Movement of substances

Mark Scheme 1

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 1

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** either diagram A or B below (or more detailed – e.g. all carbons and all bonds shown in diagram A) **;;**

A CH_30 for CH_2OH

I incorrectly numbered carbons

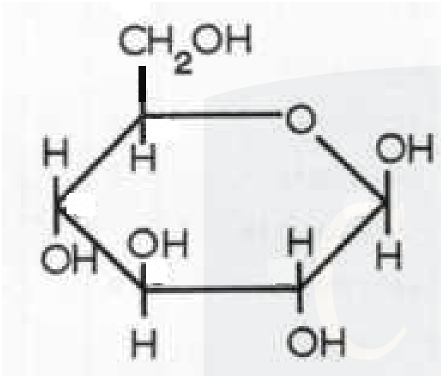

diagram A

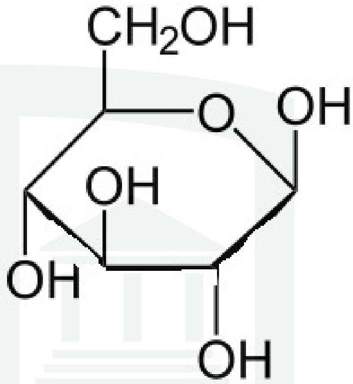

diagram B

if incorrect (e.g. If one or more H missing from the ring in diagram A ***or*** *if an H added to diagram B ring) allow one mark if*:

- hexose ring with oxygen shown in correct position <u>and</u>
- CH_2OH group in correct position <u>and</u>

OH groups of ring in correct position. **[2]**

(b) (i) accept *T. maritima* or **T** and *A.tumefaciens* or **A** throughout for the β-glucosidases
*accept **T** if stated as **B** (as long as **A** is clearly mentioned)*
*if only **A** or **T** stated, look for comparative phrase*
compare optimum temperatures

1 optimum temperature, **A** lower (than **T**) / **T** higher (than **A**) **;**
  A maximum activity **A** is at a lower temperature
2 40 °C(**A**) v 85° C(**T**) / **A** lower by 45 °C **;**
3 one difference in shape of curve before or after optimum **;**
  e.g. after optimum, **T** does not have the less steep decrease after the initial steep decrease (unlike **A**)
  before optimum, steepest increase for **A** is at the lower temperatures, (unlike **T**)

compare activity below and above 55 °C

4 below 55 °C, **A** has a higher activity **/** above 55 °C **A** has a lower activity, (than **T**) **;** ora
  A has a higher activity at low(er) temperatures and a lower activity at high(er) temperatures ora
5 comparative data to support mp 4 **;**

compare temperature ranges of activity

6 temperature range for activity is greater for **A ;** ora
7 (**A**) spans 80 °C v (**T**) spans 65 °C **; A** (**A**) 10–90 °C v (**T**) 30–95 °C

*compare **L** for both*

8 has a lower, **L** / lowest temperature for (detectable) activity **or** ora
  L is 20 °C lower for **A ; A** 10 °C (**A**) v 30 °C (**T**) **;**
9 (at **L**), A (relative) activity = 35%, **T** = 10% **;**

*compare **H** for both*

10 **T** has a higher, **H** / highest temperature for detectable activity **or** ora
  H is 5 °C higher for **T ; A** 95° (**T**) v 90 °C (**A**) **;**
11 (at **H**) (relative) activity = 4%, **T** = 60% **;**

if mp 10 data given to support mp 1, then CON = no marks for mp 1 or 10 **[max 4]**

(ii) **1** primary structure, dictates, folding of the polypeptide chain / tertiary structure **;**
  A idea that differences in primary structure leads to differences in, secondary / tertiary, structure
  A in terms of folding to give the active site

similarity

2 same / (very) similar, (shape of) active site **;**
3 active site (shape) is complementary to / AW, substrate / cellobiose **; R** matches
  A ES complex forms

differences

4 differences in, side-chain / R-group, interactions / AW **;**
5 qualified **;** e.g. differences in, numbers / types, of bonds
  differences in bonding to give different stabilities
  R different bonds without further qualification
  R peptide bond

6 suggestion for thermal stability of **T ;** e.g. more bonds / more of a named bond type
7 suggestion of how active site may work in different ways **;**
  e.g. at lower temperatures, **T** induced fit mechanism may mean active site does not mould fully round substrate **[max 4]**

[Total: 10]

2 **(a** phospholipid (and protein) molecules, move about / diffuse / AW **;**
protein (molecules), scattered / AW **;** **A** different proteins present [2]

(b) *similarity to max 1*
(contains) phospholipid (bilayer)**;** **A** detail of orientation of phospholipid
A lipid bilayer
(contains) protein **;**

difference (look for ora)
(Davson Danielli) layer(s) of protein / protein only on outside **;**
(fluid mosaic) ref. to proteins, in different locations discrete / different types / named or described **;**
(fluid mosaic) presence of cholesterol (molecules) **;** [max 2]

(c)
1 requirement for, energy / ATP **; R** ATP energy
2 uses, carrier / transport, protein **; A** pump
3 conformational change (of carrier protein) **;** AW
4 moving against a concentration gradient **; A** low to high concentration
5 specific, binding site **; A** ref. to specificity to substance moved across [max 3]

to max 2
(d)
1 loss of, tertiary structure / quaternary structure / secondary structure **;**
A loss of shape of active site *in correct context*
2 loss of globular, shape / structure / form **;**
3 breakage of, ionic / hydrogen / hydrophobic, bonds / interactions **;**

to max 2
4 loss of function of (membrane) proteins **;**
5/6 detail **; ;**
e.g. transport of, polar molecules / ions, impaired AW
loss of cell to cell adhesion
unable to receive cell signals
loss of enzyme function
7 ref. to membranes, become leaky / lose partially permeable nature **;**
A cannot regulate, entry / exit, substances
8 disrupt interaction between protein and phospholipid bilayer / described **;** [max 3]

