Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	(Radioactive) carbon dioxide/carbon is used by the tree in photosynthesis ✓ (The radioactive) carbon/carbon dioxide is trapped/converted/made/turned into sugar/glucose (in the tree)	2 (AO 1.1) (AO 2.1)	**DO NOT ALLOW** oxygen needed for photosynthesis **DO NOT ALLOW** references to mistletoe/it/plants using radioactive carbon dioxide/carbon in photosynthesis **DO NOT ALLOW** references to mistletoe/it/plants using (radioactive) carbon dioxide/carbon to make sugar/glucose **Examiner's Comments** Candidates found this question challenging and roughly half of candidates did not obtain any marks in their response. The question required the knowledge and application of photosynthesis to score here. Most candidates who did not obtain a mark here incorrectly stated it was the mistletoe photosynthesising and creating the radioactive sugar. **Misconception** Candidates stated that the radioactive carbon passed through the phloem for the mistletoe to use to create radioactive sugar. Centres could revisit photosynthesis and the role of transport vessels more frequently to make sure no misconceptions occur in key knowledge. Some candidates confused respiration with photosynthesis.
		ii	Lower/less chlorophyll/dwarf mistletoe (content) has higher percentage/more of radioactive sugar ✓	3 (3 x AO 3.2a)	**IGNORE** simple quoting of data **ALLOW ORA** **AW** radioactive carbon/carbon dioxide for sugar

			Less chlorophyll to produce/make sugar/glucose/photosynthesise ✓ More sugar needed/taken from tree ✓		**ORA** for Eastern mistletoe/more chlorophyll **ORA** for Eastern mistletoe/more chlorophyll **IGNORE** ATP **Examiner's Comments** This question discriminated well between candidates at different grades with equal number of candidates gaining two or three marks. A small proportion did not gain any marks and most marks given were for candidates correctly identifying the relationship in the data between chlorophyl content and percentage of radioactive sugar. Where candidates did not gain more than one mark they repeated the relationship with data with no space left to explain this relationship.
			Total	**5**	
2			B	1 (AO 1.1)	**Examiner's Comments** Understanding the concept of limiting factors is often challenging. Many candidates did not appreciate that at point A an increase in light intensity results in an increase in rate and so light must therefore be the limiting factor.
			Total	**1**	
3			A	1 (AO 2.1)	**Examiner's Comments** Understanding the concept of limiting factors is often challenging. Many candidates did not appreciate that at point A an increase in light intensity results in an increase in rate and so light must therefore be the limiting factor.
			Total	**1**	
4	a		**Any three from:** Concentration of solution/sodium hydrogen carbonate ✓	3 (3 xAO 2.2)	

			Volume of solution/sodium hydrogen carbonate ✓ Size/number/area of leaf discs / part of the leaf the discs were taken from ✓ Temperature ✓ Light intensity ✓ Same size/height of syringe ✓		**IGNORE** amount **IGNORE** size of leaf **IGNORE** same syringe **Examiner's Comments** There were many good responses here giving three variables that should be controlled. There were still many vague references to the 'amount' of the solution. Candidates that stated volume and concentration could score 2 marks for those variables.
	b		Oxygen is produced ✓	1 (AO 2.2)	**Examiner's Comments** Most candidates could explain this in terms of oxygen production.
	c		Use of a lamp/light at different distances from the syringe ✓ Time how long it takes for the discs to rise ✓ Use of inverse square law to calculate the light intensity ✓	3 (3 xAO 3.3a)	**ALLOW** use bulbs of different brightness/wattage **Examiner's Comments** High scoring responses included reference to the inverse square law. A number of responses described completely new methods involving the counting of bubbles from pondweed, instead of describing how to change the investigation. There was also some confusion between photosynthesis and the use of a potometer to estimate transpiration. Exemplar 2 The student could have used one leaf from a plant and used an LED lamp at different distances from the plant and measured the rate of oxygen that is released by using a syringe. Exemplar 2 shows a response that confuses this experiment with the pondweed experiment. It was given 1

					mark for the use of a lamp at different distances from the plant material.
			Total	**7**	
5			**B**	1 (AO 1.1)	**Examiner's Comments** Although the majority of candidates answered correctly, there were a small number that confused respiration with photosynthesis and so answered C.
			Total	**1**	
6	a	i	They were adding different volumes of run-off (to each jar) ✓ Keep the total/overall volume the same ✓	2 (2 xAO 2.2)	**ALLOW** to see effect/change the concentration/ratio of run-off water **IGNORE** effect of run-off on growth of duckweed **IGNORE** change concentration of pond water **ALLOW** so the total volume of run-off and clean pond water remains the same **ALLOW** to keep contents to 250cm^3 **IGNORE** volume of water/solution kept the same **Examiner's Comments** Most candidates scored at least 1 mark here for correctly identifying that the total volume of water needed to be kept the same. Most successful responses stated that different volumes of clean pond water were added as there were different volumes of run-off water added. Most unsuccessful responses stated they were keeping the water the same which isn't the case; the volumes of both clean pond water and run-off have been changed. Some responses just reworded the information in the question that they were changing the concentration of pond water which were not given marks.
		ii	Add (excess) sodium/potassium hydrogen carbonate to the water ✓	1 (1 xAO 3.3b)	**ALLOW** sodium bicarbonate / carbonate solution **IGNORE** pH probe/CO2 probe/limewater test/soda lime **Examiner's Comments**

					This was the least accessible question on the whole paper. Unsuccessful responses ranged from various devices to test the carbon dioxide concentrations without stating how they could be controlled. **Assessment for learning** Centres could provide more opportunities for candidates to analyse information and draw conclusions. These AO3 skills are accessed in the exam and make up 20%. Responses suggested candidates did not know how carbon dioxide concentrations could be controlled.
	b		Run-off water contains minerals ✓ Increases the growth of the duckweed ✓ (They do not agree) because duckweed is not a submerged plant/floats on the surface so cloudiness/light would not affect photosynthesis ✓	3 (3 xAO 3.2a)	**ALLOW** named mineral/nitrogen compounds **IGNORE** nutrients **IGNORE** more/higher yield/biomass of duckweed **IGNORE** affects growth of duckweed **Examiner's Comments** The question required candidates to analyse information and draw conclusions. This was challenging for the candidates and just under half of all responses were not given any marks. The most common response seen that gained a marking point was for increased growth. Most responses did not link run-off water containing minerals. Some responses did not link eutrophication not affecting the duckweed as it floats on the surface and its ability to photosynthesise is not affected by the cloudy water. **Assessment for learning** Centres could provide more opportunities for candidates to analyse information and draw

					conclusions. These AO3 skills are accessed in the exam and make up 20%. Most unsuccessful responses did not link minerals with run-off water and eutrophication to the answer.
	c		**Any one from:** Measure the change in mass (during the experiment) Length of stem/root of the plant (during the experiment) ✓	1 (AO 3.3a)	**ALLOW** length/height (of plant) **Examiner's Comments** Just under half of all candidates were given this mark. Most unsuccessful responses stated they could measure the growth by collecting the volume of oxygen produced and counting the number of plants.
			Total	**7**	
7			B ✓	1 (AO1.1)	**Examiner's Comments** A majority of candidates answered this question correctly. However, the majority of candidates who answered incorrectly gave option A and did not appreciate the need to square the distance.
			Total	**1**	