

A Level AQA Biology

15 Photosynthesis – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	A granum / grana; B thylakoid (membrane) / lamella; C stroma; D starch granule; E inner membrane;	Do not accept cell membrane	5	AO2 3.5.1
01.2	E; C AND B; B; E;		4	AO1 AO2 3.5.1
01.3	Any one from: little oxygen (in the early atmosphere); atmosphere mostly consisted of sulphuric gases;		1 max	AO2 3.5.1
01.4	<p><i>Any one similarity from:</i> both have photosynthetic pigments to absorb light / energy; both reduces NADP (to reduced NADP); both uses CO₂ as a reactant; both makes ATP from ADP and P_i; both produces glucose;</p> <p>AND</p> <p><i>Any one pair for difference:</i> (Normal/oxygenic) photosynthesis produces oxygen; Anoxygenic photosynthesis produces sulphur;</p> <p>OR</p> <p>(normal / oxygenic) photosynthesis uses H₂O to provide electrons and protons; (for the electron transport chain and reducing NADP) anoxygenic photosynthesis uses H₂S instead;</p>	Award max 1 mark for a similarity. Award max 2 marks for a difference.	3 max	AO1 3.5.1

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02.1	Calvin cycle / light-independent stage; made in stroma;		2	AO1 3.5.1
02.2	link reaction / oxidative decarboxylation / Krebs cycle; made in matrix;		2	AO1 3.5.2
02.3	<i>Any two from carbon dioxide:</i> reacts with ribulose biphosphate; in Calvin cycle / light-independent stage; to make two glycerate phosphate molecules; with the enzyme RuBisCo;	2	4 max	AO1 3.5.1
	AND <i>Any two from water:</i> broken down in chloroplast; using light / by photolysis; to release hydrogen ions, electrons and oxygen atoms;	2		
02.4	<i>Mitochondria:</i> substrate-level phosphorylation in the Krebs cycle; oxidative phosphorylation / chemiosmosis in the cristae through ATP synthase;	2 max	6 max	AO1 3.5.1 3.5.2
	<i>Cytoplasm:</i> substrate-level phosphorylation; during conversion (from triose biphosphate) to pyruvate;	2 max		
	<i>Chloroplasts:</i> chemiosmosis (of protons across ATP synthase) Transfer of electrons down electron transport chain; made across thylakoid membrane;	2 max		

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02.5	Any two from: have a double membrane (compared to prokaryotes having cell wall); have free / naked DNA OR DNA not in nucleus; have smaller / 70S ribosomes; circular DNA;		2 max	AO2 3.2.1.1 3.2.1.2
03.1	increasing light intensity increases rate (until point B); more light energy for increased photoionisation / more protons and electrons for more reduced NADP (for more light-dependent stage);		2	AO1 AO2 3.5.1
03.2	carbon dioxide concentration or temperature become limiting factor(s);		1	AO2 3.5.1
03.3	1.17;;	Max 1 mark if answer not in 2 d.p.	2	AO2 3.5.1
03.4	$\frac{0.05}{6.1} \times 100$ = 0.82%;	Max 1 mark if answer not to 2 sig fig	2	AO2 PS 3.3
03.5	RuBisCo / Ribulose biphosphate carboxylase; ATP synthase;		2	AO1 3.5.1
03.6	Any three from: stomatal closure; to prevent high levels of water loss; by transpiration / high transpiration rate; reducing the carbon dioxide diffusing into the plant through the stomata;		3 max	AO1 AO2 3.3.4.2
04.1	A: Carbon dioxide B and C: ATP AND reduced NADP (and ADP + Pi)	Ignore the order of answers for B and C	3	AO1 AO2 Synoptic

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04.2	triose phosphate / TP; AND the hydrolysis of ATP provides energy for reaction; reduced NADP provides hydrogen atom for reduction of GP to TP;		3	AO1 AO2 3.5.1
04.3	amino acids / nucleic acids / proteins made; using nitrates from soil; OR fatty acids made; combine with glycerol made from TP to make lipids;	1 mark for compounds made, 1 mark for molecules needed	2 max	AO1 AO2 3.5.1
04.4	Any three from: oxygen competes (against carbon dioxide) for RuBisCo; oxygen can also fit into the active site of RuBisCo (to produce 2-phosphoglycolate); less glycerate-3-phosphate / GP made; reduced rate of light-independent stage in photosynthesis; fewer (named) photosynthetic products can be made; AND one named disadvantage for farmers; e.g., slower growth rate / lower crop yield;	3 marks for suggested mechanism promoting photorespiration 1 mark for why this is not useful	4	AO2 3.5.1 3.1.4.2

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05.1	Description	Photoionisation	Oxidative phosphorylation	Substrate-level phosphorylation	1 mark per correct row	4	AO1 AO2 3.5.2 3.5.1
	light energy is involved	✓					
	electron transport chain is involved	✓	✓				
	occurs in the cytoplasm			✓			
	occurs in plant cells	✓	✓	✓			
05.2	Any three from: absorption of sunlight causes photoionisation / electrons in chlorophyll become excited; electrons leave the chlorophyll, which becomes oxidised; electron carriers in the thylakoid membrane take up the excited electrons, becoming reduced; NADP receives protons and electrons, hence can become reduced;					3 max	AO1 3.5.1

