermoregulation e.g. heat | (4) |
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Q3.

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| | <p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> fluid refers to the movement of the phospholipids in the plane of the membrane (1) mosaic refers to the random association of proteins (of different shapes and sizes) within the membrane (1) | | (2) |

Q4.

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|-----------------|--|---|---------|
| (a) QWC | <p>(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> 1. <i>alveoli</i> one cell thick / thin (<i>epithelium</i>) ; 2. {walls / <i>endothelium</i> } of <i>capillaries</i> { one cell thick / thin } ; 3. <i>Alveoli</i> covered with <i>capillaries</i> / eq ; 4. idea of short (<i>diffusion</i>) distance ; 5. reference to <i>diffusion</i> ; 6. idea of large surface area provided by {<i>alveoli</i> / <i>capillaries</i>} ; 7. idea that <i>concentration gradient</i> maintained by {<i>ventilation</i> / breathing / eq } ; 8. ref. to large numbers of red blood cells OR idea that <i>oxygen</i> combines with <i>haemoglobin</i> ; 9. idea that <i>concentration gradient</i> maintained by blood flow ; 10. {reference to / description of} <i>Fick's Law</i> ; | <p>QWC emphasis is spelling Penalise once only</p> <p>2. IGNORE capillaries are one cell thick NOT one cell thick membrane, cell wall</p> <p>4. Award Mps 4 and 5 if diffusion stated</p> <p>6. IGNORE 'many alveoli'</p> <p>10. Diffusion rate is proportional to the surface area</p> | (5) Exp |

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| (b) (i) | <ol style="list-style-type: none"> Idea that blood carries {oxygen / carbon dioxide} ; Idea that blood moving maintains concentration gradient ; Reference to mass flow ; Idea that organs have large surface area to volume ratio ; | <ol style="list-style-type: none"> ACCEPT oxygenated blood IGNORE mass transport IGNORE <i>Daphnia</i> has a large surface area | (2) Exp |

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| (b) (ii) | <ol style="list-style-type: none"> idea that one side (of heart) transports blood to the lungs other to the body ; separation of oxygenated and deoxygenated blood / eq ; idea of maintaining concentration gradient ; comment on blood pressures e.g. lower to lungs, higher to body ; Reference to mass flow / supply of O₂ to body cells maximised ; idea of need for a good supply of oxygen as (mammals are) {very active / high rate of metabolism / warm blooded / eq} ; | <ol style="list-style-type: none"> IGNORE mass transport | (3) Exp |

Q5.

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|---------|
| (a) | <ol style="list-style-type: none"> reference to phospholipid bilayer ; correct orientation and structure of the phospholipids in the bilayer ; explanation of why the phospholipids are orientated the way they are e.g. heads attracted to water OR tails repelled by water ; proteins in the membrane (described / shown) ; idea of two different locations of proteins e.g. extrinsic, intrinsic, transmembrane ; glycoproteins / glycolipids (described / shown) ; idea of cholesterol within the membrane (described / shown) ; | <p>Read what is written on the lines first Accept points made on a clearly labelled diagram If diagram and description contradict then Mp not awarded</p> <ol style="list-style-type: none"> ACCEPT heads on outside and each with two tails if drawn 2. NOT if gap between phospholipids is too large e.g. as large as a phospholipid in the diagram ACCEPT ref to heads being hydrophilic OR tails hydrophobic OR explained in terms of polarity If only one protein located then still get Mp4 | (5) Exp |

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| (b) | 1. small ; 2. non-polar / non -charged ; 3. lipid soluble / eq ; 4. idea that they are recognised by (specific) protein receptors /eq ; | 1. NOT 'size' alone 2. ACCEPT ref. to polar if correctly qualified 3. ACCEPT solubility in lipids NOT just 'solubility' NOT 'water soluble' ACCEPT 'fat soluble' | (2) Grad |

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| (c) | Similarity any one from: 1. use {carrier / channel} proteins OR 2. transport {hydrophilic / eq} molecules / named molecule ; Difference any one from: 3. idea that active transport requires {energy / ATP} / facilitated diffusion does not require {energy / ATP} OR 4. active transport moves molecules against a concentration gradient / facilitated diffusion allows molecules to move down a concentration gradient / eq ; | 1. IGNORE protein unqualified IGNORE transport protein 2. ACCEPT charged / polar | (2) Grad |

Q6.

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| | An explanation that makes reference to the following: <ul style="list-style-type: none"> partially permeable membrane is a barrier to some solutes but not water (1) enables a concentration gradient of { solutes / water } (1) | | (2) |

Q7.

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| | A description that makes reference to the following: <ul style="list-style-type: none"> B is a channel protein (1) which allows the movement of {large / charged / polar} molecules (1) by diffusion from high concentration to low concentration / down concentration gradient (1) | | (3) |