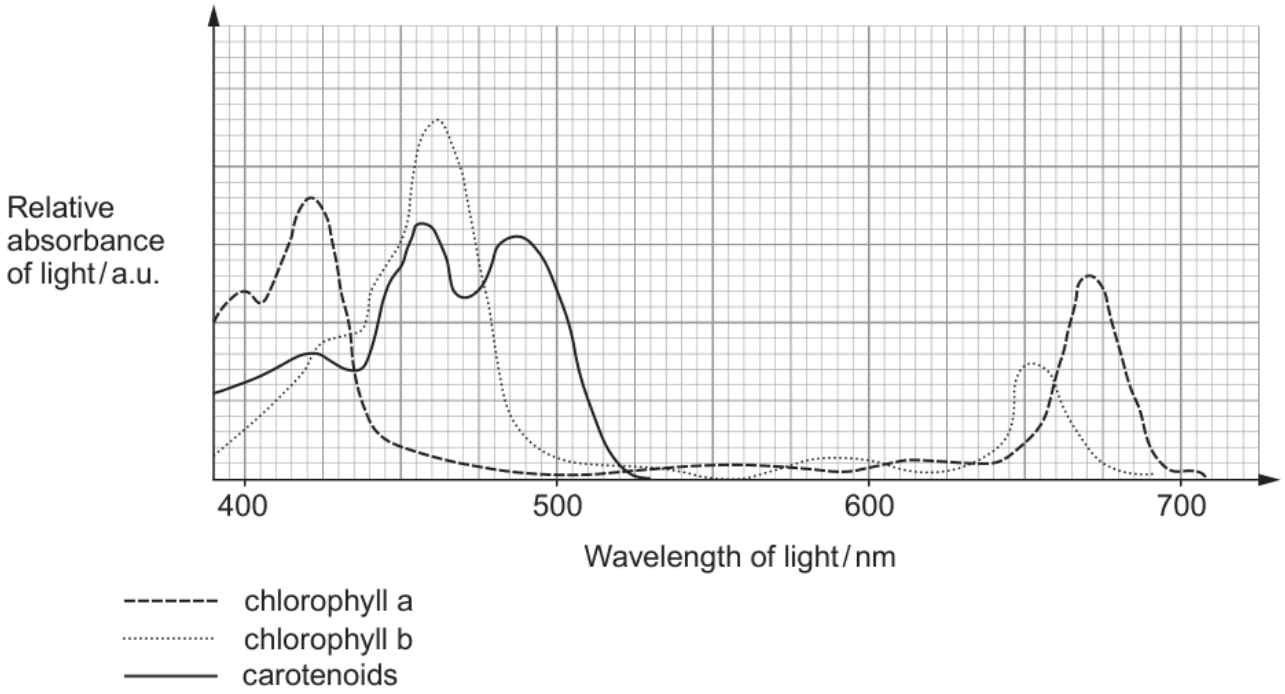
Photosynthesis (1.2): Eduqas A Level Biology Exam Questions by Topic

22 questions · 52 marks · about 62 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 1 · Autumn 2020 · Q1(a)(i) · 2 marks

1. Photosynthetic cells are transducers converting light energy into chemical energy. Several photosynthetic pigments are involved in the absorption of light energy. **Image 1.1** is an absorption spectrum showing the relative absorbance of different wavelengths of light energy by different pigments.

Image 1.1



(a) (i) Using information in **image 1.1**, describe the absorption spectrum of **chlorophyll a**. [2]

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Question 2 · A level Component 1 · Autumn 2020 · Q1(a)(ii) · 1 mark

(ii) Suggest the advantage to photosynthetic cells of having several different light absorbing pigments. [1]

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Question 3 · A level Component 2 · Autumn 2020 · Q6(a)(ii) · 2 marks

(ii) Ferns have chloroplasts with the same structure and photosynthetic pigments as flowering plants. Name **two** photosynthetic pigments found in ferns and state **precisely** where in the chloroplast you would expect to find them. [2]

.....

.....

Question 4 · A level Component 1 · Autumn 2021 · Q1(a)(i) · 1 mark

1. Plants can harvest light energy using photosystems and use this energy to synthesise organic molecules.

(a) (i) State the precise location of photosystems in plants. [1]

.....

Question 5 · A level Component 1 · Autumn 2021 · Q1(a)(ii) · 3 marks

(ii) Explain how the arrangement of pigments in photosystems harvests light energy. [3]

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Question 6 · A level Component 1 · June 2019 · Q3(b) · 3 marks

(b) Explain the role of photosystems in the light dependent stage of photosynthesis. [3]

