OCR GCSE 21ST CENTURY BIOLOGY B · J257

BIOLOGY



MARK SCHEME

B3.2 HOW DO PRODUCERS GET THE SUBSTANCES THEY NEED? (HIGHER)

SCORE	PERCENTAGE
/80	%

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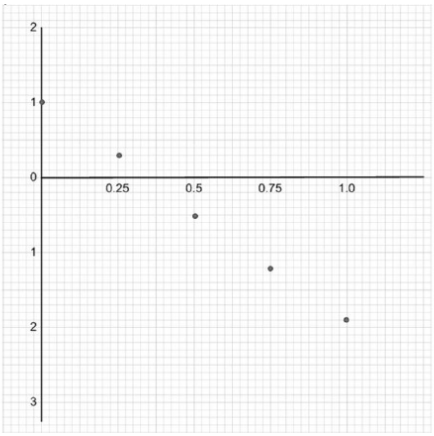
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Question			Answer/Indicative content	Marks	Guidance
1	a	i	FIRST CHECK THE ANSWER ON THE ANSWER LINE IF answer = 0.23 award 2 marks 7 / 30 ✓ 0.23 ✓	2	ALLOW 1 mark for 7 / 30
		ii	Measure the rate of water uptake with a fan running on the shoot ✓	1	DO NOT ALLOW 'place plant / apparatus outside'
		iii	Any two from: 1. Water may be lost from parts of the equipment that are not sealed ✓ 2. Some water is used for photosynthesis ✓ 3. If the plant is wilting, the plant will use water to restore turgidity ✓	2	DO NOT ALLOW incorrect use of water e.g. respiration
	b		Any two from: Potassium ions (reduce the water potential) increase the concentration in the guard cells ✓ So wa	2	
			Total	7	DO NOT ALLOW answer if not given to 1 d.p.
2	a	i	FIRST CHECK THE ANSWER IN TABLE. If answer = +6.1 award 2 marks (0.3 ÷ 4.9) × 100 (1) +6.1 (1)		
		ii	4, 1, 5, 3, 2 (1)	1	
		iii	Does not take into account width (1)	1	
		iv	Set up experiment as above and re-measure every 10 minutes / other suitable time period (1) Find out how long it takes until there is now further change in length (1)	2	
	b	i	X = sugar concentration (mol / dm^{-3}) AND Y = change in mean length (mm) (1)	1	

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Question			Answer/Indicative content	Marks	Guidance
		ii		2	5 plots correct = 2 3 or 4 plots correct = 1
		iii	Straight line through points (1)	1	
		iv	0.35 to 0.4 (1)	1	
		v	Idea that it is the same concentration / isotonic (1) Water movement is the same in both directions / no net flow (1)	1	
			Total	**12**	

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Question			Answer/Indicative content	Marks	Guidance
3	a	i	13.64 (2)	2	Award 1 mark for $\frac{2.5-2.2}{2.2}$ **OR** $\frac{0.3}{2.2}$ **OR** 13.6 / 13.63 / 13.636363 (1) Look for answer in the table if nothing written in the space **Examiner's Comments** Marks were lost here by not giving the answer to 2 decimal places. Most common error was 13.63. Other errors included 13.636 recurring. Time needs to be spent practicing this skill (rounding). Many divided 0.3 by 2.5 or, more commonly, divided 2.5 or 2.2 by 0.3.
		ii	Potato pieces had a different mass / weight (at the start of the experiment); Idea that it allows comparison of the potato pieces / results are comparable;	2	**Ignore** accuracy / precision / fair test / reliability **Examiner's Comments** The question asked candidates why it is better to calculate the percentage change rather than just the difference in mass. They made correct reference to comparison. Differences in starting masses not as frequently quoted. Candidates made reference to accuracy, reliability in question and referred to what each measurement showed. Many candidates seemed to understand what was required but couldn't express it, giving vague answers such as 'more accurate' to use percentage/then it is out of 100. Few got full marks.
		iii	Greater than 0.4 mol lose mass	1	**Examiner's Comments** This question tended to be answered well even by lower scoring candidates.

