# 4. Cell Membranes and Transport

## 4.1 Fluid Mosaic Membranes

## Paper 2

Marking Scheme

## Q1.

| | | |
|---|---|---|
| (a)(i) | 7 nm ; **A** a suitable range<br>**A** within the range 5 to 10 nm<br>*unit must be shown* | **1** |
| (a)(ii) | *one mark per row – name and letter must agree in row 3 – glycolipid and glycoprotein*<br>If no rows are correct or one row is correct, mark by column to give max 2 if one or two columns are correct | **4** |

| component | function | letter on Fig.1.1 | |
|---|---|---|---|
| channel protein | facilitated diffusion<br>**or**<br>transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances<br>**I** named examples of each category | **A** | ; |
| phospholipid | forms a bilayer<br>**or**<br>a role within bilayer<br>e.g. barrier to, water soluble / polar substances / ions<br>allows diffusion of, fat soluble / non-polar, substances<br>allows fluidity / provides stability / forms a hydrophobic core / AW | **E** | ; |
| glycoprotein<br>**A** glycolipid | receptor for cell signalling | **B**<br>**D** | ; |
| cholesterol | gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances<br>**or**<br>at low temperatures, maintains or increases fluidity / prevents close packing<br>**A** prevents hydrophobic 'tails' interacting at low temperatures<br>**or**<br>at high temperatures, stabilises the membrane / decreases fluidity | **F** | ; |

## Q2.

| | | |
|---|---|---|
| (d)(i) | *allow squamous cells or squamous epithelial cells or epithelial cells for alveolar cells*<br><br>*any **two** from:*<br><br>**1** *gpA / (P. jirovecii)* glycoprotein, binds to a, receptor / protein / glycoprotein on (surface of) alveolar cell<br>**or**<br>*gpA* binds to ECM, protein / glycoprotein ; **I** receptor<br>**A** idea that ECM proteins are on, surface of / interacting with, (cell surface membrane of) alveolar cells<br>**or**<br>receptor / protein / glycoprotein on (surface of) alveolar cell is a binding site (for gpA) **A** same idea for ECM<br><br>**2** (gpA) complementary shape ;<br>*allow ecf mp1 for gpA complementary shape to receptor on ECM*<br>**or**<br>*idea of complementary shape to attach / bind / adhere, to, alveolar cell / ECM*<br><br>**3** suggestion of adhering by, attractive charges / named bond types, between, gpA and, proteins / glycoproteins, on surface of alveolar cell / of ECM ;<br><br>**4** AVP ; e.g. gpA acts as a ligand | **2** |

## Q3.

| | | |
|---|---|---|
| (b)(iii) | *any **three** from:*<br><br>*ref. to* role in / forms part of, overall 3D shape ;<br>**A** tertiary / quaternary structure<br>**A** forms part of hydrophobic region of ghrelin<br><br>allows ghrelin to bind to receptor ;<br><br>allows, ghrelin / part of ghrelin, to have a complementary shape / be complementary (to the receptor) ;<br>**A** description<br><br>suggested detail ; e.g. interacts with hydrophobic region of the receptor molecule (for binding)<br><br>AVP ; e.g. help interaction with / embeds in, hydrophobic portion of the cell surface membrane *in context of bringing a complementary part of the molecule closer to receptor for binding*<br><br>suggestion that fatty acid chain allowed, incorporation into / attachment to, a transport molecule in plasma to reach target cell<br><br>*ref. to* effect of binding triggering reactions inside the cell ; | **3** |

## Q4.

| | | |
|---|---|---|
| (b)(i) | phospholipid with a head and two tails ;<br><br>bilayer shown ; | **2** |

| | | |
|---|---|---|
| (b)(ii) | *any **two** from:*<br><br>cholesterol regulates the fluidity of the membrane ;<br><br>membrane less able to fuse with the lamellar body ;<br><br>AVP ; | **2** |