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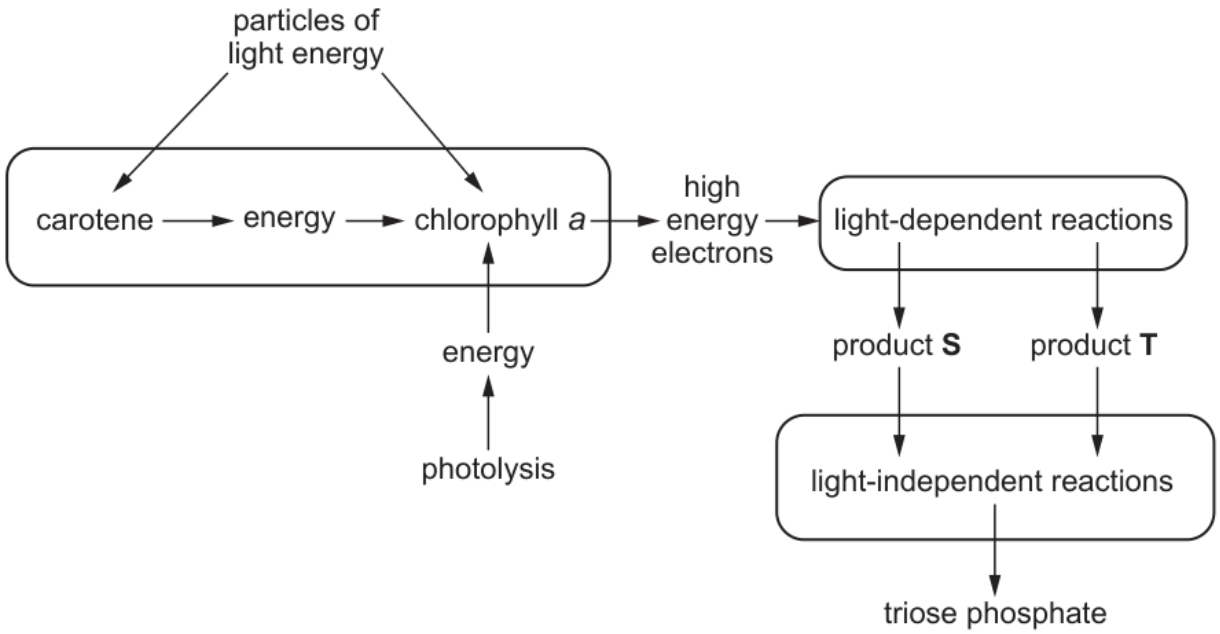
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Question 7 · A level Component 1 · June 2024 · Q4(d)(i) · 1 mark

(d) **Image 4.6** summarises the light-dependent and light-independent stages of photosynthesis.

Image 4.6



(i) State the term used to describe the **particles of light energy**. [1]

.....

Question 8 · A level Component 1 · June 2024 · Q4(d)(ii) · 2 marks

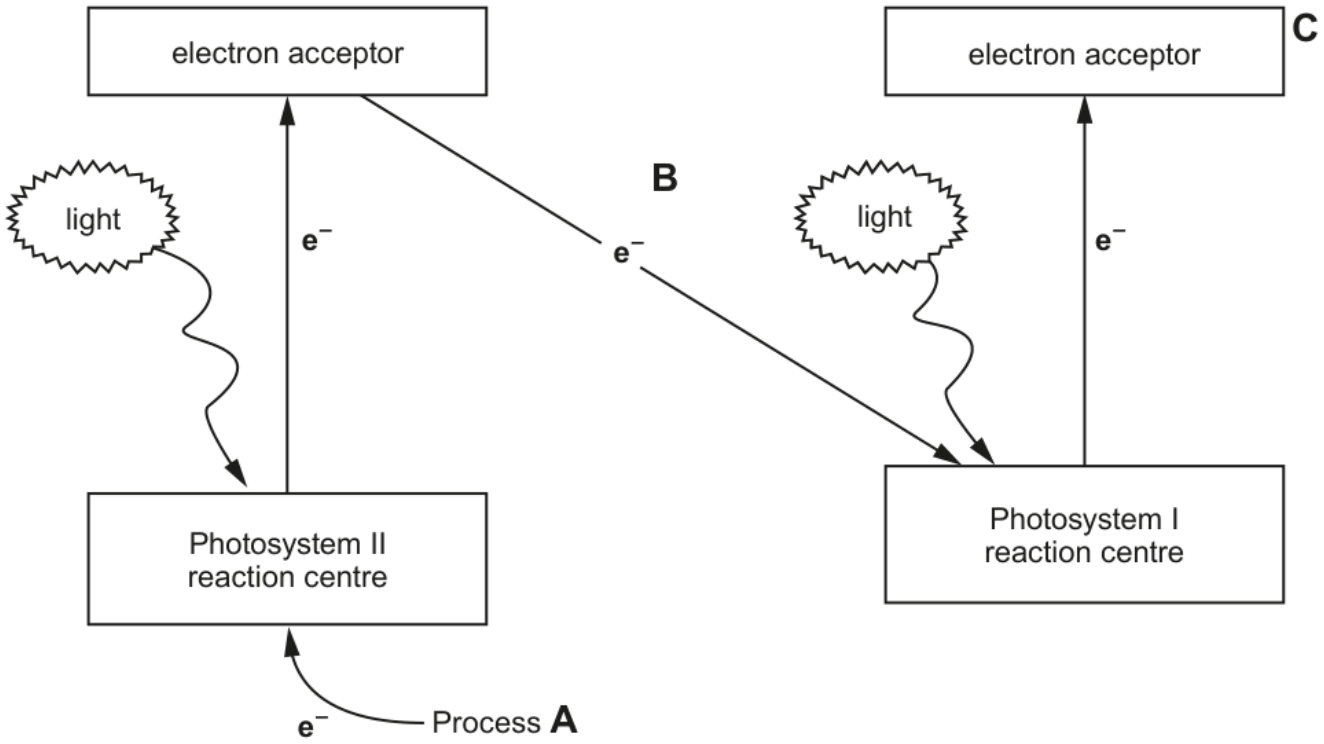
(ii) Product **S** is synthesised via an electron transport chain while product **T** is synthesised from the final electron acceptor of this series of reactions. Name products **S** and **T**. [2]

