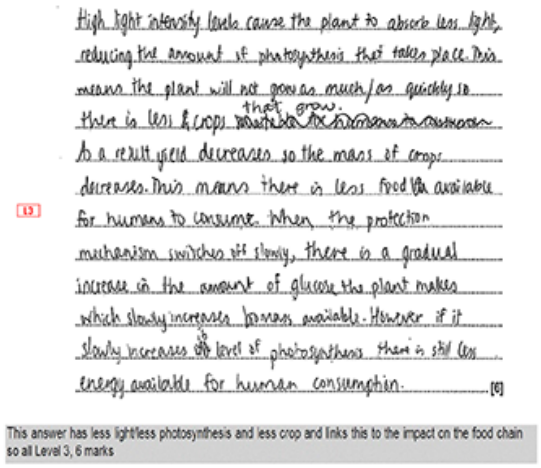
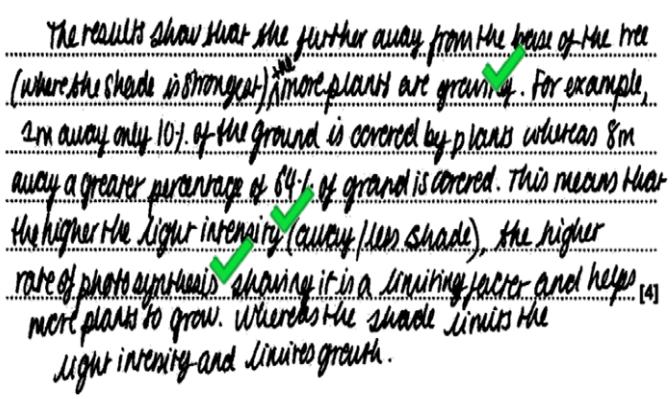
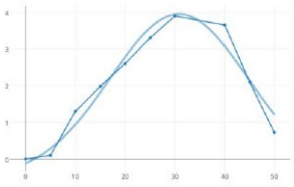
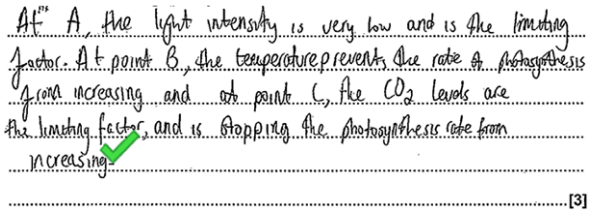
Mark scheme – Photosynthesis (H)

Question			Answer/Indicative content	Marks	Guidance
1			A	1 (AO 1.1)	
			Total	**1**	
2			B	1 (AO 2.1)	
			Total	**1**	
3			C ✓	**1 (AO 2.2)**	**Examiner's Comments** This question proved to be the most challenging question in section A. Many candidates did not apply the inverse square law and chose the answer D rather than C.
			Total	**1**	
4		i	(no) microorganisms (in the soil) ✓ no decay (takes place) ✓	2 (AO 1.1) (AO 2.1)	**AW** microbes, decomposers, saprophytes, detritivores, bacteria, fungi **AW** decomposition, rotting, break down **ALLOW** not enough nitrifying bacteria to replace nitrates / no nitrates released by nitrifying bacteria = 2 **IGNORE** no organisms to recycle the minerals **Examiner's Comments** Lower ability candidates didn't realise they needed to identify decomposer or a named type of decomposer and instead repeated the term living organisms from the question, thereby missing the AO1.1 aspect of the question. Higher ability candidates were able to name decomposers or types of decomposers. A significant number did not write about the AO2.1 aspect of the question about decomposition, using terms such as replenish or recycle minerals. Some candidates wrote about the minerals being used up but didn't go on to say why they would not be replaced.
		ii	plants release oxygen by photosynthesis ✓ organisms in the soil / microbes / animals release carbon dioxide by respiration ✓	2 (AO 2.2)	**ALLOW** correct word (or symbol) equations for photosynthesis linked to plants and respiration linked to organisms in the soil / microbes / animals **AW** microbes, decomposers, saprophytes **IGNORE** breathe out carbon dioxide **IGNORE** plants will respire and give out carbon dioxide **ALLOW** 1 mark for plants release oxygen/photosynthesise and microbes give out carbon dioxide/respire if no other marks are awarded. **Examiner's Comments**

					In this AO2.1 question, many candidates referred to plants only, indicating the importance of careful reading of the question that asked about organisms other than plants. Another frequent response from candidates that did not score was reference to 'breathing' out carbon dioxide and not specifically to respiration.
			Total	**4**	
5			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation including conclusions about how the mechanism affects photosynthesis and links this to less biomass available to humans in the food chain. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Explanation of how the mechanism affects photosynthesis or affects the biomass available to humans. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Demonstrates some knowledge of how the mechanism affects photosynthesis or affects the biomass available to humans. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6 (AO 3. × 1.1) (AO 2. × 2.1) (AO 1. × 3.2b)**	**AO1.1 Demonstrate knowledge of photosynthesis and biomass.** • Photosynthesis requires light energy • Mechanism reduces photosynthesis • Trapped by the leaves and used to produce food molecules • Photosynthesis required for plant growth • Plant biomass is a food source for animals including humans **AO2.1 Apply knowledge and understanding of photosynthesis to the production of biomass** • More light energy converted to heat, then less energy for photosynthesis • Less photosynthesis then plants can make less food / plants can grow less • Less plant biomass leads to less available food **AO3.2b Draw conclusions linking photosynthesis to biomass in food chains** • In low light intensities, light availability is the limiting factor • Less plant growth/crops therefore less food for cattle/less food for humans / in the food chain **Examiner's Comments** This Level of Response question assessed all three main assessment objectives. It was common to be limited to a low level mark due to repeating the stem of question regarding less biomass all through their response instead of linking the protection mechanism's impact to less light, less photosynthesis so less glucose/food made and consequently less food for cattle and humans. Candidates that did not appreciate that a reduction in light resulted in a reduction in photosynthesis, which also limited their answer to a low level. There was little evidence of candidates planning their response. Taking time to consider how to answer a LoR, might encourage them to make notes and think through key areas. A common low level answer was to refer to the loss of energy due to the energy needed to switch on the mechanism. It was noted how many candidates did not link biomass to growth or production of food. However, those candidates that realised

