PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 4: EXCHANGE AND TRANSPORT

CELL TRANSPORT MECHANISMS

SCORE	PERCENTAGE
/145	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • because the {two polar groups / outside layers} will interact with the aqueous environment (on each side of membrane) (1) • rest of molecule will provide hydrophobic barrier / there will be a hydrophobic layer (inside) (1)	**ACCEPT** form H bonds with water	(2) EXP

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	D ATP is broken down into ADP and phosphate ions by a hydrolysis reaction	A is incorrect because ATP is broken down B is incorrect because ATP is broken down C is incorrect because condensation reactions form bonds	

Question Number	Answer	Additional Guidance	Mark
(ii)	A malate lowers the water potential of the cytoplasm	B is incorrect because increase in solute concentration raises water potential so water would leave the cells C is incorrect because starch has no osmotic effect D is incorrect because starch has no osmotic effect	

Question Number	Answer	Additional Guidance	Mark
(iii)	D The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall	A is incorrect because entry of water would make the cell more larger B is incorrect because entry of water would make the cell more larger C is incorrect because the stoma would not form if the inner wall was flexible	

Q3.

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)(i)	An explanation that makes reference to the following: • red is absorbed (1) • because of the presence of chlorophyll (1)		(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)(ii)	An explanation that makes reference to the following: • {chlorophyll / leaf pigment} was present (1) • because some cells are damaged / discs not washed (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(a)(iii)	An explanation that makes reference to the following: • ethanol {disrupts / damages / dissolves / affects} the phospholipid (1) • therefore the membrane {becomes more permeable / allows pigment out} (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(b)	An answer that makes reference to the following: • starts at 0.05 absorbance value (1) • flat line along 0.05 absorbance value (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(c)	An answer that makes reference to five of the following: • use leaves of {same age / same position on plant} because this affects concentration of pigment (1) • obtain leaf discs from the same part of the leaf because this affects concentration of pigment (1) • use same {cork borer / size of leaf disc / diameter of leaf disc} because this affects concentration of pigment (1) • use same temperature because temperature affects the rate of diffusion (1) • use same volume of ethanol so chlorophyll is diluted the same (1) • replicate each ethanol concentration to {see if results are consistent / identify anomaly / to calculate standard deviation / allow statistical test} (1) • wash discs to remove pigment (1)		(5)

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An answer that makes reference to the following: **Similarities** • both use an electron transport chain on membranes (1) • both use ATPase driven by { H^+ gradient / chemiosmosis / eq } (1) • in both, electrons passed from one carrier to another lose energy which drives ATP production (1)	At least one similarity and one difference must be given to gain full marks. Max 2 marks if only 3 similarities provided Max 1 marks if only 2 similarities provided	**(5)**

	Differences • energy is provided by light in chloroplasts but by { glucose / pyruvate / eq } in mitochondria (1) • ATP is made by photophosphorylation in chloroplasts but by { substrate level / oxidative phosphorylation } in mitochondria (1) • in chloroplasts, electrons are provided by chlorophyll but in mitochondria, electrons are brought by reduced { NAD / FAD } (1) • in chloroplasts, (some) electrons return to chlorophyll whereas in mitochondria, electrons are accepted by oxygen (1)	Max 3 marks if only 4 differences provided Max 2 marks if only 3 differences provided Max 1 marks if only 2 differences provided	

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	• 1.5 (%)		(1) GRAD

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to two of the following: • bacteria with higher optimum growth temperatures have a greater percentage of branched chain fatty acids (1) • the greater the percentage of branched chain fatty acids the greater the range of optimum growth temperature (1) • an optimum growth temperature of more than 40°C needs at least 30% of branched chains (1)	**ACCEPT** positive correlation between optimum growth temperature and percentage of branchedchain fatty acids converse **ACCEPT** bacteria with optimum temperature between 20°C and 40°C had the greatest range in percentage of branched-chain fatty acids converse	(2) EXP

Q6.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • rate of diffusion increases due to {increased diffusion / concentration} gradient (1) • and rate of uptake levels off as {calcium ion channels / transport proteins / channel proteins} limit rate (1) • because (calcium) ions enter by facilitated diffusion (1)	**Accept** all calcium ion channels are being used	**(3)**

Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• correct division of figures provided (1) • answer in correct standard form (1)	Example of calculation (250 ÷ 3.7 =) 67.568 / correct rounding of this figure 6.8×10^{-12} g Must be standard form to 2sf with units Allow full marks for correct answer with no working.	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • a nerve cell carries out a lot of active transport (1) • so it may have a greater requirement for		**(2)**

Q8.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• correct calculation of body mass in grams divided by seconds in a day (1) • correct answer and units (1)	Example of calculation 62 000 ÷ (24 x 60 x 60) 0.72 g s^{-1} / 0.72 g per second ACCEPT 7.2 x 10^{-1} g s^{-1} / 7.2 x 10^{-4} kg s^{-1}	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • this level of mass is not gained because ATP is continually broken down to provide energy (1) • mass is fairly constant over 24 hours because { rate of breakdown is comparable to rate of synthesis / the same ADP and P_i molecules are reused many times } (1)		**(2)**

Q9.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two from: • uncharged auxin can diffuse through the {uncharged / hydrophobic / nonpolar} fatty acidtails (1) • (negatively) charged auxin has to move throughprotein channels / carrier proteins (1)		**2**

Q10.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • the phosphate (head) is {polar / hydrophilic} • therefore the phosphate can interact with the aqueous environment (1) • otherwise the lipids {will form a micelle / will not form a bilayer(and not enclose the cytoplasm) (1)	**ACCEPT** dissolve in water in the cytoplasm and environment	(2)

Q11.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • osmosis is occurring (1) • at 3%, water has left the red blood cells (by osmosis) (1) • at 0.5% and 0.3%, water has gone into the cells (byosmosis) (1) • at 0.5% and 0.3% the cells have burst (and cannot beseen) (1) • 0.7% is close to the water potential of the cells' cytoplasm (1)	Allow correct reference to {hypertonic /hypotonic / isotonic} solution or to water potential Allow at 3% water leaving RBC by diffusion Allow water potential of cells' cytoplasm is between 0.7 and 1%	**(4)**

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • the osmotic potential of the red blood cells is equivalentto 3% glucose or 6% sucrose (1) • because the molecular mass of sucrose is twice that ofglucose (1) • because it is the number of molecules that determine theosmotic potential, not % concentration (1)	Allow twice the concentration of sucrose is needed to have the same effect Accept sucrose as a disaccharide whereas glucose is a monosaccharide	**(3)**

Q13.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • *Salicornia* has {higher salt concentration / lower water potential} than the mud (1) • because salt taken up by active transport (1) • therefore water is taken up by osmosis (1)		**(3)**

Q14.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • because {cholesterol / fatty acids} are hydrophobic (so cannot be carried in bloodstream) (1) • phospholipid tails are hydrophobic so {cholesterol / fatty acids} can be carried inside lipoprotein (1) • {protein / phospholipid heads} in lipoprotein are hydrophilic (enabling transport in bloodstream) (1)	ACCEPT non-polar ACCEPT non-polar ACCEPT polar	

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	B ☒ **B** 1 and 3 *A is incorrect because facilitated diffusion does not move substances against a gradient* *C is incorrect because facilitated diffusion does not move substances between phospholipids* *D is incorrect because facilitated diffusion does not move substances against a gradient*		**1**

Question Number	Answer	Additional Guidance	Mark
(ii)	C increased permeability of the collecting duct to water, producing more concentrated urine *A is incorrect because ADH increases the permeability of the collecting duct* *B is incorrect because ADH increases the permeability of the collecting duct* *D is incorrect because ADH results in more concentrated urine*		**1**

Q16.

Question Number	Answer	Additional Guidance	Mark
	reaction A = phosphorylation ; reaction B = hydrolysis ;		**(2)**

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • (the nitrogen can be incorporated into) protein (1)	Allow {DNA / RNA / organic base / amino acid / named protein / ATP /chlorophyll}	**(1)**
(ii)	An explanation that makes reference to the following: • enzyme lowers the activation energy (for the reaction) (1) • a large number of ATP molecules is used (1) • because the reaction needs a lot of energy (1) • to compensate for nitrogen being unreactive (1)		**(4)**