Product **S** .....

Product **T** .....

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

4. The light dependent stage of photosynthesis can be represented by a diagram called the Z-scheme, shown below.



(a) (i) **Describe** the process at **A** which replaces the electrons lost from photosystem II and explain how electrons are used at **B** and **C**. [3]

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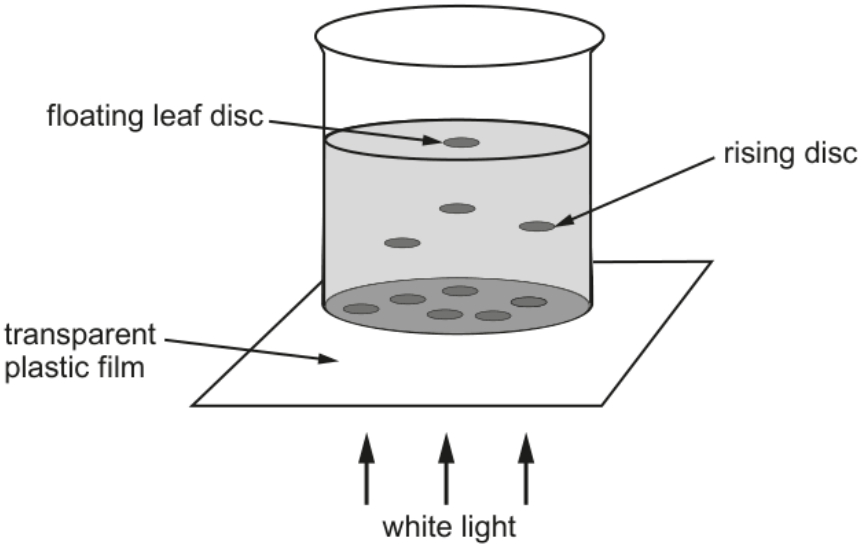
Question 10 · A level Component 1 · Autumn 2020 · Q1(c) · 2 marks

(c) In the light dependent stage of photosynthesis, molecules of chlorophyll a emit electrons. Describe how these electrons are replaced in non-cyclic photophosphorylation. [2]

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(c) An experiment was carried out to investigate the effect of leaf colour on the rate of photosynthesis. Leaves placed in water naturally float, but if small discs of leaves are punched out of the leaves and the air in the discs is replaced by hydrogen carbonate solution (a CO_2 source), they will sink.

The time taken for 15 light green leaf discs to float to the top of the solution when illuminated from below can be determined and gives an estimate of the rate of photosynthesis. This was repeated for dark green leaf discs.



The results of such an experiment are shown below.

Order of leaf discs rising	Time taken for each leaf disc to rise / seconds	
	Dark green colour discs	Light green colour discs
1st	102	296
2nd	157	324
3rd	186	358
4th	201	360
5th	240	420
6th	260	422
7th	287	665
8th	317	666
9th	396	805
10th	404	1000
11th	474	1108
12th	535	1173
13th	622	1674
14th	808	1821
15th	898	2388
Mean time	.....	898.7

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Question 11 · A level Component 1 · June 2017 · Q4(c)(ii) · 2 marks

(ii) Explain what caused the discs to rise in the solution. [2]

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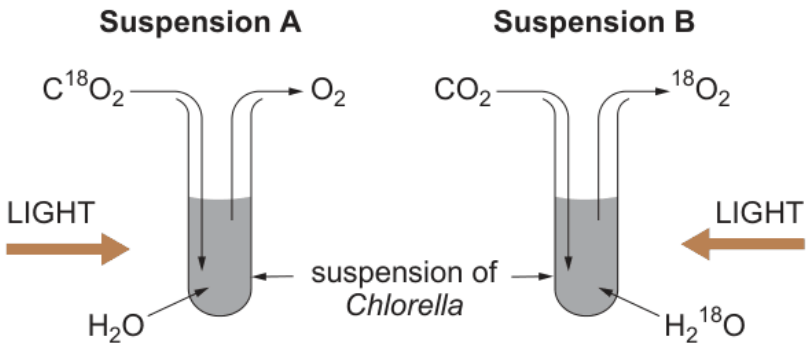
Question 12 · A level Component 1 · June 2022 · Q6(a)(ii) · 2 marks

