OCR GCSE 21ST CENTURY BIOLOGY B · J257

BIOLOGY



MARK SCHEME

B3.1 WHAT HAPPENS DURING PHOTOSYNTHESIS? (FOUNDATION)

SCORE	PERCENTAGE
/90	%

STEMUP

These questions belong to OCR, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by OCR. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with OCR and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. OCR has not endorsed, approved or been involved in the production of it. OCR and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

OCR publishes its past papers, mark schemes and examiner reports. Always check the current specification at ocr.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Question			Answer/Indicative content	Marks	Guidance
1	a		**Any two from** 1. Idea of interdependence ✓ 2. Example of interdependence e.g. food / shelter / reproduction ✓ 3. Maintaining genetic diversity ✓ 4. May be required in the future for medicines ✓ 5. Maintains the stability of the food web ✓	2	MP3 **IGNORE** 'genetic variation'
	b		1. Advantage: (can be) fast / no need to find a mate ✓ 2. Disadvantage: lack of genetic diversity / are all genetically identical ✓	2	MP2 **ALLOW** 'are clones' **DO NOT ALLOW** 'are all identical'
	c	i	Enzymes will become denatured ✓	1	If more than one box is ticked, do not award the mark even if the correct box is also ticked
		ii	Some cells may burst ✓	1	If more than one box is ticked, do not award the mark even if the correct box is also ticked
	d		Limpets will decrease in numbers ✓ As more are eaten ✓ **OR** Crabs will increase in numbers ✓ As more food ✓	2	**ALLOW** any correct species with correct explanation
			Total	**8**	
2	a		Substrate – hydrogen peroxide **AND** enzyme – catalase ✓	1	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	b		* Please refer to the marking instructions for guidance on how to mark this question. **Level 3 (5–6 marks)** *Describes in detail the pattern of the graph* ***AND*** *Links this to an explanation of the effect of all temperatures on enzyme function* ***AND*** *Identifies the optimum temperature for the enzyme* *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)** *Describes the pattern of the graph* ***AND*** *Links this to an explanation of the effect of temperature on enzyme function* ***OR*** *Identifies the optimum temperature for the enzyme* *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)** *Describes the pattern of the graph* ***AND*** *Makes reference to the effect of temperature on enzyme function between 0 and 30 °C* ***OR*** *Makes reference to the effect of temperature on enzyme function between 30 °C and 60 °C* *The information is basic and* *communicated in an unstructured way. The* *information is supported by limited* *evidence and the relationship to the* *evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*	6	**AO3.1a Identification of patterns in graph** For example: • Rate of reaction increases between 0 °C and 30 °C • Rate of reaction decreases between 30 °C and 60 °C **AO2.1 Details of effect of temperature on enzyme function** For example: • Increase between 0 and 30 °C is because there is more kinetic energy • So more collisions • So more ESC form • Decrease between 30 °C and 60 °C is because enzyme is denatured • Loss of 3D structure • ESC can no longer form as substrate does not fit into the enzyme **AO3.2a Identification of the optimum temperature of the enzyme** For example: • Optimum temperature is 30 °C