Q18.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following points: • (leghaemoglobin / myoglobin) is not S shaped / is linear / is a straight line (1) • because (leghaemoglobin / myoglobin) affinity for oxygen does not alter (1) • because (with leghaemoglobin) there is no cooperative binding (1) • (leghaemoglobin) binds to one molecule (of oxygen) (1)	**Accept** converse for haemoglobin **Accept** converse for haemoglobin **Accept** converse for haemoglobin **Accept** shape change to subunits / conformation change **Accept** (leghaemoglobin / myoglobin) has only one oxygen binding site **Accept** haemoglobin has four binding sites / binds to four molecules of oxygen	**3 exp**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following points: • (waterlogged soil has) little / low / less / no oxygen (1) • (leghaemoglobin) provides oxygen for **respiration** (1) • which enables active uptake of mineral ions / named mineral ion (1) • such as (calcium) to make calcium pectate / (nitrate) to make amino acids / (magnesium) to make chlorophyll (1)	**Accept** binds to / stores oxygen for respiration **Accept** other correct active processes e.g. synthesis of amino acids / protein synthesis / mitosis **Accept** other correct examples of minerals with functions	**3 exp**

Q19.

Question Number	Answer	Additional Guidance	Mark
(i)	**The only correct answer is D** **A** is incorrect because antibodies have two antigen binding sites **B** is incorrect because the two binding sites attach to the antigen and not the macrophage **C** is incorrect because there is only one macrophage binding site		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(ii)	**The only correct answer is B** **A** is incorrect because hydrolysis reactions breakdown molecules **C** is incorrect because nucleotides are the monomers of polynucleotides not proteins **D** is incorrect because nucleotides are the monomers of polynucleotides not proteins		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • (because water enters part of cell) by osmosis (1) • from a high water potential to a low water potential / because the osmotic potential inside the cell is lower / from a low solute concentration to a higher solute concentration (1)	**ACCEPT** more concentrated cytoplasm solute potential for osmotic potential **IGNORE** concentration gradient unqualified water concentration	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iv)	A description that makes reference to three of the following: • bacteria engulfed and {digested / broken down} (1) • antigen attached to MHC antigen (1) • macrophage becomes an antigen-presenting cell (to the T helper cell) (1) • CD4 (antigen) of T (helper) cell binds to {antigen / macrophage} (1)	**ACCEPT** macrophage presents the antigen (to the T helper cell) **NB** CD4 (antigen) of T (helper) cell binds to {antigen-MHC complex = 2 marks	(3) EXP

Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that includes three of the following: • moved {across membrane / into cell / into root} by carrier proteins (1) • against a concentration gradient (1) • using ATP (1)	Accept protein pumps Ignore channel proteins Accept from a low to a high concentration	Exp (3)

Question Number	Answer	Additional Guidance	Mark
(ii)	• suitable mineral ion named (1) • appropriate function given (1)	Mp2 can be given if suitable mineral not named eg nitrogen for nitrate eg **nitrate / (ammonium)** – formation of amino acids / proteins / enzymes / nucleic acids / nucleotides / DNA / RNA / chlorophyll **phosphate** – formation of nucleotides / nucleic acids / DNA / RNA / ATP / ADP / amino acids **calcium** – formation of middle lamella / calcium pectate **magnesium** – formation of chlorophyll Accept other correct mineral ions with correct functions potassium, sodium, iron etc	Exp (2)

Q21.

Question Number	Answer	Additional Comments	Mark
(a)	1. only (alpha) 1-4 glycosidic bonds in amylose / (alpha) 1-6 only found in amylopectin ; 2. only amylopectin has side branches / only amylose is {coiled / eq} ; 3. Amylopectin is a {larger / eq} molecule than amylose ;	**1. ACCEPT** 1-6 and 1-4 in amylopectin	(2)

Question Number	Answer	Additional Comments	Mark
(b)	1. Different individuals in the {colony / eq} take on specific {roles / jobs / eq} ; 2. Example given e.g. queen produces offspring ;	**1. Accept** division of labour **2. Accept** dominance by queen, {few of the males / kings} involved in breeding	(2)

Question Number	Answer	Additional Comments	Mark
(c) (i)	Idea that body temperature of animal mimics the ambient temperature ;	**Accept** body temp follows environmental temperature	(1)