An experiment, shown in **Image 6.1**, was carried out to confirm the origin of the oxygen molecules released in photosynthesis. In this experiment two suspensions of a photosynthetic unicellular alga, *Chlorella*, were treated as follows:

Suspension A
- provided with water containing a non-radioactive isotope of oxygen (H_2O)
- and carbon dioxide containing a radioactive isotope of oxygen ($C^{18}O_2$)

Suspension B
- provided with water containing a radioactive isotope of oxygen ($H_2{}^{18}O$)
- and carbon dioxide containing a non-radioactive isotope of oxygen (CO_2)

Image 6.1



(ii) Using evidence from this experiment and your knowledge of photosynthesis, deduce the actual origin of the atoms in the oxygen molecules. Explain your answer. [2]

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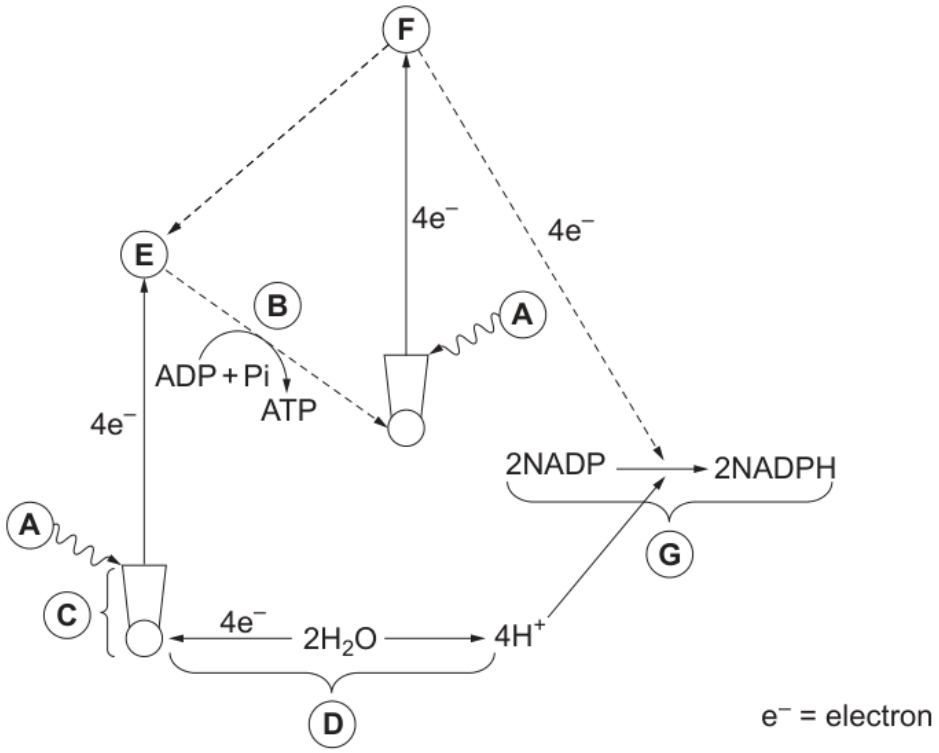
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Question 13 · information from earlier in the question

(b) The light dependent stage of photosynthesis relies on the flow of electrons between different molecules as shown in **Image 6.2**.

Image 6.2



Question 13 · A level Component 1 · June 2022 · Q6(b)(ii) · 2 marks

(ii) State the type of reaction occurring at **G**. Explain your answer. [2]

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Question 14 · information from earlier in the question

(c) DCPIP (2,6-dichlorophenol-indophenol) is a blue dye which acts as an electron acceptor and becomes colourless when it accepts electrons.

The flow diagram describes the method used by a student to isolate chloroplasts. **Image 6.4** shows a centrifuge tube containing the isolated chloroplasts.

Method

Grind spinach leaves in an ice-cold solution of sucrose and buffer.

↓

Filter extract.

↓

Centrifuge to obtain a small pellet of chloroplasts.

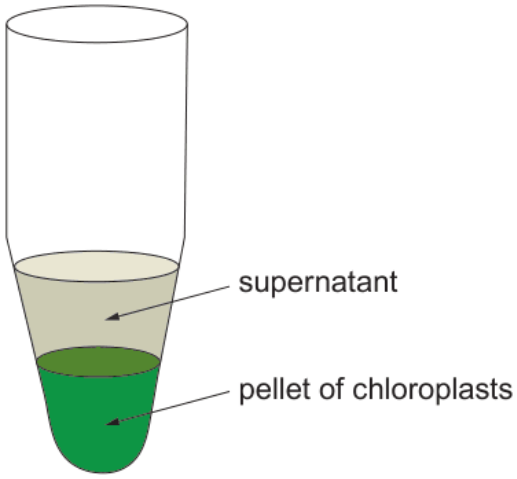
↓

Separate pellet from supernatant.

↓

Re-suspend the chloroplasts and keep cool.

