Mark scheme – Photosynthesis (F)

Question			Answer/Indicative content	Marks	Guidance
1			B ✓	**1** (**AO** 2.2)	**Examiner's Comments** This question tested AO2.2, with candidates' awareness of the role of chlorophyll in photosynthesis and practical skills of interpreting results from a starch test are needed to successfully answer the question. Candidates frequently made the choice between B and C and occasionally D was seen. Higher ability candidates were able to select the correct response, clearly distinguishing between the area that contains chlorophyll being the area that can photosynthesise in a variegated leaf.
			Total	**1**	
2		i	Three/3 ✓	1 (AO2.2)	
		ii	(sun)light / the sun ✓	1 (AO1.1)	
		iii	Award one mark for: (an organism) that lives on/in on a (host) organism ✓ Idea parasite benefits at the expense to its <u>host</u> ✓ Award two marks for: An organism that feeds on a living organism / An organism that causes harm to a living organism ✓✓	2 (AO2 x 1.1)	**IGNORE** an organism that feeds on another organism unless qualified
			Total	**4**	
3	a		distance of lamp/light source ✓	1 (AO2.2)	**ALLOW** light intensity **IGNORE** the lamp with no mention of distance or intensity
	b	i	**Any two from:** bubbles are	2 (AO2.2)	

			different sizes / has different volume of gas ✓ some bubbles may also be missed/miscounted ✓ so volume at each point may not be representative of rate ✓		**ALLOW** amount of oxygen varies / bubbles burst **IGNORE** the pondweed could be different sizes
		ii	**Any two from:** measure volume (of gas released) ✓ names a suitable apparatus for measuring for volume ✓ use a heat sink ✓	2 (AO2 x 3.3a)	**IGNORE** measure amount **ALLOW** e.g. measuring cylinder / gas syringe / Audus apparatus /graduated pipette
	c	i	axes correctly labelled, including units ✓ all points correctly plotted ✓ ✓ suitable line of best fit drawn ✓	4 (AO4 x 2.2)	**ALLOW** +/- half a square all points correctly plotted 0 to 1 correct point plotted = 0 mark 2 to 4 correct points plotted = 1 mark All 5 correct points plotted = 2 marks **ALLOW** line of best fit based on plotted points **IGNORE** dot to dot line
		ii	further lamp is from the plant photosynthesis reduced / ORA ✓ example of a decrease from data e.g. at 10cm 30 bubbles given off and at 40cm only 2 bubbles ✓ **OR**	2 (AO3.2b)	**IGNORE** type of gas mentioned in bubbles **ALLOW** description of decrease in bubbles e.g. further lamp the less bubbles **ALLOW** there is a negative correlation

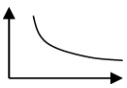
			photosynthesis stops in very low light ✓ by 50 cm there are no bubbles ✓ **OR** idea that rate of photosynthesis decrease is a non-linear relationship ✓ e.g. nearly double the number of bubbles at 10cm compared to 20cm but not double elsewhere ✓		
			Total	**11**	
4		i	(no) microorganisms (in the soil) ✓ 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** Very few candidates were able to apply their knowledge of microbes and decay to this question, and found it challenging to answer. Many candidates misinterpreted the question and talked about lack of oxygen for life or that Mars is too dry for life. This is demonstrated with Exemplar 4 which was given 0 marks. **Exemplar 4** the conditions are different. It is really not on mars so the soil would dry out. [2]
		ii	plants release oxygen by photosynthesis ✓ organisms in the soil / microbes / animals release carbon	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

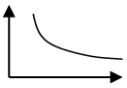
			dioxide by respiration ✓		carbon dioxide/respire if no other marks are awarded. **Examiner's Comments** Candidates had to apply their knowledge and understanding of gases given off by plants in photosynthesis and organisms in carrying out respiration to explain why air would no longer needed to be added after a while. Most non-scoring responses were too vague and just stated gases as in the stem of the question.
			Total	**4**	
5			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** A number of candidates achieved 1 mark on this question for the idea of less plants/% cover closer to the tree/shade or the reverse argument. Most candidates didn't link this to less light for photosynthesis. Less food for growth was the least credited marking point.
			Total	**4**	
6		i	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)** Provides a detailed	**6** **(AO 3 × 1.1)** **(AO 2 × 2.1)**	**AO1.1 Demonstrates knowledge of insecticides and photosynthesis.** • Insecticides will kill insect pests • Less leaves will be eaten/pests eat less leaves • Leaves are the site of photosynthesis • Less pests of the GM plant **AO2.1 Apply knowledge and understanding of photosynthesis to the production of biomass** • **More** photosynthesis • **More** light absorption for photosynthesis • **More** chlorophyll / chloroplasts for photosynthesis

			explanation drawing conclusions why GM plants would make more biomass available to humans. Links photosynthesis to agricultural food chains and function of insecticides. *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)** Provides an explanation why GM plants would make more biomass available to humans. Links photosynthesis **or** function of insecticides to agricultural food chains. *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)** Provides a basic explanation why GM plants would make more biomass available to humans. This	**(AO 1 × 3.2b)**	• **More** food/glucose/biomass made by photosynthesis **AO3.2b Draw conclusions linking photosynthesis to food chains** • More plant growth/food/biomass for cattle • More biomass passes through the agricultural food chain • Cattle receive more energy for growth • Then cattle will grow more, therefore more food for humans **Examiner's Comments** In this Level of Response question, examiners were looking for a detailed conclusion linking photosynthesis to food chains. This should link both photosynthesis and function of pesticides to agricultural food chains. This differentiated well over the whole ability range of the candidates. Exemplar 7 shows a Level 3 answer which gained 6 marks. **Exemplar 7** L3 Genetically modified plants that make insecticide are resistant to insects and repell them. This prevents biomass being lost this way and results in more biomass being available for cattle consumption which means more food for them which means more cattle are reared resulting in more food being available for humans in the form of meat or dairy. If less leaves are eaten by insects then there are more leaves available for photosynthesis as there is more surface area. A greater rate in photosynthesis means that the plants will grow stronger and faster which is more efficien for the farmers which means more food for the cattle at a lower co ...an