					that the key to the answer was essentially linked to factors influencing photosynthesis, produced excellent responses. **Exemplar 5**  High light intensity levels cause the plant to absorb less light, reducing the amount of photosynthesis that takes place. This means the plant will not grow as much/as quickly so there is less crops that grow. As a result yield decreases so the mass of crops decreases. This means there is less food available for humans to consume. When the protection mechanism switches off slowly, there is a gradual increase in the amount of glucose the plant makes which slowly increases [illegible] available. However if it slowly increases the level of photosynthesis there is still less energy available for human consumption. [6] This answer has less light/less photosynthesis and less crop and links this to the impact on the food chain so all Level 3, 6 marks This candidate has been credited Level 3 maximum 6 marks. They have structured their answer in a concise manner but included all the relevant marking points. The candidate describes the protection mechanism's impact in reducing light andphotosynthesis. The candiates states that thedecrease in mass of crops and food made means there is consequently less food for the humans to consume. They continue to give a reason why there will still be less energy available even when the plants resume photosynthesis due to the mechanism switching off slowly.
			Total	**6**	
6			idea of **less** plants/percentage of plants/% cover in shade/closer to the tree ✓ **less** light (in shade/closer to the tree) ✓ **less** photosynthesis (in shade/closer to the tree) ✓ **less** food/raw materials produced **for growth** (in shade/closer to the tree ✓	**4** **(AO 1.2)** **(AO 2.1)** **(AO 3.1b)** **(AO 3.2b)**	**ORA** for all marking points **ALLOW** shows negative correlation **IGNORE** less sun **IGNORE** in shade **no** photosynthesis / **no** light **ALLOW less** light for photosynthesis (closer to the tree) 2 marks **ALLOW** photosynthesis **less** effective (closer to the tree) **Examiner's Comments** This question assessed four different assessment objectives. Candidates had to identify the trend from the graph and apply their knowledge and understanding to give a reason for the trend. They also had to interpret reasons for the trend and draw conclusions about how the shade was affecting the plants. Most candidates identified the trend. Higher ability candidates linked this to less light closer to the tree so reduced rate of photosynthesis. However, only the highest ability candidates concluded that this would result in less glucose/food production. Most candidates just referred to reduced growth, which on its own did not score a mark.

					Exemplar 2  The results show that the further away from the base of the tree (where the shade is stronger) the more plants are growing. For example, 2m away only 10% of the ground is covered by plants whereas 8m away a greater percentage of 64% of ground is covered. This means that the higher the light intensity (away from shade), the higher rate of photosynthesis showing it is a limiting factor and helps more plants to grow. Whereas the shade limits the light intensity and limites growth. [4] This candidate has been credited with 3 marks. A mark is gained for identifying the trend as a reverse argument. They have gained a second mark for recognising that this is due to a higher light intensity further from the tree. A third mark was gained for linking the increase light intensity to an increased rate of photosynthesis. The candidate has not gained the final conclusion mark as they have only referenced the plant growth and not the food/raw materials produced to enable thegrowth to occur.
			Total	**4**	
7	a		energy/heat is taken from surroundings/into the reaction ✓	**1 (AO 1.1)**	**ALLOW** energy absorbed is more than the energy released **Examiner's Comments** Very few candidates confused endothermic with exothermic in this question.
	b		suitable smooth line of best fit is drawn ✓	**1 (AO 2.2)**	 dot to dot line = 0 **Examiner's Comments** The construction of a smooth curve seemed very challenging for candidates. Many candidates attempted to draw a straight line for part of the curve. Others just joined the points. Double lines were often seen.
	c		at point A light is limiting as increasing light intensity increases the rate / as it has sufficient temperature and carbon dioxide ✓ at point B temperature is limiting as increasing temperature increases rate / as it has sufficient light and carbon dioxide ✓	**3 (AO 3×2.1)**	

			at point C carbon dioxide is limiting as increasing carbon dioxide increases rate / it has sufficient temperature and light ✓		if no other mark scored allow one mark for correct identification of the three limiting factors with no explanations **Examiner's Comments** This question challenged many of the candidates and was a good discriminator for high ability candidates. Whilst some candidates could identify the limiting factors at the three points, few backed this up with explanations using evidence from the graph. An example of a candidate lacking full explanations and therefore only scoring 1 mark is shown in exemplar 8. **Exemplar 8**  At A, the light intensity is very low and is the limiting factor. At point B, the temperature prevents the rate of photosynthesis from increasing and at point C, the CO_2 levels are the limiting factor and is stopping the photosynthesis rate from increasing [3]
			Total	**5**	