Image 6.4



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

The student used the isolated chloroplasts to prove that electrons are released by chlorophyll during photosynthesis. **Table 6.5** shows how four different experimental tubes were set up, whether they were exposed to light or not and the colour change observed.

Table 6.5

Tube	Volume / cm^3				Light or no light	DCPIP colour change
	suspended chloroplasts	supernatant	sucrose and buffer solution	DCPIP solution		
1	0.5			5	light	blue to colourless
2			0.5	5	light	no colour change
3	0.5			5	no light	no colour change
4		0.5		5	light	no colour change

(iii) Explain why each of the **experimental tubes 1–4** were included in this investigation and conclude whether the results prove that electrons are released by chlorophyll during photosynthesis or not. Explain your answer. [4]

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Question 15 · A level Component 1 · Autumn 2020 · Q2(b)(i) · 2 marks

(b) RuBisCO is responsible for carbon fixation in the Calvin cycle.

(i) State the names of the **two** substrates that form an enzyme-substrate complex with RuBisCO. [2]

....

Question 16 · A level Component 1 · Autumn 2020 · Q2(b)(ii)I · 1 mark

(ii) State the names of the following molecules:

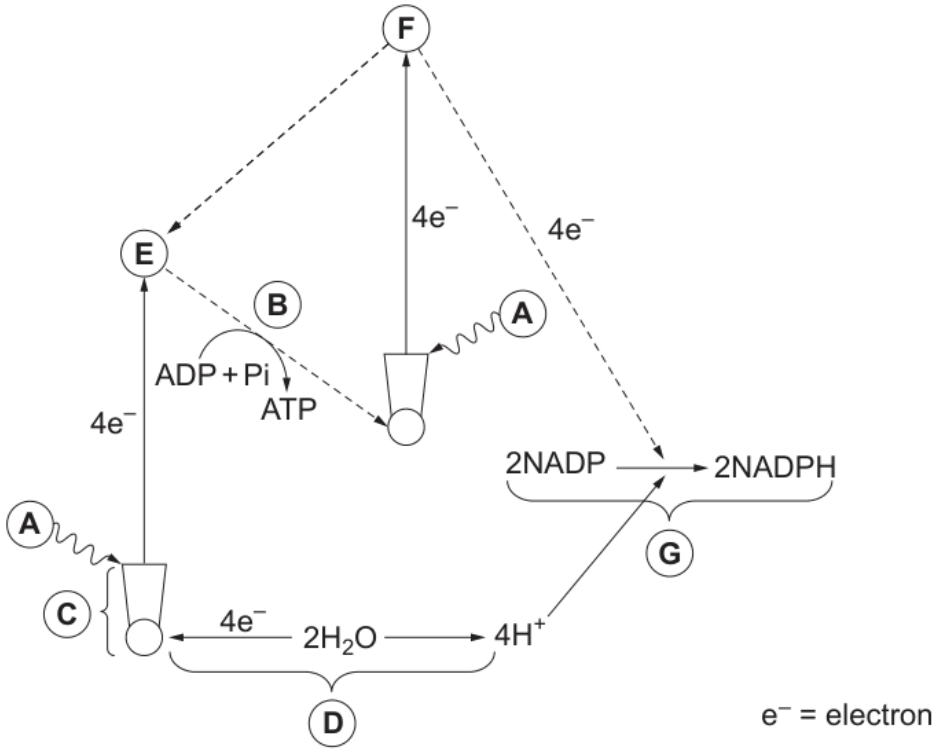
I. the first 3-carbon phosphorylated **sugar** produced by the Calvin cycle; [1]

.....

Question 17 · information from earlier in the question

(b) The light dependent stage of photosynthesis relies on the flow of electrons between different molecules as shown in **Image 6.2**.

