

Transport mechanism

Mark Scheme 4

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Transport in plants
Sub Topic	Transport mechanism
Booklet	Theory
Paper Type	Mark Scheme 4

Time Allowed : 76 minutes

Score : / 63

Percentage : /100

Grade Boundaries:

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

- 1 (a) increased / faster, movement / diffusion, of, assimilates / amino acids /
sucrose / water / solutes / ions / molecules ;
I substances / particles / carbohydrates
I freely / easily / efficiently
I osmosis

(because) more, (symplast) pathways / passages / AW ;
accept in context of blockage of some plasmodesmata

correct ref. to symplast pathway in context of an advantage ;

e.g. of complex plasmodesmata ;
from companion cell into sieve tube (elements) / when loading sucrose
into phloem

AVP ; e.g. selectivity / control / regulation, of movement

[max 2]

- (b) 1 mass flow ; A pressure flow
- 2 sucrose / solutes / assimilates / sugars, decreases, water potential /
solute potential ; A symbol(s) Ψ
- 3 water enters (sieve tubes), down water potential gradient / by osmosis ;
- 4 increase in / high(er), hydrostatic pressure ;
- 5 unloading / removal, of sucrose at the sink lowers the (hydrostatic)
pressure ;
- 6 movement (from source to sink) is by gradient in (hydrostatic) pressure ;

[max 4]

[Total: 6]

CHEMISTRY ONLINE
— TUITION —

2 (a) stomata in, pits/cavities/chambers/crypts ; I sunken stomata

no stomata on upper surface ;

few stomata ;

hairs/trichomes ;

thick (waxy) cuticle ;

thick walled epidermal cells ;

several layers of, upper epidermis/hypodermis ;

[max 3]

(b) 300 ;;

(18 000/60 or 19 000/60 or 20 000/6)

allow one mark

if correct measurement is divided by magnification but incorrect conversion factor is used if answer not to nearest 100 μm

[2]

(c) 1 loss of water vapour from, leaves/aerial parts of the plant ;

2 water evaporates from, walls/surface, of mesophyll cells ;

3 into air spaces ;

4 water vapour diffuses(out to atmosphere) ; **A** water if mp2 awarded

5 through open stomata (to atmosphere) ;

6 down a water potential gradient ;

A idea that water potential gradient established

[max 4]

[Total: 9]

- 3 (a) (i) *no mark if no units used at all*
L – 3.6 kPa ; *award the mark if units only used once*
M – 4.5 kPa ; **A** in range 4.45 to 4.55 [1]
- (ii) *ignore any similarities*
1 to the right / lower (affinity) / qualified ; e.g. lower percentage saturation
2 at, higher / lower, partial pressures, small(er) difference in percentage saturation (than others) ; **A** ora
3 comparative data quote ; *must refer to L and M*
allow ecf from (i) [3]
- (b) at partial pressures in the tissues ; *where oxygen is unloaded from Hb*
2 haemoglobin is less saturated (than **L**) ;
3 because, haemoglobin / Hb, dissociates more readily ;
A idea of unloading oxygen more readily *even if Hb not mentioned*
4 to compensate for, fewer / less effective, red blood cells / Hb ; [max 3]

CHEMISTRY ONLINE
— TUITION —

- (c) haemoglobin less well saturated (in lungs at high altitude) ;
 2 data quote from Fig. 3.1 ; **A** 80–90% saturated at ‘about 7.5 kPa’
 3 produce more red blood cells / increase in number of RBCs ;
 4 more haemoglobin ;
 5 *idea* of compensates for, smaller volume of oxygen absorbed / lower saturation (of haemoglobin) ;
- also accept the following adaptations*
- 6 increase in haematocrit / AW / decrease in plasma volume ;
 A increase in RBCs per unit volume
 R decrease in blood volume
- 7 increase in, breathing rate / tidal volume / heart rate / stroke volume ;
 8 increase in, capillary density / number of mitochondria / myoglobin / respiratory enzymes, in muscle ;
 9 ref. to (increased) secretion of, erythropoietin / EPO ;
 10 increase in (2,3), BPG / DPG, in red blood cells ; **A** rightward shift in curve [max 4]
- (d) not caused by (named type of) pathogen / non-infectious / non-transmissible / non-communicable / AW ;
 2 genetic / inherited / AW, disease ; **A** caused by a mutation / AW
 A ‘passed down from parent(s)’
 R idea of congenital diseases
 R ‘you get it from your mother’
 3 ref. to, no immune response / no antigen(s) ;
 4 affects all red blood cells so vaccine would lead to their destruction ; [max 2]

[Total: 13]