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
			Total	7	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
3			**Level 3 (5-6 marks)** Identifies some problems with experimental design **AND** suggests improvements directly linked to the problem. Quality of written communication does not impede communication of the science at this level **Level 2 (3-4 marks)** Identifies some problems with experimental design **and** suggests improvements, unlinked. Quality of written communication partly impedes communication of the science at this level **Level 1 (1-2 marks)** Identifies either a problem **OR** an improvement. Quality of written communication impedes communication of the science at this level **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit	6	**This question is targeted at grades up to C** **Indicative scientific points may include** Problem / Improvement Only 5 cress seedlings used / Increase the number of cress seedlings Light is from other one direction only / a box with light from Could be due to other areas / grow in sources / Eliminate light from other angles to see if 5 days may not be Try light source from long enough / 5 days may not be a fair test / beyond 5 days No repeats carried out / Extend experiment / Repeat experiment One seedling did not grow towards the light / Some blocked from lit / Idea that sunlight can light because / Use fixed light source in front / ensure evenly / lamp (from side) Use smaller plants near the window / Use seedlings all the same size **Examiner's Comments** Candidates were given a description of an experiment on the effect of light on shoot growth and were asked to suggest improvements to it.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					problems and solutions in the experimental design. Many candidates did not realise the purpose of the experiment, so suggested measures to get the cress seedlings to grow upright. Others suggested problems which were not visible in the diagram, such as lack of water. Higher scoring candidates related the improvements to the problems identified.
			Total	6	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
4	a	i	All correctly plotted (2 marks) Five or six correctly plotted (1 mark)	2	**Allow**1 square error margin **If plotted points invisible**, score marks from line of best fit. **ignore** bar chart Points to be plotted: 0.00, 0 0.02, 20 0.04, 28 0.06, 35 0.08, 40 0.12, 43 0.14, 43 **Examiner's Comments** Candidates were asked to plot a graph of data for the effect of carbon dioxide on the rate of photosynthesis, candidates performed well. Some lost a mark by not plotting the first point at 0,0.
		ii	Continuous, correct and smooth line of best fit, going through all plotted points, including the origin	1	**Accept** points joined with straight lines dot-to-dot **Allow** 1 square error margin. **If plotted points invisible**, score marks if line passes through the correct points on the graph **Do not accept** straight line of best fit **Allow** ecf **Examiner's Comments** Some very poor best fit lines were seen. In some cases, several lines were drawn, in others, the line was not smooth or was double in places. Random straight lines were common and also failed to score.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		iii	42	1	**Allow** 41 – 43 **Allow** ecf - correct reading of data from line **Examiner's Comments** The great majority correctly read a figure from the graph for a value for carbon dioxide concentration not given.
		iv	Any two from as carbon dioxide increases (the rate of) photosynthesis / reaction increases OR there is a positive correlation; idea that increasing carbon dioxide has no further effect/ rate remains constant / rate plateaus; because there is another limiting factor/ named limiting factor / CO_2 is no longer a limiting factor;	2	**do not accept** in reverse: as photosynthesis increases, carbondioxide increases / OWTTE **do not accept** rate of photosynthesis decreases **Examiner's Comments** Most gave the original correlation but few gave valid statements about the levelling off or the effect of another limiting factor to score 2 marks.
		v	(it is an) outlier / anomalous result / anomaly (1) it does not fit the trend / pattern / line of best fit (1)	1	**Allow** does not fit in **Ignore** does not match /look similar to other results **Examiner's Comments** The idea of an outlier was very well known, but fewer were able to state why it was not included, with reference to the pattern or trend of other results.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	b		**Level 3 (5-6 marks)** Uses point(s) of information provided alongside biological knowledge. Quality of written communication does not impede communication of the science at this level **Level 2 (3-4 marks)** Uses point(s) of information provided. Quality of written communication partly impedes communication of the science at this level **Level 1 (1-2 marks)** States condition(s) required for growth. Quality of written communication impedes communication of the science at this level **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit	6	**This question is targeted at grades up to C** **Indicative scientific points may include:** **Conditions** • Temperature • use heaters / greenhouse (to raise temperature) • pH (of soil) • light (intensity) • use lamps to increase light intensity • water • minerals /nitrates • provide fertilisers (to provide minerals) • carbon dioxide levels should be above that of atmospheric levels • burn fuels to produce CO_2 **Using information provided** • pH (of the soil) 6-8/neutral ORA • temperature 28-35 ORA **Biological knowledge** • optimising conditions for **enzymes ORA** • correct reference to limiting factors **Examiner's Comments** Candidates were asked to use graphs and their biological knowledge to describe what conditions should be provided to grow tomatoes. It was generally well answered, with many candidates scoring 4 marks for reference to the information provided. Few gained the full 6 marks, which required an understanding of optimum conditions for enzyme action or a clear explanation of limiting factors. Even weaker candidates gained 1 or 2 marks by referring to temperature and pH.
			Total	**14**	