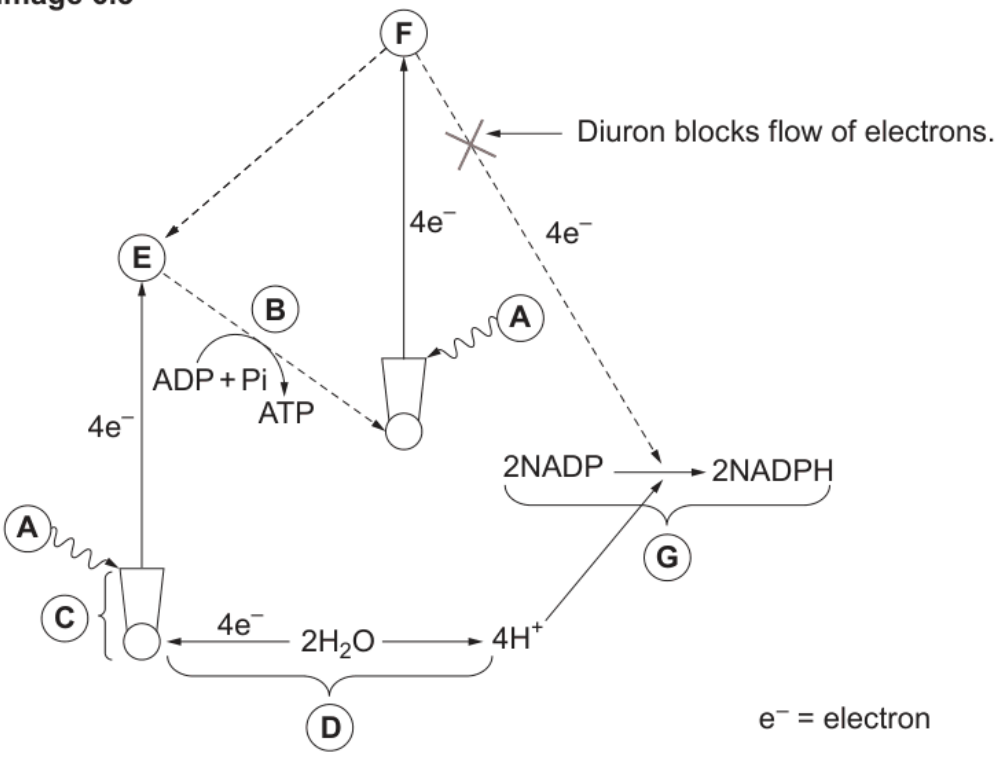
Image 6.2



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

(iv) Weeds are commonly controlled by using herbicides. Diuron is a herbicide which binds to a molecule preventing the flow of electrons, as shown by **X** in **Image 6.3**.

Image 6.3



Using information from **Image 6.3**, and your knowledge of photosynthesis, suggest how the action of Diuron results in the death of weeds. [4]

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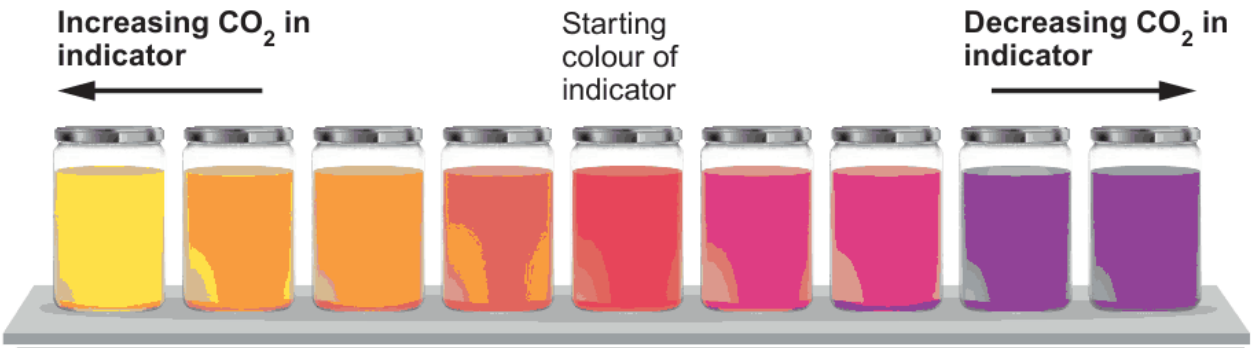
Question 18 · A level Component 1 · June 2019 · Q3(e) · 4 marks

(e) Herbicides inhibit photosynthesis in many ways.
One group of herbicides block electron transport, so chlorophyll continues to absorb light energy but cannot pass this energy on.
Light energy not used in electron emission damages chlorophyll leading to chlorosis.
Desiccation occurs because of the formation of oxygen free-radicals, which are highly destructive to cell membranes.

Use the information given and your own knowledge to explain how blocking electron transport from photosystems with this herbicide could lead to the death of a plant. [4]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

5. Hydrogen carbonate indicator can be used to assess the carbon dioxide concentration in solution.
The colours displayed by hydrogen carbonate indicator at different concentrations of CO_2 are shown below.



yellow		orange		red		magenta		purple
pH 7.6	pH 7.8	pH 8.0	pH 8.2	pH 8.4	pH 8.6	pH 8.8	pH 9.0	pH 9.2

An experiment was carried out to find the light intensity where the rate of respiration and photosynthesis are exactly equal (the compensation point) in a species of alga immobilised in algal balls.

- Six glass bottles were set up each containing 50 algal balls and 25 cm^3 hydrogen carbonate indicator at the same CO_2 concentration. A range of five light intensities at the same wavelength were used.
- One was covered in aluminium foil to exclude all light.
- All of the bottles were left for one hour.
- The absorbance of the six solutions was measured in a colorimeter.
- The colorimeter measured the light absorbed by the sample as less than or greater than the initial colour of the tube.

The results are shown in the table.

