4. Cell Membranes and Transport

4.2 Movement into and out of Cells

Paper 2

Mark Scheme

Q1.

(d)	0.2 mmol dm^{-3} constant rate v 5.0 mmol dm^{-3}, rate not constant / described ; 0.2 mmol dm^{-3} lower rate than 5.0 mmol dm^{-3} ; **ora** 5.0 mmol dm^{-3} higher rate **A** faster / slower, rate for higher / lower, rate **A** (overall) steeper rate / less steep rate calculated rates to support ;	**2**
(e)	*any **four** from:* **1** (experiments suggest mainly) active transport / active uptake ; **A** uptake, is an active process / needs energy / needs ATP *if mp8 given, allow 'active transport and facilitated diffusion'* **2** comparison of experiments with control, any one ;	**4**

expt	discussion point
1	oxygen required for (complete) uptake **A** aeration required **or** almost no /AW, uptake, with no oxygen / in anaerobic conditions
2	almost no / AW, uptake, in, low temperature / at 3°C **or** uptake, higher / AW, at 30°C / in control
3	proteins / enzymes, are, required for / involved in, uptake **or** (much) lower / AW, uptake when, proteins not synthesised / protein synthesis inhibitor present
4	slightly lower / very similar, uptake / AW, without any bacteria **or** slightly higher / very similar, uptake / AW, with bacteria (control)

3 one comparative result / manipulated data, with units, to support mp2 ;

Q2.

(b) **3**

net movement of K^+	membrane protein needed (yes or no)	ATP used (yes or no)	name of transport mechanism
against the concentration gradient	yes	yes	active, transport / uptake
down the concentration gradient	yes	no	facilitated diffusion

one mark each correct column ;;;

if no marks gained, allow one mark for a correct row

Q3.

(d)(i)	endocytosis ; **A** phagocytosis	**1**

Q4.

(d)(iii)	*any **three** from:* **I** *ref. to* concentration of water / solute concentration **A** ψ for water potential mineral ions / nutrients, are solutes / dissolve in water ; (solutes) decrease / lower, water potential, within cell / in cytosol / in cytoplasm ; **A** water potential becomes, more negative / low increases / steep(er) / presence of / AW, water potential gradient ; **A** the difference in ψ between soil solution and cell increases **A** water moves from high to low water potential water follows osmotically / water enters by osmosis ; *in context of, presence / uptake, of mineral ions*	**3**

Q5.

(a)	polar / water soluble / hydrophilic, substances cannot pass through the, phospholipid bilayer / hydrophobic core (in cell surface membranes) ; **I** too large / active transport / facilitated diffusion / (hydrophobic) fatty acid 'tails'	**1**
(b)(i)	rate of uptake, becomes constant / reaches a plateau **or** at high concentrations / concentrations of > 150 μmol dm^{-3}, rate of uptake remains constant ; **A** levels off protein carriers / (hexose) transporters / VvHT1s, are working at their highest rate / are saturated ; **A** the number of protein carriers is limiting factor / AW **A** V_{max} is reached *in context of transporters*	**2**

(b)(ii)	*any **two** from:* **I** *size / quality of grapes / grapevines* **1** grapes will, be sweeter / have improved taste ; **2** *idea that* concentration of sugars in grapes determines uptake of water by osmosis ; **3** *idea of* more energy for growth of the grapes ; **4** larger yield ; **5** increased, profit / income, for farmers ; **6** AVP ; e.g. producing grapes in shorter time	**2**

Q6.

(a)	*allow ideas from a diagram* 1 blood arriving, is deoxygenated / has low(er) partial pressure of oxygen **A** low, concentrations / levels, of oxygen **or** oxygen-poor **or** blood arriving has, high(er) partial pressure / AW, of carbon dioxide ; **A** carbon dioxide-rich 2 *idea that* newly oxygenated blood is, constantly / continually, removed ; **A** oxygenated blood passed to pulmonary vein **A** oxygen that diffuses, from alveoli / into blood, is transported away (by blood flow)	**2**
(b)	*any **two** from:* allow alveoli to, expand / stretch, on, inhalation / inspiration / breathing in / AW ; prevent alveoli from, overstretching / rupturing / bursting (on, inhalation / inspiration / breathing in) ; **I** collapse recoil / recoiling, to help, exhalation / expiration / breathing out / force air out ;	**2**
(c)	*if stated as facilitated diffusion allow max 1 for mp1 or mp2 or mp5* *any **three** from:* 1 membrane / carrier / transport, protein (move phospholipids across into lamellar body) ; **R** channel protein / cotransporter (protein) 2 has binding site(s) (specific for surfactant phospholipids) ; **R** ATP binding site for phospholipids / binds ATP **R** has receptors to bind to phospholipids 3 ATP, used / hydrolysed / needed, for active transport / to provide energy (for transport) ; **A** ATP binding site for active transport **A** *ref. to* ATPase and, active transport / for energy release **I** has / presence of, ATP energy 4 (surfactant) phospholipids move, against a concentration gradient / from a low(er) to a high(er) concentration ; 5 able to carry out conformational change / AW ;	**3**

Q7.