			could include ideas about photosynthesis **or** function of insecticide **or** agricultural food chains. *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.		
		ii	**any two from:** concern that they may be harmful to humans if eaten ✓ plants may escape into the wild ✓ useful /pollinating insects might be harmed ✓ disrupt food chains ✓ ethically wrong ✓	**2 (AO 2 × 2.1)**	**ALLOW** harmful effects not discovered to humans **IGNORE** dangerous **ALLOW** resistance / resistance gene could get into other plants **IGNORE** harmful to insects/pests **ALLOW** harm the environment /reduce biodiversity **ALLOW** morally / religiously wrong **IGNORE** playing God / not natural / disrupt nature **IGNORE** may not taste good **IGNORE** reduced gene pool / genetic variation / susceptible to the same disease **Examiner's Comments** The most common credited mark was that it was ethically wrong. A lot of responses focused on it not being natural, which was a non-credit worthy answer.
			Total	**8**	
7	a	i	$6H_2O$ ✓ $6O_2$✓	**2 (AO 2 x 1.1)**	must be on correct side of equation **ALLOW** unbalanced/incorrectly balanced H_2O O_2 for one mark **Examiner's Comments** This question assesses AO1.1 recall of knowledge. However, many candidates seemed to lack any recall and tried to separate out combinations from the formulae given in the question, in many cases these were unrecognisable formulae. Only a few

					higher ability candidates scored both marks. Common mistakes were to get the correct balanced formula but, unfortunately, put them on the wrong side of the equation. Numbers within molecules were sometimes written as a superscript rather than subscript, or even the same size as the letter.
		ii	endothermic✓	**1 (AO 1.1)**	**Examiner's Comments** Here, many candidates were able to identify this as an endothermic reaction in this AO1.1 question. Only a few incorrectly opted for exothermic but a significant number mistakenly interpreted the question as what would provide the energy and gave respiration as their response.
	b	i	30(^{0}C)✓	**1 (AO 2.2)**	**Examiner's Comments** Nearly all candidates gained marks here, showing good application of scientific techniques AO2.2. Occasionally candidates put 3.9 as their answer, showing they had misinterpreted the graph.
		ii	record at narrower temperature intervals✓ narrower intervals around the 30^{0}C value✓	**2 (AO 2 x 3.3b)**	**ALLOW** any temperature increment less than 5^{0}C **ALLOW**narrower intervals around the optimum **ALLOW** narrower interval range between 25–35^{0}C but must include 30^{0}C **Examiner's Comments** This question assesses AO3 to analyse information to improve experimental procedures. Many candidates identified the need for narrower temperature intervals, often stating the actual interval they would use, but very few targeted these to around the optimum temperature.
			Total	**6**	
8			algae gain protection (1)	1	**allow** idea about prevention of drying out / absorbing water / minerals
			fungi gain sugars (1)	1	
			Total	**2**	
9	a	i	bubbles may be different sizes (1)	1	
		i	may miscount / difficult to count (1)	1	
		ii	would measure total volume (1)	1	

	b	i	 line decreasing = (1) but curved line decreasing = (2)	2	
		ii	**any two from** as the distance increases, the light intensity decreases (1) as the light intensity decreases, there is less light / energy for photosynthesis (1) the line curves because the light will not decrease to zero / AW (1)	2	
	c	i	light energy (1)	1	
		i	splits water (1)	1	
		i	in chloroplasts (1)	1	
		ii	respiration (is also occurring) (1)	1	
		ii	some oxygen is used up (in respiration) / AW (1)	1	**allow** idea that oxygen given out is the net production
			Total	**12**	
10			B	1	
			Total	**1**	
11			A	1	
			Total	**1**	
12	a		oxygen (1)	1	
	b		respiration (is also occurring) (1)	1	

			some oxygen is used up (in respiration) / AW (1)	1	**allow** idea that oxygen given out is the net production
	c		bubbles may be different sizes (1)	1	
			may miscount / difficult to count (1)	1	
	d		do more repeats / more distances / greater range of distances (1)	1	**allow** specific values if they match the marking points
			longer than 10 seconds (1)	1	**ignore** simply do more measurements
			Total	**7**	
13		i	contains genes / genetic material / DNA (1)	1	
		i	controls cell (functions) (1)	1	**allow** protein synthesis
		ii	(onion cells) do not photosynthesize (1)	1	
		ii	(because) they are underground / in the dark (1)	1	
			Total	**4**	
14		i	 as the light intensity decreases (1)	2	
			there are fewer bubbles in 10 seconds (inverse proportional relationship) (1)		
		ii	**any two from** as the distance increases, the light intensity	2	

			decreases (1) as the light intensity decreases, there is less light / energy for photosynthesis (1) the line curves because the light will not decrease to zero / AW (1)		
			Total	**4**	
15			B	1	
			Total	**1**	