Movement of substances

Mark Scheme 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Cell Membranes and Transport
Sub Topic	Movement of substances
Booklet	Theory
Paper Type	Mark Scheme 3

Time Allowed : **70 minutes**

Score : **/ 58**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a (i)** *penalise once if the term genetic material is used instead of DNA*

1 no nuclear envelope / no (true) nucleus ;
A no nuclear membrane
A no nucleus envelope
A DNA free in cytoplasm ora
A DNA as nucleoid

2 DNA, loop / circular ;
A DNA not linear

3 DNA, not in chromosomes / DNA not associated with, histones / proteins ;
A naked DNA

4 no nucleolus ;

5 (presence of) plasmids ;

6 (only) have, 70S / small / 18–20 nm, ribosomes ;

7 presence of, capsule / slime layer ;

8 ref. small (cell) size / less than 5 μm / (only) 1 μm ;
A ora for eukaryotes [max 3]

(ii) *plant cell*
cellulose ; *treat as neutral ref. to microfibrils / fibres*

bacterial cell
murein / peptidoglycan ;
A peptoglycan / polysaccharide and amino acid [2]

(b) 1 cell contents shrink / cytoplasm shrinks ; AW
R cell shrinks *unless clear that the cell wall remains, intact / same size*

2 cell (surface) membrane / plasma membrane, peels away / AW, from cell wall ;
A plasmolysis occurs **/** cell becomes flaccid

3 (movement of) water out by osmosis ;
4 down water potential gradient / from high to low water potential / to lower water potential /from less negative to more negative water potential ;
A ψ for water potential [max 3]

(c) 1 (mutation involves) change in sequence of, bases / nucleotides (of DNA);
A (mutation leads to) altered, mRNA / codons
A change leads to new alleles
(genes code for, polypeptides / proteins, so)

2 different, protein structures / proteins, possible / synthesised ;
A different, primary / tertiary / 3-D, structure

3 (so) range of / different, functions possible / AW ; [max 2]

[Total: 10]

2 **(a)** *accept ora*
penalise once if refs. in context of rates e.g. faster
no cells remaining, correct concentration value given (accept up to 0.26%) **;**
100% / AW, cells remaining, ref. from 0.86%–0.9% / AW **;**
steep increase in percentage cells remaining between 0.5–0.8% **;** **A** to 0.7% *if next marking point included*
steepest increase between 0.7–0.8% **;**
comparative data quote to support ref. to increase **;** [max 3]

(b) *max 5 if no mention of water potential anywhere in the answer*
correct use of term osmosis linked to water potential (in context of high to low) **;**

0% and 0.7%
(net) water in (to red cells) **;**
0%, all cells burst / (haemo)lysis of all cells **;** } general ref. to bursting at
0.7%, some cells burst **;** ora } either concentration **;**
cell membrane cannot withstand pressure **;**
(0.7%) (remaining) cells swollen / cell volume increases **;**
0.7% water potential gradient not as steep as in, water / 0% **;**

1.5%
(net) loss of water from cells **;**
cells, shrink / AW *or* cell volume decreases **;** **A** descriptions relative to biconcave disc shape [max 6]

(c) 4, oxygen molecules / O_2, per (molecule of) haemoglobin **;**
(forms) oxyhaemoglobin (in lungs) **; A** marking points 1 and 2 as equation
ref. oxygen remains bound until blood in area of low pO_2 / high pCO_2 / high(er) temperature **; A** in area of respiring tissues (max 3)
carbon dioxide combines with haemoglobin **;**
terminal, amine / amino, group of haemoglobin **; A** $–NH_2$
carbamino-haemoglobin **; R** carboxyhaemoglobin
ref. to hydrogen ions from carbonic acid **;**
ref. carbon dioxide remains bound until blood in area of low pCO_2 / high pO_2 **;** [max 4]

(d) **(i)** 19.7 / 20 (%) **;;**

allow 1 mark if incorrect answer but correct working shown
7.3 – 6.1 / 6.1 × 100 / 1.2 / 6.1 × 100 [2]

(ii) partial pressure / AW, of oxygen is, low / lower than at sea level **;**
haemoglobin less well saturated **;**
more red blood cells / more haemoglobin **;**
compensates for, smaller volume of oxygen absorbed (per red blood cell) / lower saturation of haemoglobin **;**
A ref. to tissues receiving sufficient oxygen
AVP **;** e.g. ref to erythropoietin (EPO) [max 3]

