

Answers to examination-style questions

Answers	Marks	Examiner's tips
<p>1 a) i) chlorophyll molecule / electron gains energy / becomes excited / is raised to higher energy level; chlorophyll molecule loses electron / becomes positively charged</p>	2	The term 'excited' electrons refers to electrons which have gained energy from the light energy absorbed by the chlorophyll molecule. The electrons gain enough energy to leave the chlorophyll molecule.
<p>ii) energy lost by electrons is used to form ATP from ADP and Pi</p>	1	Pi is used as an abbreviation for an inorganic phosphate molecule.
<p>b) reduction / described; of GP to triose phosphate</p>	2	
<p>2 a) electrons; from chlorophyll / photolysis / water</p>	2	Reduction of NADP involves the gain of electrons. Remember 'oil rig' – o xidation i nvolves loss of electrons or hydrogen, r eduction i nvolves their g ain.
<p>b) i) RuBP combines with carbon dioxide to produce 2 × GP</p>	1	The explanation must show that two GP molecules are produced when one RuBP molecule combines with carbon dioxide.
<p>ii) less used to combine with carbon dioxide / less used to form glycerate 3 phosphate / named photosynthetic product</p>	1	
<p>c) i) allows detection of products / carbon compounds</p>	1	Simply stating that carbon dioxide is used to form photosynthetic products would not gain a mark.
<p>ii) ATP and reduced NADP not formed; GP is not being used to form RuBP / is being formed from RuBP</p>	2	
<p>iii) used in respiration / formation of starch / cellulose</p>	1	

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<p>3 a) i) pigment reflects / does not absorb green or yellow or orange; pigment absorbs blue or violet; pigment absorbs red</p>	1	References to correct wavelengths instead of colours would be credited. Two of these properties must be described for one mark.
<p>ii) light (energy) absorbed by chlorophyll; raises energy level of electrons / electrons are excited / emitted; ATP formed</p>	3	
<p>b) more wavelengths / colours absorbed; more efficient photosynthesis can occur at these depths / low light intensities <i>or</i> more efficient photosynthesis can occur; when some wavelengths are not present</p>	2	The presence of additional pigments enables more wavelengths of light to be used in photosynthesis.
<p>4 a) i) 100 / reference to original value / blank reading minus light meter reading (%)</p>	1	
<p>ii) oxygen produced per unit time / change in oxygen concentration per unit time</p>	1	To measure the rate of photosynthesis there must be some indication of per unit time.
<p>b) i) suitable factor kept constant, e.g. light intensity / type of glass / carbon dioxide concentration / concentration of algae</p>	1	
<p>ii) decrease in carbon dioxide / hydrogencarbonate ions</p>	1	Carbon dioxide dissolves to give carbonic acid, so less carbon dioxide would reduce acidity and cause an increase in pH.
<p>c) light-dependent reaction / chlorophyll absorbs light / physical reaction; no direct enzyme involvement</p>	2	The light-dependent reaction is considered not to be affected by temperature.

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5 a) NADPH / reduced NADPH	1	
b) i) 2	1	You are expected to know that RuBP has five carbon atoms and that GP has three carbon atoms. Consequently phosphoglycerate must have two carbon atoms.
ii) less GP; reduced amount of triose phosphate carbohydrate; less RuBP regenerated / made; less carbon dioxide taken up / less fixation	3 max.	If RuBP is being used to combine with oxygen, less is combining with carbon dioxide which gives twice as much GP (glycerate 3-phosphate). Less GP will reduce the rate of production of photosynthetic products.
iii) higher levels of oxygen reduce photosynthetic rate, effect greater at higher temperatures; higher concentration more effective competitor / more RuBP combines with oxygen (instead of carbon dioxide) / greater chance of binding with the active site / colliding with the enzyme	2	One mark is awarded for describing the graph. The other mark requires a fuller explanation of how the rate of photosynthesis is reduced as outlined in part (b)(ii).
6 a) the more light absorbed, the greater the rate of photosynthesis; light provides the energy for light-dependent reactions / photolysis / light-independent reactions / production of reduced NADP / exciting electrons in chlorophyll	2	It is important to refer to light <i>energy</i> for the second mark. All too often candidates simply refer to light!
b) count the number of oxygen bubbles / measure the volume of oxygen produced / measure the change in pH / carbon dioxide / hydrogen carbonate ions	1	These methods measure the net rate of photosynthesis.
c) 530–630 nm; limited absorption of light / (green) plants reflect green light / limited photosynthesis at these wavelengths of light	2	Any values within this range would be credited. Allow references to no light absorbed or no photosynthesis.
d) i) chlorophyll excited / reduced NADP formed; electrons from chlorophyll / reduced NADP changes the dye colour	2	

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ii) ADP and phosphate needed to produce ATP / ATP is a product of the light-dependent reaction; ADP levels are a limiting factor	2	To obtain the second mark you must clearly explain that ADP is a limiting factor. Answers such as 'more ADP causes more photosynthesis' would not be credited.
7 a) i) light intensity	1	
ii) as light intensity increases, so does the rate of photosynthesis	1	
iii) X marked somewhere on horizontal of lowest or middle line	1	
iv) higher CO ₂ level shows higher rate of photosynthesis	1	
b) add manure / compost / decaying organic material / CO ₂ cylinders	1	Combustion of fuel, for example using a paraffin heater is another alternative.