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Question	Answers	Extra information	Mark	AO Spec reference
05.3	<p>Indicative content:</p> <ul style="list-style-type: none"> • NAD and FAD, involved in respiration • found in cytoplasm and in mitochondria • associated with, dehydrogenase enzymes / dehydrogenation/redox • 2 reduced NAD made in glycolysis per glucose molecule • 1 reduced NAD made in link reaction per pyruvate • 3 reduced NAD made per Krebs cycle • 1 reduced FAD made per Krebs cycle • details of how reduced NAD is made in any reactions above (e.g., NAD reduced from triose phosphate to pyruvate) • carriers / transfers, hydrogen to, inner mitochondrial membrane / cristae • coenzyme used in oxidative phosphorylation • NADP involved in photosynthesis • found in chloroplasts • produced in non-cyclic photophosphorylation • hydrogen comes from, water / photolysis • hydrogen used in Calvin cycle / light independent stage to reduce glycerate phosphate (GP) to triose phosphate (TP) 	<p>Level 3 Describe multiple differences between the coenzymes, including details of where in the cell they are found and the processes they are involved in. Details of how they are made and used are included. All the content is relevant and accurate.</p> <p>Level 2 Describe at least two differences between the coenzymes, with some details of their locations and processes in the cell. Most of the content is relevant, with some error.</p> <p>Level 1 Describe at least one difference between the coenzymes, not a lot of details are included. Little content is relevant and contains more errors.</p> <p>Level 0 No relevant content</p>	6 max	AO1 3.5.1 3.5.2

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06.1	$d = \frac{1}{24^2};$ = 0.0017;	If the answer is correct but not presented to 4 decimal places, award 1 mark (e.g., 0.00174 or 0.002)	2	AO2 3.5.1
06.2	radius / diameter of the capillary tube		1	AO2
06.3	Any one <u>pair</u> from: carbon dioxide; produced in respiration; OR nitrogen; some left in air spaces in the leaves;	1 mark for correctly named gas, 1 mark for correct explanation	2 max	AO2 AO1 3.5.1
06.4	Any one from: some used in aerobic respiration; some dissolved in the water in the capillary tube; some might escape the capillary tube;		1 max	AO2 3.5.1
06.5	increasing light intensity increases rate of photosynthesis; more light energy for more <u>photolysis</u> / excite <u>more</u> electrons / for <u>photophosphorylation</u> ;		2	AO1 3.5.1
06.6	<i>Temperature:</i> set up (thermostatically controlled) water bath to place test tube of plant in; <i>Carbon dioxide concentration:</i> fill test tube with sodium/potassium hydrogencarbonate solution (HCO_3^-);		2	AO3

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07	<p>Write an essay describing the effects of different environmental factors on plant growth, and the importance of controlling these factors for farming:</p> <table border="1"> <thead> <tr> <th>Specification reference</th> <th>Topic area</th> </tr> </thead> <tbody> <tr> <td>3.1.4.2</td> <td>Enzyme-catalysed reactions</td> </tr> <tr> <td>3.1.6</td> <td>ATP</td> </tr> <tr> <td>3.1.7–8</td> <td>Water and inorganic ions</td> </tr> <tr> <td>3.2.2</td> <td>Cell division</td> </tr> <tr> <td>3.2.3</td> <td>Transport across membranes</td> </tr> <tr> <td>3.2.2</td> <td>Gas exchange</td> </tr> <tr> <td>3.3.4.2</td> <td>Mass transport in plants</td> </tr> <tr> <td>3.4.2</td> <td>DNA and protein synthesis</td> </tr> <tr> <td>3.5.1</td> <td>Photosynthesis</td> </tr> <tr> <td>3.5.2</td> <td>Respiration</td> </tr> <tr> <td>3.6.1.1</td> <td>Plant responses to stimuli</td> </tr> </tbody> </table> <p>Note: other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.</p>	Specification reference	Topic area	3.1.4.2	Enzyme-catalysed reactions	3.1.6	ATP	3.1.7–8	Water and inorganic ions	3.2.2	Cell division	3.2.3	Transport across membranes	3.2.2	Gas exchange	3.3.4.2	Mass transport in plants	3.4.2	DNA and protein synthesis	3.5.1	Photosynthesis	3.5.2	Respiration	3.6.1.1	Plant responses to stimuli	<p>The answer should include the different environmental factors and how they can become limiting at different situations. It should include how transpiration and respiration may occur at certain situations and the <i>idea</i> that the rates of all three processes should be balanced or monitored. It should also include a discussion of how these different factors, and rates of transpiration and respiration, positively and negatively impact upon farming, and how they might be controlled in farming.</p>	25	AO1 AO2 3.1.4.2 3.1.6 3.1.7–8 3.2.2 3.2.3 3.2.2 3.3.4.2 3.4.2 3.5.1 3.5.2 3.6.1.1
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Skills box answers

Question	Answer
1a	$\frac{1.2}{3.3} = 0.36$
1b	$\frac{1.7}{3.3} = 0.52$
1c	$\frac{3.2}{3.3} = 0.97$
2	pigment A – chlorophyll <i>b</i> pigment B – chlorophyll <i>a</i> pigment C – phaeophytin pigment D – carotenes
3	it is difficult to measure the exact distance any pigment has travelled from the origin, and some colour zones may be a mixture of pigments (e.g., xanthophylls)