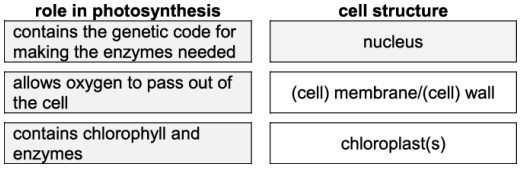
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Question			Answer/Indicative content	Marks	Guidance
		iv	0.3 (1) 0.4 (1)	2	**Accept** 0.31 **accept** 0.39 **accept** either order **Examiner's Comments** Candidates did not seem to use the data provided in the table to consider what the range could be, they focussed mainly on the range of concentrations used in the experiment. It was poorly answered by majority of candidates, many scoring 0 or 1 mark.
	b		*any three from*repeats (more) tests between 0.3 and 0.4 Keep surface area the same Keep temperature the same leave them in for longer same starting mass / weight same age / variety of potato OR use same potato correct ref. to more accurate measuring **apparatus** removal of excess solution by blotting pieces must be totally immersed in the solution / prevent evaporation of water	3	**Ignore** greater range / other concentrations **Ignore** size / volume **Examiner's Comments** The most common correct answer was ‘repeat’, and ‘use the same starting mass’ was the next more commonly seen answer. Many candidates wanted to test more concentrations or do more intervals, but they were not specific. Very few made reference to controlling temperature as a variable. No candidates made reference to evaporation or prevention of evaporation. Many candidates made reference to a bigger variety of concentrations in order to make experiment accurate, peer reviewing or getting someone else doing the experiment
			Total	10	

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Question			Answer/Indicative content	Marks	Guidance
4			[Level 3] Candidates include a detailed explanation of all 3 stages Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Candidates include a detailed explanation of two stages Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Candidates include a detailed explanation of one stage Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	• uptake of / absorption of / taking in / takes up / taking (nitrates into plants) **ignore** "passes into" / "goes in" • via roots / root hairs • active transport • (nitrates) used to make proteins This question is targeted at grades up to CIndicativ stage B: • plants eaten by animals • digestion / assimilation • transfer of nitrogen (compounds) / protein along food chain (ignore transfer of **nitrate** from plant to animal) stage C: • excretion / egestion / urine / faeces / waste • death • decay / decomposition / decomposers / fungi / bacteria • break down waste into nitrates • returns to the soil ignore denitrification / nitrogen fixation Examiner's Comments It was encouraging to see very detailed descriptions of the stages in the nitrogen cycle in the majority of student responses.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
5	a			1	**both answers required for one mark** **Examiner's Comments** Many candidates scored a mark here. Those that did not score the mark usually wrote 'cytoplasm' instead of 'chloroplast'.
	b	i	(cell) membrane; respiration;	1 2	**both answers required for one mark** **Examiner's Comments** A significant number of candidates scored a mark here. The most common error was to suggest that active transport requires energy from photosynthesis. A few wrote 'cell' instead of 'cell membrane' and there were some descriptions of active transport given in the first gap, e.g. 'movement from a low concentration to a high concentration'. **do not allow** 'no energy' **allow** 'produced'
		ii	***(link between respiration and energy):*** anaerobic respiration / less aerobic respiration so less energy / ATP rele no / less energy for active transport / active uptake (1)		**Examiner's Comments** Overall this question was not very well answered. Many candidates did not pick up on the idea that there is a lack of oxygen in the water-logged roots, despite it being clearly expressed in the question. Instead they proceeded to talk about the concentration of nitrogen and how that would affect the uptake. There were also frequent references to a lack of photosynthesis in the absence of oxygen. However, a significant number of candidates were able to identify that there would be less respiration but few referred specifically to less aerobic respiration or more anaerobic respiration. Only the very best candidates could then link this to a lack of energy released and make it clear that they understood that energy was required for active transport. This highlighted itself as being an area of the specification about which many candidates are very confused.