CHEMISTRY ONLINE
 — TUITION —

- 4 (a) (i) **G** ; [1]
- (ii) **B / C** ; [1]
- (iii) **A / F** ; [1]
- (iv) **B** ; [1]
- (v) **D** ; [1]
- (b) 1 nitrogen and hydrogen / substrates, bind to / AW, active site ;
- 2 enzyme-substrate complex (forms) ;
- 3 ref. lock and key / induced fit, mechanism ;
- 4 activation energy of reaction is lowered ;
- 5 example of how activation energy lowered ;
e.g. strain on (triple) bond of, N_2 / (di)nitrogen
A bond broken between nitrogen (atoms)
nitrogen and hydrogen ions held close together for bond formation
transfer of electrons
alternative pathway
- 6 product / NH_4^+ , leaves active site ;
- 7 ATP, required / used / provided from respiration ;
- 8 ref. anaerobic conditions for enzyme action ;
- 9 suggestion as to use of, vanadium / molybdenum, in active site ;
e.g. act as cofactor / coenzyme
transfer of, electrons / protons [4]

CHEMISTRY ONLINE
— TUITION —

- (c) 1 concentration of all the ions is greater in the root tissue than in the solution ; ora
 A roots
2 comparative data quote ;

according to these data

- 3 (so) ions will not diffuse into the root tissue ;
 A if (facilitated) diffusion only, initially / till equilibrium reached
4 (so) active transport ; **A** active, uptake / pumping **I** facilitated diffusion
5 use ATP ; **A** energy
 R ATP energy
6 move ions, against concentration gradient / from low to high concentration;
 A diffusion gradient
7 use, membrane / integral / intrinsic / transmembrane / transport / carrier, proteins ;
 R channel proteins
8 are specific / have specific binding sites ;
9 involve, conformational / shape, change ;
10 comparative data quote to suggest that some ions are pumped more than others ;
 e.g. steepest gradients for K^+ and SO_4^-
11 phospholipid bilayer / hydrophobic core (of cell surface membrane) is impermeable to ions ;
12 so ions cannot diffuse out / (membrane) proteins only allow inward flow of ions ;
13 AVP ; e.g. suggestion of differing numbers of specific membrane proteins to explain observation of mp 10 [max 5]

[Total: 14]

CHEMISTRY ONLINE
— TUITION —

- 5 (a) (×) 400 ;;
 if answer incorrect or not to nearest 100 allow one mark for correct working
 e.g. (scale bar) 19 000–21 000 divided by
 award max one mark if a unit (e.g. μm) is included [2]
- (b) 1 thick(ened) / lignified, walls prevent, collapse ;
ignore strengthened
A withstands, compression / negative pressure
ignore bursting
 2 lignified (wall), prevents leakage / provides waterproofing ;
 3 cellulose, wall / lining, allows adhesion of water (molecules) ;
A hydrogen bonding / hydrophilic
 4 (relatively) large diameter / large cross-sectional area / wide / large lumen ;
 5 hollow / empty / no contents / no cytoplasm ;
 6 no end walls / continuous 'tubes' / AW ;
 7 elongated ;
A if referenced to cells or vessels **A** cells end to end (to make tubes)
 only allow mps 4–7 in terms of ease / efficiency of water movement
 mp 4 e.g. more space allows a greater volume to flow / greater volume per unit time
 or mp 5–6 e.g. minimal resistance to flow, allows unimpeded flow, allows free flow of water
 8 pits / pitted walls, to allow lateral movement ;
R pores [max 3]
- (c) 1 water moves, down a water potential gradient / from a high(er) water potential to a
 low(er) water potential, accept ψ for water potential ;
 2 apoplast pathway, described / used in correct context ;
 3 symplast pathway, described / used in correct context ;
 4 evaporation from mesophyll cell walls ;
A surface of mesophyll cells
 5 into air space(s) ;
 must be linked to evaporation / water vapour
 6 water vapour diffuses (out) ;
 accept if no vapour but follows from evaporation
 7 out / through / via stoma(ta) ;
R 'evaporates from the stomata'
 8 **AVP** ; ref. to water leaves unlignified terminals of xylem vessels [max 5]
- [Total: 10]

- 6 (a) (i) **A** - Golgi (body/apparatus)/dictyosome; **R** Golgi vesicles
- B** - (rough) endoplasmic reticulum/ER/RER; **R** SER
- C** - mitochondrion/mitochondrial, matrix/envelope; **3**
- (ii) sieve plate(s); **1**
- (iii) sucrose/amino acid(s)/named amino acid; **R** sugar, glucose **1**
- (b) little/watery/peripheral, cytoplasm/no tonoplast/no vacuole/ few organelles/few ribosomes/so little resistance/AW e.g. easy transport/move more easily/minimum obstruction;
- pores in sieve plate provide little resistance/permit continuous flow/allows movement/AW e.g. as above;
- sieve plate braces/prevents cell bulging under pressure/collapsing;
- plasmodesmata only between sieve tube element and companion cell allows pressure to build up;
- plasmodesmata allows loading/AW e.g. sucrose to be transported in from companion/transfer cell;
- (strong) cellulose walls prevent, excessive/too much, bulging/expansion;
- mitochondria (and starchy plastids) for ATP, for repair/maintenance;
- R** reference to mitochondria in companion cells **3 max**
- (c) sucrose/sugars/assimilates, are pumped/loaded (by companion cells);
- reference to pumping H^+ ;
- reference to co-transport/AW e.g. H^+ carry sucrose with them;
- mitochondria provide, ATP for active transport; **2 max**
- [Total 10]**