## Q5.

| | | |
|---|---|---|
| (a)(ii) | heads / phosphate, (groups) of phospholipids are hydrophilic<br>**or**<br>fatty acid tails of phospholipids are hydrophobic ;<br>**A** heads are hydrophilic and tails are hydrophobic<br><br>heads / phosphates, point towards the centre (of the virosome so, must be aqueous / water present) ; **ora** *for tails* | **2** |

## Q6.

| | | |
|---|---|---|
| (b) | *any two from:*<br>1 can cross / AW, hydrophobic core (of bilayer) / phospholipid bilayer<br>**or**<br>can pass through gaps between, fatty acid tails / phospholipids ;<br><br>2 is, hydrophobic / lipid-soluble / non-polar / not ionic / not charged<br>**or**<br>not, hydrophilic / water-soluble / polar / ionic / charged ;<br><br>3 small size ; | **2** |
| (c) | **Reject** if hormone S or receptor **R** described as an antigen or enzyme<br><br>complementary (shape) to / only fits into / specificity for (binding to),<br>**R** / receptor ; | **1** |

## Q7.

| | | |
|---|---|---|
| (b) | *any **three** from:*<br><br>**A** particles *for substances* **I** *ref. to* size<br><br>**1** for transport of ions and, hydrophilic / polar, molecules / substances AW<br>**or**<br>for transport of substances that cannot pass (directly) across the (phospholipid) bilayer / hydrophobic core ; AW<br>**R** if implied that all substances cannot cross the bilayer<br>**I** substances, bypass / do not need, to cross the bilayer<br><br>**2** carrier proteins for active transport and facilitated diffusion and channel proteins for facilitated diffusion ;<br><br>**3** further detail carrier protein ; **I** water-filled / hydrophilic interior<br>e.g. have specific binding sites<br>are specific in, molecule / ion / named example, transported AW<br>carry out conformational change (following binding) / AW<br>use, ATP / energy active transport)<br>moves substances against the concentration gradient / AW (active transport)<br>moves substances down the concentration gradient / AW (facilitated diffusion) *accept once in mp3 or 4*<br>**I** moves substances by diffusion<br><br>**4** further detail channel protein ;<br>e.g. hydrophilic / water-filled, pore / channel **A** hydrophilic lining<br>some, ion channels / proteins channels for ions, are selective (for size and charge)<br>(most) channel proteins are not selective<br>aquaporins for passage of (larger quantities of) water<br>some, are gated / voltage-gated<br>moves substances down the concentration gradient / AW | **3** |

## Q8.

| | | |
|---|---|---|
| (e) | (cell surface) receptor(s) ; | **1** |

## Q9.

| | | |
|---|---|---|
| (b)(i) | bilayer drawn with heads pointed outwards and tails pointed inwards ;<br>phospholipid drawn with one (phosphate) head and two fatty acid tails ; | **2** |
| (b)(ii) | *any **one** from:*<br>cholesterol, maintains / regulates, the fluidity of the membrane ;<br>**A** reduces fluidity at high temperature / increases the fluidity at low temperatures<br>maintains / regulates, (mechanical) stability of the membrane / AW;<br>prevents entry of hydrophilic substances / AW / ions ; | **1** |

## Q10.

| | | |
|---|---|---|
| (a) | *any two from:*<br><br>('kinks') prevents close packing of, phospholipids / membrane components, (at low temperature) ;<br><br>keeps / maintains, fluidity ; **A** increases<br>**A** ora - prevents becoming too rigid<br><br>*idea of* preventing damage to membranes by preventing freezing ;<br><br>maintains movement of (named) substances across membranes ;<br>**A** any named example of movement across membrane<br>**R** increases<br><br>AVP ; e.g. maintains movement of proteins within membrane | **2** |