(a)(i)	*any **three** from:* active transport ; **A** active uptake against the concentration gradient ; **A** use of values to support using, energy / ATP ; conformational change / described (of protein carrier) ; *ref. to* specific binding site ;	**3**
(a)(ii)	*similarity max 1* *ref. to* diffusion / (movement) down concentration gradient ; passive **or** no, energy / ATP, required ; *difference max 1* sodium ions enter by facilitated diffusion and oxygen molecules enter by (simple) diffusion ; **A** passive diffusion sodium ions, use a carrier / channel / transport, protein ; **or** sodium ions do not, pass through the phospholipid bilayer / cross the hydrophobic core (of the bilayer) ; **A** ora for oxygen	**2**

(a)(iii)	*any **two** from:* hydrogen carbonate ions move out of red blood cells (to be transported in plasma), so / and, chloride ions move in ; to maintain electrical neutrality (inside, cytoplasm / cell) ; **A** balance the charges (either side of membrane) **A** to prevent build-up of negative charge (in cytoplasm) AVP ; e.g. maintain equilibrium to increase reaction between carbon dioxide and water	**2**
(b)	endocytosis / pinocytosis ; **A** bulk transport	**1**

Q8.

(c)(i)	*any **two** from:* (movement of substances) against concentration gradient / from low(er) to high(er) concentration ; (protein has) binding site(s) ; specific ; **A** description e.g. shape complementary to shape of substance *can be in context of protein or binding site* *ref. to* (binding causes protein), conformational change / change of shape ;	**2**
(c)(ii)	*any **two** from:* **1** glucose is moving against a (concentration) gradient ; AW e.g. low to high **2** movement powered by inward movement of Na^+ ; AW **3** Na^+ movement (into cell from gut lumen) down an electrochemical gradient **or** down a (Na^+), concentration / diffusion, gradient **or** by facilitated diffusion ; **A** diffusion if response includes *ref. to* the cotransport protein / cotranporter 4 AVP ; e.g. *idea that*, cotransport needed so that <u>all</u> glucose will be removed from gut lumen ora facilitated diffusion of glucose will only be to equilibrium / AW cotransporter has (specific) binding site for glucose **I** cotransporter has a complementary shape *idea that* there is no specific active uptake protein for glucose	**2**
(c)(iii)	increases / larger / large, surface area (over which glucose can enter cell per unit time) ; **A** increases / higher / high, SA:V *idea of* (so) more, transport / carrier / cotransport, proteins **A** more cotransporters **or** more proteins, located in membrane / AW ; **R** pump proteins **A** *idea of* more space / places, where proteins can transport glucose	**2**

Q9.

(e)	exocytosis ;	**1**

Q10.

(a)(i)	exocytosis ;	**1**

Q11.

(b)	*any **three** from:* **1** (Golgi /secretory) vesicles, detail ; e.g. packaging of / containing, collagen vesicles bud off from Golgi body *context of movement to surface (not movement to other areas within cell)* **2** vesicles moved by, microtubules / cytoskeleton (to cell surface membrane) ; **3** ATP required ; **A** energy required / active process **R** active transport **4** fuse / merge / combine, with the cell surface membrane ; **A** plasma membrane **5** AVP ; e.g. budding from trans face of Golgi detail of fusion e.g. phospholipid bilayers merge into one	**3**

Q12.

(c)(i)i	*any **three** from:* increased permeability to water ; increased, aquaporins / protein channels (in the tonoplast) ; water potential in vacuole is lower than that of cytoplasm ; **A** more ions in vacuole lower water potential more water enters (vacuole) by osmosis ; vacuole increases, in volume / pressure (until it bursts) ; AVP ; e.g. fewer transport proteins for exit of ions	**3**

Q13.

(b)	*correct units for volume* cm^3 ; *SA and volume calculation* (SA) = 54 (V) = 27 ;	**2**
(c)	**A** → **B** → **C** ; **A** 6:1 → 3:1 → 2:1 **A** 1 → 2→ 3	**1**

Q14.

(a)	*any three from* **1** *differences in height show that* concentrations of sucrose, 0, 0.4 and 0.8 (mol dm^{-3}) *or* ⩽ / less than, 0.8 / 0.9, water moves out of Visking tubing ; **A** one of 0, 0.4 or 0.8 **R** sucrose moving **2** concentrations of sucrose 1.2, 1.6, 2.0 (mol dm^{-3}) *or* ⩾ / more than, 0.9 /1.2, water moves into Visking tubing ; **A** one of 1.2, 1.6 or 2.0 **R** sucrose moving **3** *ref. to* net water movement ; *if water enters Visking tubing* – **A ora** *for water leaving* **4** external solution has higher water potential (than contents of Visking tubing) ; **A** high water potential to low water potential **5** water moves, down, water potential / Ψ, gradient ;	**3**

