

WJEC (Wales) Biology A-level
Topic 3.2: Photosynthesis
Questions by Topic - Mark
Scheme

1. **Question** **Marking details** **Marks Available**

- (a) (i) **1 mark for both** 1
 Y Cyclic photophosphorylation
 Z Non cyclic photophosphorylation
- (ii) (High energy) electrons/electron {carriers/acceptors}; 1
- (iii) NADP → NADPH₂/ reduced NADP; 1
- (iv) Oxygen/ O₂/ ½ O₂; 1
- (v) Carbon dioxide/ CO₂; 1
- (vi) Glucose; 1

(b) 4

Area	Letter	Name of region
Where the light dependent stage occurs	C;	Grana/Thylakoid;
Where the light independent stage occurs	D;	Stroma;

One mark for each box

- (c) Synthesis of amino acids/proteins **using {a nitrogen source/ named nitrogen source}**; Max 3
 Synthesis of phospholipids with **phosphate**;
 Synthesis of chlorophyll with **magnesium**;
 Synthesis of {nucleotides/named nucleotide} with a **nitrogen source and phosphate source**;

Question 5 Total [13]

2.

Question		Marking details	Marks Available
(a)	(i)	A;	1
	(ii)	A <u>and</u> D;	1
	(iii)	C;	1
(b)	(i)	{RuBP/ 5C compound} and carbon dioxide linked together / carbon dioxide is fixed with RuBP; RuBP carboxylase / RUBISCO {is the enzyme / catalyses the reaction}; unstable 6C {substance/compound} {initially formed/ splits into two 3C};	2 max
	(ii)	Glycerate 3 phosphate reduced; using reduced NADP; ATP also required (to supply energy) / Glycerate 3 phosphate is phosphorylated; {reduced NADP / ATP} from the light dependent reactions;	3 max
(c)	(i)	some (triose phosphate) needed to {regenerate/ make more} RuBP;	1
	(ii)	six times;	1
Question 3 Total			[10]

3.	Question	Marking details	Marks Available
	(a)	It stops electrons from PS II being moved to PS I; So blocking the reduction of NADP ⁺ to NADPH; Cyclic Photo Phosphorylation only involves PSI; is not stopped as the electrons pass from PSI and return to PSI/ eq; And the carrier involved in this is not affected;	4
	(b)	Plant cannot generate {NADPH ₂ / NADPH/ reduced NADP} {so Calvin cycle cannot work/ description of part of process which is prevented}; {No glucose/ hexose sugar} will be formed; For respiration;	3
	(c)	(i) 1. Ribulose bisphosphate; 2. Glycerate(-3-)phosphate; 3. Glyceraldehyde(-3-)phosphate/triose phosphate;	3
		(ii) <u>Catalyses</u> {the reaction between RuBP and carbon dioxide/ to fix carbon dioxide} ;	1
	(iii)	X ATP; Y NADPH ₂ ;	2
	(iv)	A CO ₂ Fixation/ 6C intermediate/ RuBP binds to CO ₂ ; B Regeneration/resynthesis of RuBP; C Reduction;	3
	Question 3 Total		[16]

4.

Question		Marking details	Marks Available
4	(a)	Any 2 from: Reaction centre / antenna complex; In a photosystem; In the thylakoid (membrane);	2
	(b)	19/68 or 20/68; 0.28 or 0.29; (2d.p.) ecf Xanthophyll;	1 1 1
	(c)	(i) <u>Absorption</u> spectrum;	1
		(ii) (Green) light is reflected (by the pigments);	1
		(iii) Any 2 from: <ul style="list-style-type: none"> • {light / photons} can be absorbed over {a greater range of / more} wavelengths; Accept correct use of figures • More {light / photons} absorbed means more products from the light dependent stage; • {Greater rate of / faster} photosynthesis / Photosynthesis is more efficient; 	2
(d)	Any 3 from: <ul style="list-style-type: none"> • Light absorbed by (pigments in) {photosystems / PSI / PSII / description of photosystem}; • {Excites electrons / raises electrons} to higher energy level; • Electrons emitted from reaction centre/chlorophyll a; • Used to power proton pumps / generate an EC gradient; • Movement of protons through a stalked particle / ATP synthase allows ATP generation; 	3	
Question 4 Total			[12]

5. (a) absorbs light energy [1]
- (b) (i) 440 nm [1]
- (ii) any pigment / chlorophyll absorbs or uses a limited part of the spectrum / light wavelength; additional pigments increase range of wavelengths; from which energy can be obtained (any two) [2]
- (c) all wavelengths except green are absorbed / green is reflected or transmitted. [1]
- (d) since they follow a similar trend / pattern / shape; it suggests that the pigments / wavelengths responsible or used in light absorption are used in photosynthesis. [2]
- (e) (i) A – light harvesting unit / complex / centre / antenna complex [1]
- B – reaction centre [1]
- (ii) cross in circle of reaction centre [1]
- (iii) thylakoid membrane / granal membrane / intergranal membrane [1]

[Total 11 marks]

6.

Question	Marking details	Marks Available
(a)	(i) Respiration Combustion; Both for 1 mk. Accept deforestation	1
	(ii) Chloroplast;	1
	(iii) Light independent; Calvin cycle; RUBP; Rubisco; (unstable 6 C substance) 2 mols of GP;	2
(b)	(i) Produces carbohydrate / glucose / respiratory substrate;	1
	(ii) Produces oxygen;	1
	Question 6 Total	[6]

7. (a)	they have increasing numbers of spots (not: the number of spots)	1
(b)	A - GP, B-malic acid, C-glycine (all 3 for 1 mark)	1
(c)	First - GP; second-Triose phosphate	2
(d)	Nitrogen (not: nitrate)	1
(e) (i)	Y - ATP to ADP (+P); X-NADPH ₂ to NADP	1 1
(ii)	light dependent reactions/(<u>non cyclic</u>) photophosphorylation; (not: Z scheme/cyclic photophosphorylation)	1
(iii)	grana/thylakoids	1
(f)	6	1
		Total 10 marks

8. (a) carbon dioxide [1]
- (b) ATP;
Reduced NADP / NADPH / NADPH₂ [2]
- (c) D;
G (any order) [2]
- (d) energy source / cellulose / lipids / food store /
amino acids / proteins / pentose sugar / disaccharide.
[accept: named sugars] [1]

[Total 6 marks]

9.

