

Photosynthesis as an energy transfer process

Mark Scheme 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Photosynthesis
Sub Topic	Photosynthesis as an energy transfer process
Booklet	Theory
Paper Type	Mark Scheme 1

Time Allowed : 63 minutes

Score : / 52

Percentage : /100

Grade Boundaries:

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

- 1 (a) (light microscope) observe living cells/cells would be killed (with EM) ;
vacuum used in electron microscope ;
(light microscope) can have water on slide (to allow cells to move) ; ora
AVP ; e.g. more readily available for use
organisms move in response to light

[max 2]

- (b) (i) (part of/used in synthesis, of) chlorophyll (molecule) ;
R gives chlorophyll green colour

in translation/joining of large and small subunits (of ribosomes) ;

enzyme, cofactor/activator/described ; *idea of role in enzyme catalysis*
A correctly named enzymes e.g. DNA polymerase

AVP ; e.g. stabilizing, cell wall/proteins/nucleic acids/membranes
important in energy transfers/ATP synthesis
DNA, synthesis/replication
ref. to role in, light absorption/capture (for photosynthesis)

[max 1]

- (ii) *any two from*
1 good solvent/polar (for substances needed by the organism) ; AW
2 transparent/allows light through, (for photosynthesis) ;
3 liquid over wide range of temperatures ;
4 high specific heat capacity ; A description
5 high latent heat of vaporisation ;
6 ref. to density ; e.g. ice/solid, less dense than, water/liquid
circulation bringing nutrients to surface
7 ref. to low viscosity for locomotion ;

[max 2]

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- (c) *assume multicellular organisms unless stated, then accept ora*
- 1 small, surface area to volume ratio / SA:V ;
A as organisms increase in size, SA:V decreases
 - 2 ref. to (larger size means) long distances (to reach, cells/tissues) ;
 - 3 diffusion, too slow / insufficient / unable to satisfy needs ;
 - 4 transport system decreases time to supply cells ;
 - 5 require, bulk / mass, flow ;
 - 6 ref. to transport system means efficient supply (to cells) of nutrients / named / assimilates / water ; **A** brings supplies close to cells (for transfer)
- [max 4]

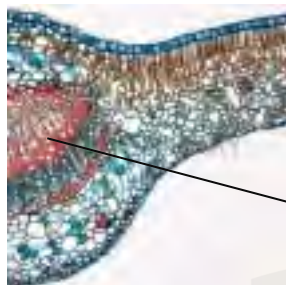
- (d)
- 1 mass flow ; **A** pressure flow
 - 2 sucrose / solutes / assimilates / sugars, decreases, water potential / Ψ ;
A more negative / lowers, water potential
A for water potential **A** solute potential
 - 3 water enters (sieve tubes) by osmosis ;
 - 4 (water enters) down water potential gradient ;
 - 5 (increased volume) increase in / high(er), hydrostatic pressure ;
ref. to hydrostatic required once only in mp 5 or mp 7 or mp 8
 - 6 unloading / removal, of sucrose / AW, at the sink / named sink ;
 - 7 lowers hydrostatic pressure / low pressure at sink ;
 - 8 movement is, down pressure gradient / from high to low (hydrostatic) pressure ;
- [max 5]

[Total: 14]

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2

(a)



P / palisade mesophyll (tissue) ;

X / xylem (tissue) ;

[2]

- (b) *large surface area*
(to get) more, light / carbon dioxide ; **A** gas exchange **I** oxygen

thinness

small(er) / short(er) / reduced, diffusion distance for gases **OR**
fast(er) diffusion of gases ; **A** named gas, either CO₂ or O₂

1 mark only if both points made but not related to features in italics

[2]

- (c) (i) have chloroplasts / varying thickness of (cell) walls / no plasmodesmata ;

[1]

- (ii) water potential / Ψ , of (guard) cell(s), increases / becomes less negative ;

water leaves cell(s) ;

(by) osmosis / down a water potential gradient ; **I** diffuses

(guard cell) becomes, flaccid / less turgid / AW ;

[max 3]

[Total: 8]

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3 (a) label **L** to any thylakoid membrane ;

label **R** to stroma ;

[2]

(b) to absorb, more / maximum, light ;

to avoid damage by high light intensities ;

[2]

(c) 1 carbon dioxide ; **A** CO_2

2 ATP ;

3 reduced NADP ;
mp 2 and mp3 in either order

4 acetyl CoA ;

[4]

[Total: 8]

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4 (a) (i) stroma ; [1]

(ii) lower CO₂ concentration ;

less, carbon fixation / CO₂ combining with RuBP / RuBP converted to GP ;

RuBP reformed from TP ; [max 2]

(iii) 0.01 ;;

A 0.012 or $1.8 \div 150$ or $\frac{2.0 - 0.2}{150}$ or $\frac{2.0 - 0.2}{350 - 200}$ for 1 mark [2]

(b) less TP ;

(so less) conversion to, (other) carbohydrates / lipids / amino acids / proteins ;

A named examples, e.g. glucose / hexose / cellulose / starch

AVP ; e.g. 1 – (amino acids) used to make proteins for, growth / cell division

e.g. 2 – (carbohydrate / lipid) for respiration for, growth / cell division [max 2]

[Total: 7]

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5 (a) transport proteins – Y ;

pigments – X ;

[2]

(b) DNA

codes for, proteins / polypeptides / enzymes ;

one example of protein or enzyme ;

e.g. rubisco / electron acceptor / ATP synthase / transport

ref. transcription / mRNA ;

[max 2]

(c)

factor	stage	✓ or ✗
carbon dioxide concentration	Calvin cycle	✓
	photolysis	✗
light intensity	Calvin cycle	✗
	photolysis	✓
temperature	Calvin cycle	✓
	photolysis	✗

...

all 6 correct = 3 marks

4 or 5 correct = 2 marks

2 or 3 correct = 1 mark

[3]

[Total:7]

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Question Expected Answers

6 (a) **A** – palisade, mesophyll/cell/tissue/layer;

B – guard cell;

C – (sub-stomatal) air space;

[3]

(b) (i) 1. through the stoma(ta);

2. b diffusion/description;

3. from the, atmosphere/air;

[max 2]

(ii) ribulose biphosphate;

I RuBP

[1]

(iii) reduces/donates hydrogen ;

A H/hydrogen atoms/ H^+ **AND** e^-

R H^+ / H_2

[2]

GP to TP ;

A PGA to PGAL

[Total: 8]

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