[Total: 18]

3 **(a)** spherical / ball-shaped / AW **;** **A** round(ed) / circular
has tertiary structure **;** **R** 3D
hydrophilic / polar, (R) group(s), on outside / face to watery exterior **;**
hydrophobic / non-polar, (R) group(s), in centre **;**
<u>water</u> soluble **;** [max 3]

(b) **(** *idea that plant cell walls and fungal cell walls have different components*
fungal cell walls made of, glucans / chitins / fungal cellulose / different components to plant cell walls **;** **A** peptidoglycan / murein
A plant cell walls contain cellulose, but fungi do not
idea of specificity in context of question
enzymes are specific **;**
A specificity explained e.g. both substrates not complementary / shape of active site specific to one substrate [2]

(ii) **1** (at optimum pH) maximum / peak, activity **;** **A** most efficient / works best
2 above / below, optimum, activity declines **;**
A description / graph sketched with pH and rate / activity
3 changing pH changes hydrogen ion concentration **;**
4 hydrogen / ionic, bonds (between amino acids), break / disrupted **;**
5 hydrogen / ionic, bonds, important in maintaining shape of, tertiary structure / active site **;**
R 4 and **5** if refer to disulfide, hydrophobic interactions, peptide
at sub-optimum pH
6 active site / tertiary, shape altered **; A** enzyme denatured
7 charges at the active site may be affected **;**
8 further detail **;** e.g. transfer of electrons may not be possible
9 the substrate may be altered by pH changes **; R** cell wall unqualified
10 (therefore) substrate no longer fits / ES complexes not formed **;** [max 3]

(c) osmosis, defined in terms of water potential / used in correct context **;**
0% and / or 0.4%
higher / less negative, water potential outside so water enters **;**

0%, higher / less negative, water potential than 0.4%, so cells burst **;** *ora*

0.9%
equal / same, water potential inside and outside cells, water in = water out **;**
A no net movement of water / ref. to isotonic / no water potential gradient
R 'no osmosis' / no movement of water

1.5% and / or 3.0%
lower / more negative, water potential outside so water moves out **;**

3.0%, lower / more negative, water potential than 1.5% so cells, smaller / AW **;** [max 4]

(d) cells, increase in size / burst **;** **A** vacuole increases in size **R** becomes turgid
no cell wall to, prevent cell bursting / withstand (turgor) pressure **;**
A *idea that* cell membrane alone cannot withstand increase in size / bursting [2]

[Total: 14]

4 **(a)** 1 water lost by, evaporation / transpiration **;**

2 no water uptake (by roots) **;** [2]

(b) **(i)** 1 as water potential increases, oxygen uptake increases **;**
must be stated

2 levels off (at 5 kPa / at 225 au) **;**

3 figures **;** *two water potential plus two oxygen uptake figures plus kPa* [2 max]

(ii) 1 succinate converted to oxaloacetate **;**

2 dehydrogenation / oxidation **;**

3 NAD, is reduced / accepts hydrogen **;**

4 (hydrogens move to) ETC **;**

5 hydrogen splits into protons and electrons **;**

6 electrons pass along ETC **;**

7 ADP + Pi $\longrightarrow$ ATP **;**

8 oxygen, receives protons and electrons / is final electron acceptor, to form water **;** [4 max]

(c) **(i)** 1 water leaves mitochondrion **;** **A** other named organelle

2 by osmosis / down water potential gradient **;**

3 idea mechanical disruption to membranes **;**

4 membranes made of <u>phospholipid</u> (bilayer) **;**

5 hydrophilic heads / glycoproteins / glycolipids, form fewer hydrogen bonds with water **;**

6 reduces, stability / fluidity (of membrane) **;**

7 ref. (proteins with) hydrophilic channels **;** [3 max]

(ii) 1 inner membrane (of mitochondrion) / cristae, site of ETC ;

2 fewer carriers held in position ;

3 fewer electrons pass along ETC ;

4 less ATP produced / less energy released ;

5 less oxygen required to act as electron acceptor ;

6 protons can move freely through the damaged inner membrane ;

7 proton gradient not formed ;

accept ora for less damaged membranes for marking points 2–7 [3 max]

(d) 1 extensive / deep, roots ;

2 <u>leaves</u> have small surface area ;

3 <u>leaves</u>, are curled / are waxy / have bulliform cells / have hinged cells ;

4 reduced stomata numbers / stomata in pits ; [2 max]

[Total: 16]