Question Number	Answer	Additional Comments	Mark
(c) (ii)	1. Lack of insulating layer: Idea that does not impede transfer of heat energy / allows exchange of heat energy more easily ; 2. A marked reduction in sweat glands: Idea that they do not need to cool down OR less water lost ;	**1. Accept** enables heat transfer between environment and NMR	**(2)**

Question Number	Answer	Additional Comments	Mark
(d)	1. (Cancer causing) gene identified / eq ; 2. Gene {cut / isolated / eq} from DNA / eq ; 3. Using a {restriction / eq} enzyme / eq ; 4. Gene in {vector / named vector} ; 5. Mechanism for getting {gene/vector} into host cells (of mice) / eq ;	**1. Accept** screen for the gene **2. Accept** extracted **3. Accept** correctly named restriction enzyme e.g. EcoR1 **4. Accept** Named egs – retrovirus, virus, liposome, plasmid, bacteria **5. Accept** reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler, transduction	**(3)**

Question Number	Answer	Additional Comments	Mark
* (e)	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence 1. {*neurone* (cell) surface membrane exposed / no *myelination* / eq} at nodes of *Ranvier* ; 2. Nodes are the site of clusters of {*sodium-gated channel proteins / potassium channels*} ; 3. Which {open / close} when *impulse* arrives / eq ; 4. Allowing *depolarisation* at nodes / eq ; 5. idea that *myelin*/eq acts as an (electrical) *insulator* (on *neurone* surface between nodes) ; 6. reference to *Schwann* cell ; 7. idea that *impulse*/*depolarisation* 'jumps' to next node ; 8. Reference to this being *saltatory conduction* ; 9. idea that this happens between the *myelin* layers of the *Schwann* cell ;	**QWC emphasis on spelling** **3. Accept** influx of sodium ions	**(5)**

Question Number	Answer	Additional Comments	Mark
(f)	1. idea of heart working less efficiently ; 2. idea of less oxygen absorbed at lungs / eq ; 3. less blood pumped to brain ; 4. concentration gradient (for oxygen) at brain reduced / eq ; 5. less oxygen in blood (in brain) diffuses into brain tissue / eq ; 6. idea of less oxygen in brain tissue due to continual (aerobic) respiration ;		(3)

Question Number	Answer	Additional Comments	Mark
(g)	gonadotrophin-releasing (hormone) stimulates gonadotrophin release / gonadotrophin stimulates ovulation / testosterone stimulates {sperm production / (male) secondary sexual characteristics / other named example} ;		(1)

Question Number	Answer	Additional Comments	Mark
(h)	1. Idea of effect on mitochondria ; 2. (therefore) reduced {energy / ATP / eq} for flagellum movement ;	**1. Accept** less efficient / fewer / none **2. Accept** tail for flagellum	(2)

Question Number	Answer	Additional Comments	Mark
(i)	1. idea that fat is an energy store ; 2. reduces dependence on external food source / eq ; 3. enables disperser to travel / eq ; 4. (metabolic) water is released (on oxidation) / eq ; 5. acts as a thermal insulator / eq ;	**Accept** energy-rich	(3)

Question Number	Answer	Additional Comments	Mark
(j)	1. idea that unfamiliar males are likely to be genetically different ; 2. idea that this is outbreeding ; 3. idea that this increases genetic diversity ;	**3. Accept** producing offspring that are genetically different	(2)

Question Number	Answer	Additional Comments	Mark
(k)	the order of the {bases / genes and non-coding sequences / eq} in the DNA (of the naked mole rats) is found / eq ;	**Accept** exons and introns **Ignore** genes unqualified	(1)

Question Number	Answer	Additional Comments	Mark
(I)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. Idea of pain relief e.g. dealing with post traumatic pain, post surgical pain, joint pain after a knee operation ; 3. haemoglobin has higher affinity for oxygen ; 4. Idea of dealing with reduced oxygen situations such as due to a heart attack or stroke ; 5. Naked mole rat {incisors / eq } grow through skin (of lip) without damage ; 6. Idea of better prosthesis e.g. new {coatings / permanent seal} at {skin / bone / metal} interface, soft tissue not damaged, avoid infection ; 7. High protein stability / does not (easily) lose 3D shape ; 8. (so) reduced effect of oxidative {damage / stress} / reduced effect of oxygen-containing free radicals / live healthily into old age ; 9. Cell overcrowding early warning gene / ref. to two tiered contact inhibition / presence of gene p16 ; 10.Idea of cancer prevention e.g. cancer resistance, future cancer therapy ; 11.Naked mole rat neurones display immature {characteristics / physiological properties} / brain cells that cope with {low oxygen / hypoxia} ; 12.To treat people with temporary loss of oxygen to brain e.g. heart attack, stroke, drowning / to prevent permanent brain damage ; 13.High levels of oxytocin receptors in {brain / nucleus accumbens}; 14.Idea of links to autism ; 15.Naked mole rats do not experience menopause ; 16.Ref to osteoporosis {treatment / prevention} (without side effects) ; 17.circadian rhythms / sleep patterns of naked mole rats ; 18.Idea that may help with sleep disorders ;	**9. Accept** anticancer mechanism	