Light intensity as a percentage of maximum / %	Light absorbance of the sample / a.u.
0.0	–0.15
12.5	–0.10
25.0	–0.03
50.0	0.17
75.0	0.30
100.0	0.34

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Question 19 · A level Component 1 · June 2018 · Q5(a)(iii) · 4 marks

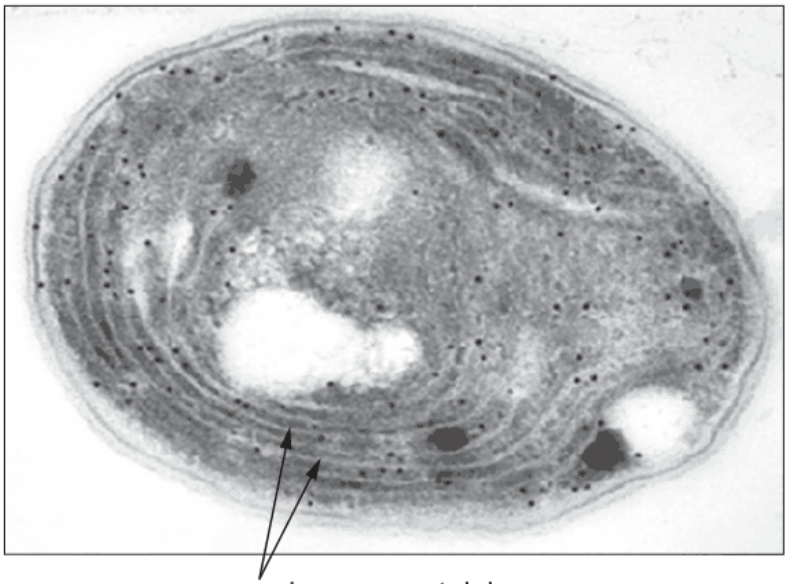
(iii) With reference to the biochemical pathways of photosynthesis and respiration, explain how a light absorbance of 0 a.u. could be observed in this experiment. [4]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 20 · A level Component 2 · June 2023 · Q1(b)(i) · 2 marks

(b) A labelled branch on **Image 1.1** represents a group called the cyanobacteria. **Image 1.2** shows one of these organisms.

Image 1.2



Some bacteria contain an enzyme called nitrogenase. This enzyme is used in nitrogen fixation. It does not function in the presence of oxygen.

(i) Describe and explain the evidence from **Image 1.2** that shows that nitrogen fixation is not taking place in this cyanobacterium. [2]

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Question 21 · A level Component 1 · June 2019 · Q3(d) · 3 marks

(d) Following the synthesis of carbohydrate, a number of inorganic ions are needed to synthesise other biological molecules.

State **three** different biological molecules **and** the inorganic ions required to synthesise them. [3]

I. ....

II. ....

III. ....

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 22 · A level Component 2 · June 2022 · Q4(a)(i) · 2 marks

4. The process of phytoremediation involves growing plants that are tolerant to heavy metals on contaminated land. As they grow, the plants absorb the heavy metals. At the end of the growing season, the plants are harvested and removed from the habitat. In this way, the concentration of heavy metals in the soil is reduced.

Alpine pennycress, *Thlaspi caerulescens*, is able to absorb cadmium ions from contaminated soils. Plants from some populations of this species can survive in concentrations of cadmium over 75 times greater than plants of other species.

Seeds of alpine pennycress were collected from a habitat contaminated with cadmium. They were grown hydroponically (soil-free) with their roots submerged in an oxygenated solution containing all the minerals required for growth.

(a) (i) Explain why **nitrate** and **phosphate ions** each need to be included in the solution used in the hydroponic system. [2]

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Mark schemes

Question 1 · A level Component 1 · Autumn 2020 · Q1(a)(i) · 2 marks

1	*(a)*	(i)	Absorption peak blue and red /peaks at 425 and 675 (1) less absorption in green/ minimal absorbance between 480-650 (1)	1	1	2

Question 2 · A level Component 1 · Autumn 2020 · Q1(a)(ii) · 1 mark

(ii)	Absorb over a greater range/ increased {rate/ efficiency} of photosynthesis NOT All light	1	1

Question 3 · A level Component 2 · Autumn 2020 · Q6(a)(ii) · 2 marks

(ii)	Any 2 of: chlorophyll a / chlorophyll b / carotene / xanthophyll (1) photosystem **+** thylakoid membrane/ antenna complex/ reaction centre (1)	2	2

Question 4 · A level Component 1 · Autumn 2021 · Q1(a)(i) · 1 mark

1	(a)	(i)	Found in grana / thylakoid membranes	1		1	

Question 5 · A level Component 1 · Autumn 2021 · Q1(a)(ii) · 3 marks

	(ii)	**Any three (×1) from:** Groups of different {pigments / accessory} + which absorb light at different wavelengths. (1) Chlorophyll a at centre / chlorophyll a in reaction centre (1) PS 1 and PSII (1) Chlorophyll at centre absorb slightly different wavelengths. (1)	3		3	

Question 6 · A level Component 1 · June 2019 · Q3(b) · 3 marks

(b)	A. Absorb {light (energy)/ photons} (1) 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) C. Which can be used to power proton pumps/ synthesise ATP/synthesise reduced NADP/ electrons passed down the electron transport chain (1)	3	3

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Question 7 · A level Component 1 · June 2024 · Q4(d)(i) · 1 mark