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Question			Answer/Indicative content	Marks	Guidance
			Total	4	

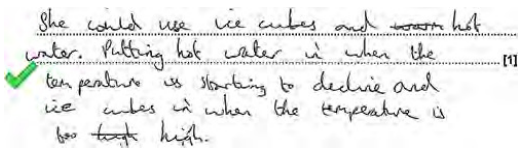
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Question			Answer/Indicative content	Marks	Guidance
6	a	i	Concentration of solution in arbitrary units — Potato chip 0.0 — **D** 0.3 — **B** 0.6 — **A** 0.9 — **C**	2	4 correct = 2 marks 2 or 3 correct = 1 mark 1 or 0 correct = 0 marks
		ii	answer between 0.01 - 0.29 (2) between D and B **OR** close to D (1)	2	**ignore** ref. to units **ecf** accept correct value between D and B ? based on the values presented in (i) = 1 mark max. **Examiner's Comments** Relatively few candidates used the images and scenario to identify the correct labelling of the potato chip. However, for those who did this correctly they were able to move on to part (ii) and note the correct value for the unknown potato chip.
	b		membrane energy / ATP (1)	1	both correct responses needed for 1 mark **ignore** permeable **ignore** oxygen **Examiner's Comments** Although some candidates completed this question correctly some struggled to identify the importance of the membrane and/or that energy was involved.

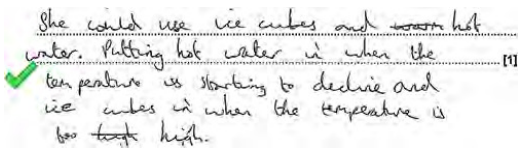
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Question			Answer/Indicative content	Marks	Guidance
	c		**any two from** water-logged soils are low in oxygen ; anaerobic respiration takes place / **less** (aerobic) respiration ; **less** energy / active transport	2	OWTTE **ignore** general reference to active transport needs energy **reject** no respiration **ignore** leaching / dilution of nitrates **Examiner's Comments** Very few candidates applied their knowledge to the scenario of water-logged soils. Some completed the question well but most struggled, often referring back to the earlier question of active transport without substance.
			Total	7	

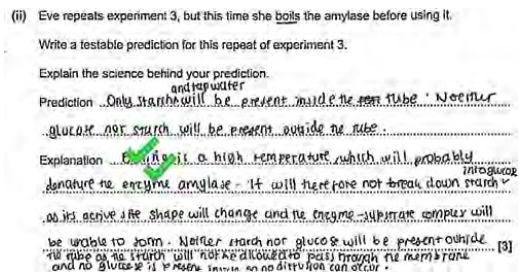
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Question			Answer/Indicative content	Marks	Guidance
7	a		to measure the temperature ✓	1 (AO 1.2)	more than one tick = 0 marks Examiner's Comments This question was generally well answered although some candidates confused 'record' with 'measure'.
	b		place beakers in (electric/thermostatically-controlled) water bath ✓	1 (AO 2.2)	IGNORE mention of thermometer ALLOW description of water bath Examiner's Comments Only about half of the candidates gave the correct response of a water bath (or a description of such) as the means to keep the experiment at the correct temperature. Exemplar 3  This response although not specifying 'water bath', does have an acceptable description of one, possibly reflecting the method that they have used in the laboratory. It gained 1 mark.