| | | |
|---|---|---|
| (c) | *any four from:*<br><br>**1** thromboxane is a (cell) signalling molecule ;<br>**A** 'thromboxane acts as a signal' **I** 'messenger' / hormone<br>**2** released into / circulates in / AW, blood / plasma ;<br>**3** (smooth) muscle, cell / tissue, is <u>target</u> ;<br>**4** thromboxane binds to <u>receptors</u> ;<br>**5** *ref. to* thromboxane is complementary to receptor ;<br>**6** (specific) response is smooth muscle (cell) contraction ;<br>**R** smooth muscle constricts<br>**7** AVP ; e.g. detail of change, such as activating G proteins / secondary messenger / enzyme cascade / chain of reactions / AW | **4** |

## Q11.

| | | |
|---|---|---|
| (b) | *any three from:*<br><br>*allow points from an annotated diagram*<br>**1** phosphate head = hydrophilic / polar ;<br>**2** fatty acid / hydrocarbon, tail / chains = hydrophobic / non-polar ;<br>*if mps 1 and 2 not gained, allow one mark for, hydrophilic / polar, heads and, hydrophobic / non-polar, tails*<br><br>**3** (so) heads face, watery environment / tissue fluid / cytoplasm / cytosol / aqueous environment ;<br><br>**4** (fatty acid) tails, form hydrophobic core / form area away from water / face each other / AW ;<br><br>**5** ref. tails and hydrophobic interactions ; | **3** |

## Q12.

| | | |
|---|---|---|
| (b)(ii) | *four from:*<br><br>1 channel protein ; **A** pore protein / has a pore / has a channel<br><br>2 channel / pore, can form from polypeptides<br>**or**<br>(protein) has quaternary structure ;<br><br>3 hydrophilic R-groups, on amino acids lining channel / face inwards (towards channel) ;<br>**A** hydrophilic, lining / channel<br>**A** water-filled, channel / AW<br>**A** idea that passage is through hydrophilic region of protein<br><br>4 allows facilitated diffusion ; **A** diffusion alone if in context of through the protein but **R** if via phospholipid bilayer<br><br>5 increases permeability for, movement of water / osmosis ;<br>**I** faster<br><br>6 no (specific) binding sites / (channel) not specific / not selective / allows more than one type of substance through / AW ;<br><br>7 globular ;<br><br>8 AVP ; e.g. ref. to hydrophobic part of protein, faces / interacts with, hydrophobic, region / core / fatty acid tails<br>ref. to hydrophilic parts of, protein / polypeptide, extend into, external environment / periplasm / aqueous regions / AW | **4** |

## Q13.

| | | |
|---|---|---|
| (c) | *any three from*<br>**1** chemicals (released) are cell signalling, molecules / compounds ;<br><br>**2** liver cells, are target cells ;<br>**A** liver tissue for liver cells<br><br>**3** binding of, chemicals / cell signalling molecules, to receptors (of liver cells) ;<br>**R** receptor cells<br><br>**4** *ref. to* specificity (of receptors) / chemicals complementary to receptors ;<br>*if **R** above, then allow ecf for idea of complementary*<br><br>**5** (specific) response is, cell enters the cell cycle / mitosis / cell division ;<br>**A** DNA replication<br><br>**6** AVP ; e.g. *idea of* communication between cells<br>suggestion of detail following binding, e.g. second messenger activated / enzyme cascade /signal transduction / phosphorylation events / enzyme activation<br>**I** cascade of reactions | **3** |

## Q14.

| | | |
|---|---|---|
| (b)(ii) | *any two from*<br>*ref.* target cells are endothelial cells ;<br>VEGF / cell signalling molecule, binds / AW, to receptor ;<br>**R** receptor cells<br>*ref.* specificity (of receptors) / VEGF / cell signalling molecule, complementary to receptors ;<br>suggestion of detail following binding ;<br>e.g. triggers secondary messenger<br>activates enzymes / enzyme cascade<br>signal transduction<br>phosphorylation events | **2** |