[Total: 10]

3 **(a** *one mark each column*

transport mechanism
(passive / simple) diffusion **R** facilitated diffusion
endocytosis / phagocytosis **R** bulk transport ;

example
glucose / amino acids / ions / named ion **A** polar / hydrophilic, molecules
accept any relevant
water ; [2]

(b) *ignore correct examples of materials if given in addition to transport mechanism*
R *if incorrect examples given*

<u>facilitated</u> diffusion **;**
active, transport / uptake **;** **A** sodium-potassium pump (mechanism)
(passive / simple) diffusion <u>or</u> osmosis **;**
endocytosis <u>or</u> exocytosis **;**
A (for endocytosis) pinocytosis / micropinocytosis / phagocytosis [4]

[Total: 6]

4 **(a** water moves <u>down</u> water potential gradient ; **A** high(er) to low(er) water potential / less negative to more negative water potential
apoplast pathway / through cell walls ;
symplast pathway / through, plasmodesmata / cytoplasm ;
evaporation ;
from <u>spongy</u> <u>mesophyll</u> <u>cell</u> <u>walls</u> ;
into (substomatal / intercellular) air space ;
diffusion of water vapour ; **A** diffusion of water if evaporation used in correct context elsewhere
through stomata ; [4 max]

(b) *explanation must correctly relate to structure before marks can be awarded*
any three from the following six pairs

either
cellulose, cell wall / lining ;
allows adhesion of water ;
or
<u>thick</u> (cellulose) cell wall ;
prevents collapse / idea of providing support (under tension) ;

either
lignin ;
waterproofing / prevents water loss ;
or
lignin ; **A** rings / spirals / thickening / AW (of walls)
prevents collapse / idea of providing support (under tension) ;

no cytoplasm / lack of contents / hollow / empty lumen ; **R** dead
less resistance to / unimpeded / uninterrupted / unhindered / ease of / AW, flow / AW ;
A greater volume per unit time / faster rate **R** continuous, smooth

lack of end walls / continuous tube ;
less resistance to / unimpeded / uninterrupted / unhindered / ease of / AW, flow / AW ;
R continuous, smooth

pits / pores ; **R** holes
lateral movement / movement around air bubbles / supplies (water) to (surrounding), cells / tissues ;

wide / large diameter / large lumen ;
so large volume of water can be transported ; [6 max]

[Total: 10]

5 **(a)** 7.0 nm ; [1]

(b) **K** permits movement of, ions/(small) water soluble molecules/
charged/polar/hydrophilic/any e.g. ;
facilitated diffusion/active transport ; [max. 1]

L cell recognition/(surface) antigen/receptor/cell adhesion/cell marker/ binding site ;
forms hydrogen bonds with water to stabilize membrane structure ; [max. 1]

M barrier to, water soluble compounds/ions ;
allows passage of lipid soluble substances / named e.g. ;
ref hydrophobic interactions with integral proteins ;
ref structure of fatty acid tails maintains fluidity ; [max. 1]

N regulates, fluidity/stability ;
storage ;
restricts movement of phospholipids ;
influences permeability of membrane ; [max. 1]
[4]

(c) idea of large molecule ;
polar ;
<u>water</u> soluble/not lipid soluble ; **A** hydrophilic
A not able to pass through phospholipid bilayer / AW [max. 2]

(d) *facilitated diffusion because* the rate of uptake increases with increasing glucose concentration, up to a plateau/constant rate ; **A** figs to explain because no more proteins available/all proteins in use ;
if passive diffusion rate would continue to rise ;
cannot be active transport as rate would be independent of concentration (except at low concentration) ; [max. 2]

(e) (active transport) uses, energy/ATP, to move (substance) against a concentration gradient ; *ora* [1]

[Total: 10]

Question			Expected Answers	Marks
6	**(a)**	**(i)**	**X** to xylem vessel;	
			S to phloem sieve tube element; **R** companion cell	
			E to lower epidermal cell; (including guard cells) **R** cuticle	
			D to palisade mesophyll cell;	**[4]**
		(ii)	<u>Award 1 mark for correct working;</u>	
			<u>Award 1 mark for correct answer;</u>	
			Expect 120/0.5 = 240	
			A 119 - 121/0.5 = 238 - 242 or <u>any</u> working that gives the correct answer	
			R all others,	**[2]**
	(b)		sucrose; amino acids; **A** two named amino acids for two marks	**[2]**
	(c)		lower/more negative, water potential; **A** ref to water potential gradient/xylem has a higher water potential **R** less water potential	
			(of) spongy mesophyll cell/tissue; **R** leaf cells	
			large surface area/many cell walls(of spongy mesophyll cells);	
			(moves through) <u>through</u> cell walls/surfaces; **R** ref to appoplast/symplast	
			evaporation of water;	
			from spongy mesophyll cell walls;	
			into (substomatal/intercellular) air space;	
			diffusion of water <u>vapour</u>;	
			through stomata;	**[max 4]**
				[Total: 12]