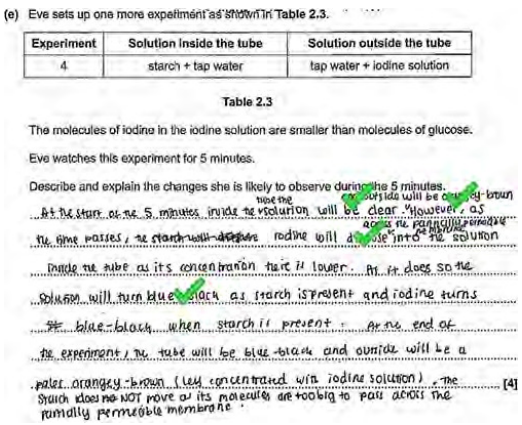
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Question			Answer/Indicative content	Marks	Guidance
	c		add Benedict's solution ✓ look for a red-brown precipitate ✓	2 (AO 2.2)	ALLOW glucose testing strip with correct colour change DO NOT ALLOW red solution Examiner's Comments Candidates were very unsure of the correct reagent to use and the resulting colour to test for glucose. (Benedict's (reagent) with the resulting red precipitate). Exemplar 3  This response although not specifying 'water bath', does have an acceptable description of one, possibly reflecting the method that they have used in the laboratory. It gained 1 mark.
	d	i	glucose (molecules) can diffuse through the tubing/membrane ✓ starch (molecules) too large to diffuse/move/fit through the tubing/membrane ✓ amylase breaks down starch ✓ starch is broken down into (molecules of) sugar ✓	4 (AO 3.2b × 4)	NO MARKS FOR DESCRIBING THE RESULTS ALLOW go through the tubing/membrane ALLOW maltose/glucose Examiner's Comments One of the problems encountered here was that candidates did not follow the rubric (conclusion) and described the results. Another problem here and also in (ii) & (e) was the incorrect references to osmosis when diffusion was required.

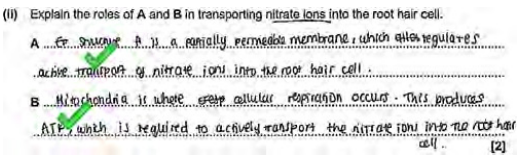
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Question			Answer/Indicative content	Marks	Guidance
		ii	*Prediction*: the tests for glucose will be negative ✓ **Any two from:** *Explanation*: the amylase/enzyme has been denatured ✓ has (permanently) changed the shape (of the active site) ✓ by the high temperature /boiling ✓ no longer works/cannot bind ✓	3 (AO 2.1) (AO 1.1 ×2)	<u>Examiner's Comments</u> The first mark required a testable prediction to be stated. Very few candidates did so, some merely stating that glucose would not be present. A considerable number also stated that boiling the enzyme would make the reaction work at a faster rate and did not link the information about amylase and the effect that high temperature would have on it. Exemplar 4  (ii) Eve repeats experiment 3, but this time she boils the amylase before using it. Write a testable prediction for this repeat of experiment 3. Explain the science behind your prediction. Prediction Only starch will be present inside the tube and tapwater. No glucose nor starch will be present outside the tube. Explanation Boiling is a high temperature which will probably denature the enzyme amylase - it will therefore not break down starch into glucose as its active site shape will change and the enzyme-substrate complex will be unable to form. Neither starch nor glucose will be present outside the tube as starch will not be allowed to pass through the membrane and no glucose is present inside so no diffusion can occur. [3] This response answers the explanation part well but the prediction is not testable. It gained 2 marks.
	e		**Any four from:** at the start, the solution outside the tube will be pale brown/red ✓ at the start, the solution inside the tube will be colourless ✓ the solution inside the tube will start to turn black / blue/black ✓ starting from the edges ✓ because iodine can diffuse through the tubing/membrane (molecules small enough)✓	4 (AO 2.2 × 4)	**Must be clear whether in inside or outside of tube** **DO NOT ALLOW** 'through osmosis' **Examiner's Comments** The table in this question clearly had two places, inside the tube and outside the tube. Also it required the candidate to take