(b)	*mark whole question to a max of four marks* *descriptions* **1** at concentrations, less than / ⩽, 0.04 mol dm^{-3} all cells, burst / AW ; **2** at concentrations between 0.04 and 0.14 mol dm^{-3} decreasing percentage of cells burst / AW ; **A** use of percentages **3** at concentrations, greater than / ⩾, 0.14 mol dm^{-3} no cells, burst / AW ; *explanations to max 3* **4** in low concentrations / ⩽ 0.04, of sodium chloride water moves into cells down water potential gradient / from high Ψ to low Ψ ; **5** cells increase in, volume / size / internal pressure ; **6** *either* cell membranes are not strong enough to withstand increase in volume / pressure **or** red blood cells burst because they have no cell wall ; **7** between 0.04 and 0.14 (mol dm^{-3}) water potential gradient into cells, decreases / becomes less steep / AW ; **8** above 0.14 (mol dm^{-3}) / in high concentrations, water potential inside cells is the same or higher than the sodium chloride solution ; **9** at high concentration / ⩾ 0.14, water leaves cells / cells shrink / cells shrivel / cells show crenation ;	**4**

Q15.

(c)	phagocytosis / endocytosis ;	**1**

(e)	moves / pump(s), hydrogen ions / protons, into the lysosome against concentration gradient ; active transport / uses ATP / energy from respiration / ref to conformational change of carrier ; **R** if a ref to facilitated diffusion	**2**

Q16.

(c)	*any three from* virus binds to receptors (on host cell surface membrane) ; *ref. to* specificity / complementary shapes / complementary binding ; endocytosis ; description ; e.g. membrane infolds / pinches in vesicle formed ; **A** vacuole	**3**

Q17.

(b)(i)	the larger elephant has a smaller surface area to volume ratio ; **ora**	**1**
(b)(ii)	*any **three** from:* are multicellular / have many cells ; need a large quantity of / enough, oxygen to supply, every cell / all parts of body ; active so high demand for, oxygen / removal of CO_2 ; diffusion across body surface is not fast enough (to meet needs) ; AW long diffusion distance (so diffusion is not fast enough to meet needs) ;	**3**

Q18.

(a)(ii)	(existence of / down, a) water potential gradient ; **I** *ref. to* solute / osmotic, potential **A** lower / more negative, water potential of (cell) **C** (than cell **B**) **A** higher / less negative, water potential of (cell) **B** (than cell **C**) **A** Ψ for water potential	**1**

Q19.

(a)	between 0 – 0.2 mol dm^{-3} the mass of the potato increases **or** between 0.2 – 1.0 mol dm^{-3} the mass of the potato decreases ; no change in mass at 0.2 mol dm^{-3} ; from approximately 0.2 mol dm^{-3} increasing concentration gives a greater decrease ; comparative data quote including two concentrations and two percentage changes ; *units for concentration of sucrose and reference to percentage change in mass must appear once to award this point*	**3**
(b)	*three from* *decrease in mass because* water (molecules) leave the cells ; by osmosis ; down a water potential gradient / from higher water potential to lower water potential **or** solution has a more negative water potential than the potato tissue ; *ref. to* plasmolysis / loss of turgidity ;	**3**

Q20.

(e)	*any three from:* *(water potential gradient created / loss of equal water potentials, so)* *similarities* **1** water enters cells, by osmosis / down the water potential gradient / from high to low water potential ; **A** Ψ for water potential **2** both type of cell, swell / increase in size ; *differences* **3** spherocytosis cells, burst / lyse, more easily / before red blood cells ; **A** spherocytosis cells burst more quickly **A** spherocytosis cells burst and red blood cells do not burst **4** AVP ; e.g. spherocytosis cells already more swollen spherocytosis cells have more pressure exerted (on their cell surface membrane) than normal red blood cells AW *idea of* spherocytosis cells unable to take in as much water and stay intact ref. to less stable / less support for membrane, so weaker membrane (for spherocytosis cells) **I** less flexible	**3**

Q21.

(d)	*accept symbol Ψ for water potential* *three from:* **1** chloride presence outside cell causes water potential (outside cells) to, decrease / become more negative / become lower **or** chloride leaving cell causes water potential (in cell) to increase / AW ; **2** water potential gradient, created / present (between inside and outside of cell) ; **3** water leaves cell by osmosis (to be taken up by mucin to form mucus) ; **4** from higher to lower water potential / AW ; **R** if term gradient included	**3**

Q22.

(c)(i)	*any two from:* (passive / simple) diffusion (of oxygen) across the phospholipid bilayer ; **A** movement from a higher to a lower concentration *for diffusion* **A** between phospholipids / between fatty acid chains / across hydrophobic core / across bilayer / AW, *for phospholipid bilayer* small size ; non-polar / uncharged ;	**2**

Q23.

(b)(i)	ATP not required ; **A** (metabolic) energy not required	1

Q24.

(d)	*assume answer is about facilitated diffusion unless told otherwise – accept* ***ora*** *for active transport* *two from:* movement is, down a concentration gradient ; passive / ATP not required / (metabolic) energy not required ; carrier and channel proteins are involved ;	2

Q25.

(c)(ii)	active transport ;	1

Q26.

(b)(ii)	*any two from* (lactose) lowers the water potential (in the lumen of the intestine) / AW ; reduces the water potential gradient (between the intestine and the blood) ; osmosis occurs ; (must be in the correct context)	2