Question		Marking details	Marks available															
			AO1	AO2	AO3	Total	Maths	Prac										
(a)	(i)	Clear labelled arrow (thylakoid/ grana/ photosystem) to any thylakoid membrane	1			1												
	(ii)	Chlorophyll <u>a</u>	1			1												
(b)		<p>A. Absorb {light (energy)/ photons} (1)</p> <p>B. Act as a transducer/ transferring light energy to high energy electrons/ excites electrons/ causing chlorophyll a to emit electrons/ pass energy to reaction centre (1)</p> <p>C. Which can be used to power proton pumps/ synthesise ATP/synthesise reduced NADP/ electrons passed down the electron transport chain (1)</p>	3			3												
(c)		<table border="1"> <tr> <td>Any three (x1) from:</td> <td></td> </tr> <tr> <td>Amino acids/proteins</td> <td>Nitrates (Sulfates)</td> </tr> <tr> <td>Phospholipids</td> <td>Phosphates</td> </tr> <tr> <td>Nucleotides/ any example</td> <td>Nitrates and phosphates</td> </tr> <tr> <td>Chlorophyll</td> <td>Magnesium (ions) (nitrates)</td> </tr> </table>	Any three (x1) from:		Amino acids/proteins	Nitrates (Sulfates)	Phospholipids	Phosphates	Nucleotides/ any example	Nitrates and phosphates	Chlorophyll	Magnesium (ions) (nitrates)	3			3		
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Nucleotides/ any example	Nitrates and phosphates																	
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(d)		<p>Any four (x1) from:</p> <p>A. Destruction of chlorophyll- no PS/unable to absorb light (energy) (1)</p> <p>B. {No/ less} {red NADP/ ATP} for {Calvin cycle/ light independent reactions} (1)</p> <p>C. {No/ less} {carbohydrate/ named carbohydrate} synthesised for {respiration/ synthesis of biological molecules} (1)</p> <p>D. {No/ less} respiration, therefore {no/ less} ATP for {cell division/protein synthesis/ active transport} (1)</p> <p>E. Destruction of cell membranes – kills/dries out cells (1)</p>			4	4												
Question 3 total			8	0	4	12	0	0										

10.

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
(a)	(i)	A. Water is split to release electrons , protons and oxygen (1) reject reference to enzymes splitting water Accept equation B. ATP synthesis/ $ADP + P(i) \rightarrow ATP$ / fuel proton pumps (1) C. $NADP^+ + 2e^- + 2H^+ \rightarrow NADPH + H^+$ (Accept $NADPH_2$) / reduction of NADP (1)	3			3		
	(ii)	Line from electron acceptor above photosystem1 to diagonal line	1			1		
(b)	(i)	Chlorophyll b/c Carotene Xanthophyll 3 correct = 2 marks 2 correct = 1 mark 0/1 correct = 0 marks	2			2		
	(ii)	Thylakoid (membrane) in a chloroplast	1			1		
(c)	(i)	392.5 seconds		1		1	1	
	(ii)	Oxygen produced from {photosynthesis/ photolysis of water}(1) (O_2 fills the airspaces in the leaf so) the leaf is {less dense/ lighter/ more buoyant} (and so rises) (1)(must be in correct context)		2		2		2
	(iii)	Any 4 (x1) from: A. (the darker leaves rise more quickly because they have) more {chloroplasts/chlorophyll/ pigment} (in the palisade mesophyll) (1) B. So more {photons will be trapped/ light (energy) absorbed} /more energy transferred to high energy electrons (1) Ignore more wavelengths C. More light dependent stage/ or description of (1) D. More photolysis of water (1) E. More O_2 production (1)			4	4		4
(d)	(i)	A. Change light wavelength/ or description e.g. using filters/ bulbs (1) B. Record the time taken for discs to rise (1) C. Keep hydrogen carbonate concentration constant/ temperature constant/ light intensity/ height of solution (1) D. same colour leaf/ {area/diameter/ size} discs/ species of plant (1)			4	4		6
	(ii)	{Less time/ faster} to rise at the {blue/ violet/ short/ approx. 350nm} and {red / longer/ approx. 650nm} wavelengths (1) {Slower to /More time to/ does not } rise in the {yellow/green/ approx. 500nm} wavelengths (1)		2		2		
Question 4 total			7	5	8	20	1	12

11.

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths *	Prac **
(a)	(i)	X ATP and Y Reduced NADP/ $NADPH_2$ / $NADPH + H^+$ / NADPH Not NAD	1			1		
	(ii)	RuBisCO/ carboxylase/ ribulose bi(s)phosphate carboxylase/ RuBP carboxylase	1			1		
(b)		Any five (x1) from: A. (Initially), Carbon dioxide + RuBP reaction continues/ GP continues to be produced(1) B. GP cannot be {converted/ reduced} to TP (1) C. because ATP and reduced NADP are needed (1) D. ATP and reduced NADP {only produced in light/ not produced in dark}(1) E. (therefore) less TP available {to regenerate RuBP/ as it used produce glucose} (1) F. (Therefore) rate of reaction of carbon dioxide and RuBP decreases (1)		3	2	5		