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Question			Answer/Indicative content	Marks	Guidance
					into account the start as well as the final observations. Very few candidates described the situation at the start, and limited the marks available. Most marks that were credited were for the colour change from brown to (blue) black inside the tube. There was some confusion as to the correct colour change that should occur. Exemplar 5  (e) Eve sets up one more experiment as shown in Table 2.3. Experiment: 4 — Solution inside the tube: starch + tap water — Solution outside the tube: tap water + iodine solution Table 2.3 The molecules of iodine in the iodine solution are smaller than molecules of glucose. Eve watches this experiment for 5 minutes. Describe and explain the changes she is likely to observe during the 5 minutes. At the start of the 5 minutes inside the tube the solution will be clear. However, as the time passes, the starch will diffuse into the solution. Iodine will also diffuse into the solution inside the tube as its concentration there is lower. As it does so the solution will turn blue-black as starch is present and iodine turns blue-black when starch is present. At the end of the experiment, the tube will be blue-black and outside will be a paler orangey-brown (less concentrated with iodine solution). The starch does not move as its molecules are too big to pass across the partially permeable membrane. [4] This response answers all four of the five available mark points available and gained 4 marks
			Total	15	
8			**Any one from:**Reference to gaseous exchange ✓1.1) Movement of carbon dioxide/oxygen ✓ Transpiration/ loss of water (vapour) ✓	1 (AO	**Examiner's Comments** Common errors seen in this question included water or sunlight entering the plant via the stomata.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
9	a		(nitrate ions are the plant's only source of) nitrogen ✓ to make amino acids/proteins/nitrogenous compounds ✓	2 (AO 1.1 × 2)	**ALLOW** examples e.g. enzymes / DNA **Examiner's Comments** This question required candidates to recognise that nitrates were the plant's source of nitrogen and that nitrogen was needed to make amino acids or other nitrogenous compounds.
	b	i	**A** (cell/partially-permeable) membrane ✓ **B** mitochondrion ✓	2 (AO 2.1 ×2)	**ALLOW** mitochondria **Examiner's Comments** Most candidates were able to recognise that structure A was the cell membrane. Fewer candidates identified structure B as a mitochondrion and many identified it as a chloroplast - failing to take into account that the question was about a root hair cell.
		ii	**A**(transports nitrate ions into the cell by) active transport _____ (using carrier proteins) (against a concentration gradient) ✓ **B** provides ATP/energy (from cellular respiration) (for active transport) ✓	2 (AO 1.1 ×2)	**Examiner's Comments** Only a few higher ability candidates were able to demonstrate that nitrate ions had to be actively transported into the root hair cell and mitochondria provided ATP to enable this process to occur. Exemplar 1  (ii) Explain the roles of A and B in transporting nitrate ions into the root hair cell. A ...it's known as a partially permeable membrane, which also regulates active transport of nitrate ions into the root hair cell. B Mitochondria is where cellular respiration occurs - this produces ATP which is required to actively transport the nitrate ions into the root hair cell. [2] This response contains both marking points.