(d)	(i)	Photons 1		1	

Question 8 · A level Component 1 · June 2024 · Q4(d)(ii) · 2 marks

(ii)	S = ATP (1) T = $NADPH_2$ / reduced NADP / NADPH (1) Ignore charges Reject NADH etc.	2	2	

Question 9 · A level Component 1 · June 2017 · Q4(a)(i) · 3 marks

4	(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) -→ ATP/ fuel proton pumps (1) C. $NADP^+ + 2e^- + 2H^+ \rightarrow NADPH + H^+$ (Accept $NADPH_2$) / reduction of NADP (1)	3	3	

Question 10 · A level Component 1 · Autumn 2020 · Q1(c) · 2 marks

(c)	Photolysis (1) Description or equation of (1)	2	2

Question 11 · A level Component 1 · June 2017 · Q4(c)(ii) · 2 marks

(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

Question 12 · A level Component 1 · June 2022 · Q6(a)(ii) · 2 marks

(ii)	O_2 from {water/ photolysis} (1) as $^{18}O_2$ only produced {when $H_2{}^{18}O$ is used/ in suspension B} (and not $C^{18}O_2$) (1)	2	2	2

Question 13 · A level Component 1 · June 2022 · Q6(b)(ii) · 2 marks

(ii)	Reduction (1) Gain of {electrons/ H^+/ hydrogen (atom)} (1)	2	2

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 14 · A level Component 1 · June 2022 · Q6(c)(iii) · 4 marks

(iii) **Any four (x1) from:**

A	Tube 1	in the light chloroplasts {release electrons/ causing colour change} (1)
B	Tube 2	{cell contents/ named cell contents} must cause {release electrons/ causing colour change}/ sucrose buffer does not {release electrons/ causing colour change} (1)
C	Tube 3	with no light {chloroplasts/ light dependent reactions} do not release electrons (so no colour change)
D	Tube 4	supernatant does not contain chloroplasts/ it must be the chloroplasts causing change colour (1)
E	(Chlorophyll only found in chloroplasts so must be) chlorophyll that releases electrons (1)	

4 4 4

Question 15 · A level Component 1 · Autumn 2020 · Q2(b)(i) · 2 marks

(b)	(i)	RUBP (1) CO_2 (1)	2	2

Question 16 · A level Component 1 · Autumn 2020 · Q2(b)(ii)I · 1 mark

(ii)	I	Triose Phosphate	1	1

Question 17 · A level Component 1 · June 2022 · Q6(b)(iv) · 4 marks

(iv) **Any four (x1) from:**

A. Reduced NADP / $NADPH_2$ not produced. [1]
B. ATP not made by non cyclic photophosphorylation/ less ATP [1]
C. So G(3)P is not reduced to TP (1)
D. {Ribulose 5 phosphate/ RuBP} is not regenerated (1)
E. Carbon fixation stops / Calvin cycle / light independent stage of photosynthesis cannot take place [1]
F. No glucose produced for respiration (so plant dies) (1)
reject reference to energy for respiration

4 4

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Question 18 · A level Component 1 · June 2019 · Q3(e) · 4 marks

(e)	Any **four** (×1) from: A. Destruction of chlorophyll- no PS/unable to absorb light (energy) (1) B. {No/ less} {red NADP/ ATP} for {Calvin cycle/ light independent reactions} (1) C. {No/ less} {carbohydrate/ named carbohydrate} synthesised for {respiration/ synthesis of biological molecules} (1) D. {No/ less} respiration, therefore {no/ less} ATP for {cell division/protein synthesis/ active transport} (1) E. Destruction of cell membranes – kills/dries out cells (1)		4	4

Question 19 · A level Component 1 · June 2018 · Q5(a)(iii) · 4 marks

(iii)		• (At 29%) rates of photosynthesis and respiration would be equal (1) • The uptake of CO_2 by the plant through {Calvin cycle/ light independent reaction} is equal (1) • to its release of CO_2 through {link reaction and Krebs cycle/ or description of} (1) • At the compensation point there is no change in indicator colour/ stays red **because** there is {no change in the concentration of dissolved CO_2/no change in pH} (1)	4	4

Question 20 · A level Component 2 · June 2023 · Q1(b)(i) · 2 marks

(b)	(i)	Contains photosynthetic pigment/ photosynthesis takes place (1) Oxygen is produced (which inhibits nitrogen fixation) (1) MP2 linked to MP1	1	1	2

Question 21 · A level Component 1 · June 2019 · Q3(d) · 3 marks

(d)

Any **three** (x1) from:	
Amino acids/proteins	Nitrates (Sulfates)
Phospholipids	Phosphates
Nucleotides/ any example	Nitrates **and** phosphates
Chlorophyll	Magnesium (ions) (nitrates)

3 3

Question 22 · A level Component 2 · June 2022 · Q4(a)(i) · 2 marks

4	(a)	(i)	Nitrate: Phosphate:	synthesis of {proteins/ amino acids / nucleic acids / chlorophyll/ ATP/ any compound containing nitrogen} {nucleic acids / phospholipids/nucleotides/ ATP/ DNA/ RNA}	2		2	

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