

Photosynthesis - Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> • use of light (energy) to excite electrons in chlorophyll (1) • {photolysis / splitting of water} to produce oxygen, electrons and hydrogen ions (1) • electrons used { in the electron transport chain / to replace those lost by chlorophyll } (1) • generation of ATP / photophosphorylation (1) • reduction of NADP (1) 	<p>ALLOW electrons promoted to higher energy level ALLOW photosystem (PS) I or II for chlorophyll</p> <p>ALLOW correct equation</p> <p>ALLOW electrons used in redox reactions / electrons move along electron carrier proteins</p>	5

Q2.

Question Number	Answer	Additional Guidance	Mark
	<ol style="list-style-type: none"> 1. idea that carbon dioxide dissolves (in the water / in the oceans) ; 2. for {carbon fixation / light-independent reaction / eq} ; 3. by {photosynthesis / eq} of {seaweed / algae / (phyto) plankton / autotrophs / eq} ; 	<p>1 ACCEPT absorbed / reacts with /diffuses into / becomes carbonic acid</p> <p>3 ACCEPT plants (that live in the sea) IGNORE organisms</p>	(2)

Q3.

Question Number	Answer	Additional Guidance	Mark
	<p>1. idea that light is reduced by the deeper water ;</p> <p>2. idea that carbon dioxide levels might be lower deeper down ;</p> <p>3. idea that temperature might be lower deeper down ;</p> <p>4. idea that {photosynthesis / eq} will be reduced ;</p> <p>5. idea that less {glucose / hexose / GALP / GP / eq } produced to convert into {biomass / NPP / eq} ;</p> <p>6. idea that GPP goes down but respiration {stays the same / increases} ;</p>	<p>NB ACCEPT converse of mp 1 - 5 if in context of shallow water</p> <p>5 IGNORE energy</p>	

Q4.

Question Number	Answer	Additional Guidance	Mark
	<p>reaction A = phosphorylation ;</p> <p>reaction B = hydrolysis ;</p>		(2)

Q5.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(i)	An answer that makes reference to the following: <ul style="list-style-type: none"> • {cold / buffered} to stop enzyme denaturation (1) • sucrose to stop osmotic loss of water from chloroplasts (1) 		(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(ii)	<ul style="list-style-type: none"> • tube 3 is a control to show DCPIP does not change colour over time (1) 		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(iii)	An explanation that makes reference to the following: <ul style="list-style-type: none"> • set up tubes identical to tube 1 so that chloroplasts are available (1) • set up several tubes to ensure data is reliable (1) • tubes exposed to light of different wavelengths for same time because time affects number of electrons released / tubes exposed to light of same intensity because intensity affects number of electrons released (1) • use a colorimeter with a red filter to measure absorbance (1) 		(4)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	C		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	A		(1)

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> • correct measurements from the photograph (1) • correct answer 	<p><u>Example of calculation</u></p> <p>Starch grain 27mm and width of chloroplast 60mm</p> $27000 \div 22 = 12\ 273$ $60000 \div 12\ 273 = 4.889\ (\mu\text{m})$ <p>ALLOW 4.9 / 4.89 / 4.8 recurring (μm)</p> <p>(ALLOW one mark for correct calculation from different measurements)</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> • (granum) is formed from many layers of thylakoid membranes to increase surface area (for absorbing light) • thylakoid membranes contain chlorophyll to absorb light • electron carrier molecules in thylakoid membrane involved in ATP production 	<p>ALLOW stacks of thylakoids provide a large surface area</p> <p>ALLOW photosystems / photosynthetic pigments in place of chlorophyll</p> <p>ALLOW for light dependent reaction in place of absorb light</p> <p>ALLOW ATP synthase / photophosphorylation</p>	(3)

Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	$2\text{H}^+ + \frac{1}{2}\text{O}_2$	Allow 'hydrogen ions', 'protons' and 'oxygen'	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	C (photolysis)		(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	C (chlorophyll)		(1)

Question Number	Answer	Additional Guidance	Mark
(iv)	B (chloroplast stroma)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(v)	<p>A description that makes reference to two of the following:</p> <ul style="list-style-type: none"> • electron transport (1) • movement of hydrogen ions across thylakoid membrane (1) • ATP production / photophosphorylation (1) 		(2)

Q8.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. Molecule P - water / H ₂ O ; 2. Molecule Q - oxygen / O ₂ ;		(1)

Question Number	Answer	Mark
(a)(ii)	D ATP and reduced NADP ;	(1)

Question Number	Answer	Additional Guidance	Mark
(a)(iii)	1. reference to RUBISCO as an {enzyme / catalyst} ; 2. in the Calvin cycle ; 3. involved in {carbon fixation / bonding of CO ₂ to RuBP / reaction between CO ₂ and RuBP / eq} ; 4. to form GP / eq ; 5. GP converted to GALP / eq ; 6. using ATP and {reduced NADP / NADPH} (CO ₂ to GALP / GP to GALP) ;	1. ACCEPT catalyses 3. ACCEPT formation of 6C intermediate from RuBP 5. ACCEPT reduced to NB Award formation of GALP from reaction between CO ₂ and RuBP if mp 4 not awarded	(4)

Question Number	Answer	Mark
(b)(i)	C stroma	(1)

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(b)(ii)	1. (image length) 76 / 76.5 / 77 (mm) ; 2. (correct calculation = length /7500) / eq ; 3. (correct units for given answer) μm / eq ;	Correct answer with units = 3 marks 2. CE applies 3. CE applies ACCEPT as standard form	(3)																														
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(b)(iii)	1. idea of compartmentalisation (from stroma) ; 2. site of light-dependent reaction ; 3. credit named molecules {within / on / eq} membrane ; 4. idea of {ATPase / eq } in (thylakoid) membranes ; 5. idea that (thylakoid) membranes provide a space for accumulation of H^+ ; 6. reference to photophosphorylation ;	1. ACCEPT description of separation 3. e.g. photosynthetic pigments / chlorophyll / carotenoids / photosystems / electron carrier proteins IGNORE electron acceptors 4. ACCEPT {ATP synthase / synthetase}, NADP reductase 6. ACCEPT chemiosmosis	(3)