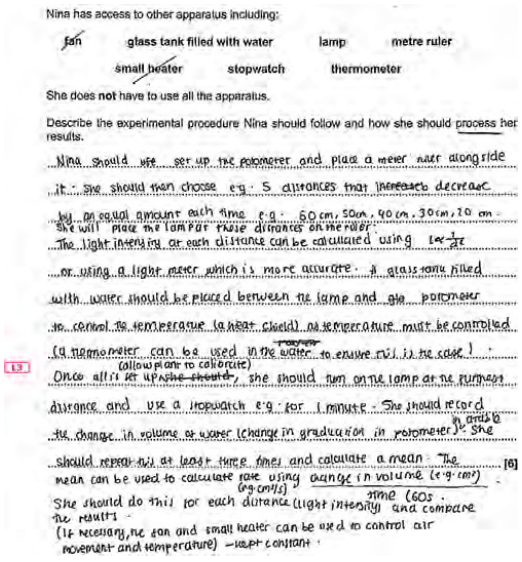
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		iii	Increased/large surface area (to volume ratio) ✓ so there is increased/more active transport/absorption/uptake (of nitrate ions) ✓	2 (AO 1.1 × 2)	ALLOW quicker (but not quickly as comparison required) Examiner's Comments A number of candidates were able to link the shape of the cell to its ability to absorb ions more effectively. A lower number also linked this to the increased uptake of ions.
	c		osmosis ✓ xylem ✓ diffusion ✓ stomata ✓	4 (AO 1.1 × 4)	Examiner's Comments Most candidates were credited with at least three marks in this question. A number of candidates confused xylem and phloem tissue.
	d		*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this quest* **Level 3 (5–6 marks)** A detailed description of the apparatus/procedure **and** variables that will be controlled. **AND** A detailed description of how the results should be processed or the measurements to be taken. *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)** A detailed description of apparatus/procedure or variables. **AND** A description of how the results should be processed or the measurements to be taken. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some*	6 (AO 3.3a × 3) (AO 2 × 3)	**AO3.3a Developing an experimental procedure** Apparatus and procedure - use the lamp - to change/vary the light intensity - by placing it at different distances from the leafy shoot - use metre ruler - to measure distance of lamp from leafy shoot - use at least four different distances - use the stopwatch - repeat the experiment several times at each distance/light intensity **IGNORE** ref. to thermometer Variables to control or keep the same - same amount of time for each distance/light intensity and for each repeat (**ALLOW** example e.g. 30 min) - control the amount of ambient light e.g. by closing blinds - control air movement e.g. by closing doors/windows - control temperature by shining lamp

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Question	Answer/Indicative content	Marks	Guidance
	evidence. **Level 1 (1–2 marks)** A description of the apparatus/procedure or variables. OR A description of how the results should be processed or the measurements to be taken. *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.		through tank of water / use the tank of _____ temperature **AO2.2 Applying understanding of measurement and data processing techniques to this type of investigation** Measurements to be taken For each distance/light intensity/repeat: • record the volume of water in the pipette at the start • record the volume of water in the pipette at the end (e.g. after 30 min) • how much water taken up / how much water decreased Processing the results • calculate the change in volume of water at each distance/light intensity • by subtracting the final volume from the starting volume • calculate the mean change in volume of water of all the repeats at each distance/light intensity • calculate the rate of water uptake by dividing the (mean) change in volume of water by the time • compare results for different light intensities/distances Examiner's Comments Over 50% of candidates were credited with a Level 3 mark and it was clear that this practical had been studied during the course. Amongst those candidates that did not achieve Level 3 were some who attempted to describe how they would investigate several factors, such as temperature, wind etc, despite the question asking for the effect of light. Some candidates did not observe that the graduated pipette should be used to

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Question			Answer/Indicative content	Marks	Guidance
					measure the volume of water transpired and wrote about the method that they had probably used involving a capillary tube to measure the distance a bubble would move. Exemplar 2  Nina has access to other apparatus including: fan glass tank filled with water lamp metre ruler small heater stopwatch thermometer She does not have to use all the apparatus. Describe the experimental procedure Nina should follow and how she should process her results. Nina should use set up the potometer and place a meter ruler alongside it. She should then choose e.g. 5 distances that increase/decrease by an equal amount each time e.g. 50cm, 50cm, 40cm, 30cm, 20cm. She will place the lamp at these distances on the ruler. The light intensity at each distance can be calculated using $\frac{1}{d^2}$ or using a light meter which is more accurate. A glass tank filled with water should be placed between the lamp and the potometer to control the temperature (a heat shield) as temperature must be controlled (a thermometer can be used in the water to ensure this is the case) (allow plant to calibrate) Once all is set up/ready, she should turn on the lamp at the furthest distance and use a stopwatch e.g. for 1 minute. She should record the change in volume of water (change in graduation in potometer) in cm3 She should repeat this at least three times and calculate a mean. The mean can be used to calculate rate using change in volume (e.g. cm3) / time (60s). She should do this for each distance (light intensity) and compare the results. (If necessary, the fan and small heater can be used to control air movement and temperature) – kept constant. [6] This response perfectly covers all points required for Level 3, with 6 marks achieved.
			Total	18	

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