Q22.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • pond water has greater water potential than the cytoplasm therefore water enters by osmosis (1) • *Paramecium* has { only cell membrane / has no cell wall } (1) • so would burst if water not removed (1)		**(3)**

Q23.

Question Number	Correct Answer	Additional guidance	Mark
(a)	An explanation that makes reference to the following: • wash immerse in water / water without nitrate ions (1) • at a suitable temperature / stated temperature (less than 25 °C) (1) • reference to sterile water (1)		**(3)**

Question Number	Correct Answer	Additional guidance	Mark
(b)	An answer that makes reference to the following: • reading from graph 5 mins = 4 μmol dm^{-3} 30 mins = 8 μmol dm^{-3} (1) • mean rate = increase ÷ time (4 ÷5) (1) • correct answer with units = 0.8 μmol dm^{-3} min^{-1} (1)	Candidate must state units for full marks	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
(c)	An explanation that makes reference to the following: • rate the same for both solutions between 0–10 minutes because initial uptake in both by (passive) diffusion (1) • rate with DNP zero between 20–30 minutes because uptake requires {energy / ATP} for active transport (1) • DNP prevents formation of ATP by chemiosmosis (1)		**(3)**

Question Number	Correct Answer	Additional guidance	Mark
(d)	An explanation that makes reference to the following: • DNP transports protons across the inner mitochondrial membrane (1) • therefore preventing the establishment of a gradient across the membrane (1) • which prevents the formation of ATP (1)	cristae Accept inhibits interaction between protons and ATP synthase	**(3)**

Q24.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • glycerol attached to two fatty acids (by ester bonds) (1) • and one phosphate attached to glycerol (1)	**ACCEPT** from a labelled diagram **NB** made from one glycerol two fatty acids and one phosphate = 1 mark if neither mark awarded	(2) EXP

Q25.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • photosynthesis causes a decrease in concentration of CO_2 inside the cell, producing a concentration gradient (1) • therefore CO_2 diffuses from solution into cells (1)		**(2)**

Q26.

Question Number	Answer	Additional guidance	Mark
(i)	C (the strength of the middle lamella between cells)		**(1)**

Question Number	Answer	Additional guidance	Mark
(ii)	A (active transport)		**(1)**

Q27.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: **A** phospholipid (bilayer) and **B** (glyco) protein / (channel) protein / (integral) protein / (carrier) protein / (intrinsic) protein		**(1)**

Q28.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • polar molecules are {charged / water soluble / hydrophilic} (1) • {phosphate / head} is hydrophilic / {fatty acids / tails} are hydrophobic (1) • {phosphate / head} on outer side / {fatty acids / tails} on inside (1) • therefore {polar / charged / ionic} substances do not pass through the {hydrophobic centre / fatty acids / tails} (1) • and so pass through {carrier / channel} proteins (1)		**(4)**

Q29.

Question Number	Correct Answer	Additional guidance	Mark
	A description that links the following: • phospholipid bilayer (1) • sodium-potassium pump (1) • voltage-gated sodium ion channels (1) • (voltage-gated) potassium ion channels (1)		**(4)**

Q30.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • 7.0% salt solution {lowers the water potential / is hypertonic / creates a concentration gradient / creates water potential gradient} (1) • therefore water moves in (to mucus) by osmosis (1)	**Accept** out (of cells)	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • use of 0.9% means {no concentration gradient / same concentration / isotonic } (1) • therefore water will not move / no osmosis (1)	**Do not accept** references to pure water	**(2)**