© OCR 2019.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
5			any two from plants get more light; more photosynthesis / growth / food; plants can compete better	2	OWTTE Examiner's Comments This question had one mark available for the idea that the plant gets more light, and a second mark for the idea that more light leads to more photosynthesis. Many candidates failed to score at all on this question, and for those who did it was unfortunate that they seemed unprepared to construct an argument based on the recall of a plain statement in the specification.
			Total	2	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
6	a		sunlight; build up; energy; break down	4	Examiner's Comments Nearly all candidates scored at least two marks, and many did even better than that. Where marks were lost it was most common to have the idea that photosynthesis builds up large food molecules wrong.
	b		any two from each step contains different molecules / substrates / reactants; each enzyme / substrate molecule has a different / specific shape; molecules must be the correct shape to fit together (into the active site of the enzyme); correct reference to 'lock and key' model;	2	not "same shape" "fit" has to clearly refer to enzyme and substrate Examiner's Comments This question was one where the weaker candidates struggled to express their ideas clearly. While there was a good deal of mention of the lock and key model few seemed able to link this to other ideas on the markscheme for a second mark, and it was surprising to see so many responses which had a confused idea such as the enzyme has to fit into the active site.
	c	i	30 (°C) = 40 (units); ~~45°C = 5 (units)~~	2	~~Examiner's Comments~~ This question was generally very well answered, The great majority of candidates seemed well able to read data from the graph.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	as the temperature increases the rate of reaction decreases / negative correlation; enzymes not at optimum / stop working	2	**ignore** description of increase from 0 to 30 **allow** denatured **Examiner's Comments** This was an area where candidates often struggled to express themselves clearly, their biggest difficulty being to link a comment about the rate of reaction to the temperature. It is true to say that the rate of reaction increases and then decreases across the whole temperature range, but the question is about the range from 30°C to 45°C, and so the correct response is that the rate decreases. More were able to score a mark on the explanation than on the description of the pattern of results.
		iii	two plots: one at 10°C **and** one at 25°C	1	**Examiner's Comments** This question tended to be very well answered, with most candidates able to correctly identify both outliers. Some candidates lost a mark here by being careless and drawing such a large ring around the point at 10°C that they included the point at 15°C as well and so could not be awarded the mark.
	d	i	More water is available. The light intensity is at its highest. ? The temperature of the soil is at its highest.	1	**Examiner's Comments** Was generally very well answered, with most candidates picking up on the idea that the highest rate of photosynthesis is best explained by the light intensity being highest, which should have been helpful to them in part iii.

© OCR 2019.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	35 (arbitrary units)	1	Examiner's Comments This question called for a calculation of the difference between 50 and 15, and it might have been expected from the high degree of skill in reading the graphs demonstrated in other questions that even more candidates would have scored this mark than actually did.
		iii	the difference would be less; reduced (rate of) photosynthesis (but not as much for respiration)	2	Examiner's Comments Many scored one mark on part iii for the idea that the difference would be less, or for the idea that the rate of photosynthesis would be lower on a cloudy day, but very few candidates seemed able to put the two ideas together and it may be that this was simply a failure to give enough detail for two marks here rather than a problem with Biological knowledge.
		iv	10.00–12.00	1	Examiner's Comments This question was generally well answered, showing that many of the candidates were able to draw a conclusion based on the evidence in the graph.
			Total	16	

© OCR 2019.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
7	a		**Level 3 (5–6 marks)** Explanation uses ideas from: photosynthesis, temperature and enzymes Quality of written communication does not impede communication of the science at this level **Level 2 (3–4 marks)** Explanation uses ideas from two of: photosynthesis, temperature, enzymes Quality of written communication partly impedes communication of the science at this level **Level 1 (1–2 marks)** Makes ref. to either photosynthesis OR temperature OR enzymes Quality of written communication impedes communication of the science at this level **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit	6	**This question is targeted at grades up to C** **Indicative scientific points may include** **Photosynthesis** • (If enzymes do not function) the rate of photosynthesis drops / stops • If there is no photosynthesis less / no glucose will be made • Less / no respiration • Idea of (temp) limiting factor for P/S **Temperatures** • temperature is **too** hot / high / low / cold (algae die) **ignore** ref to figures • Reaction slows (photosynthesis) • Fewer collisions / ref to kinetic energy changes **NB** Credit “reaction slows” only once (either temperature or photosynthesis) **Enzyme** • enzyme works best / fastest at optimum temperature • Enzyme is damaged / denatured / changes shape (at **high** temperatures); **Ignore** killed / dies • Ref. To active site • ref to lock and key / substrate no longer complementary AW **Examiner's Comments** This question asked for explanation of how changes in sea water temperature can lead to algae dying. Six marks were available for a full answer describing the effect on photosynthesis, the role of temperature and the effect on enzyme function. Weaker answers did not refer to photosynthesis, referred to temperature changes rather than being too hot or too cold, and

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
				3	reference to enzymes being killed, or being denatured above or below optimum temperature. Good answers covered points such as photosynthesis producing glucose and temperature being a limiting factor, at temperatures which are too high the enzymes will be denatured and correct references to active site and substrate. Few described the effect of temperature on particle collisions. Award marks for natural habitat OR Experimental sit ~~Accept appropriate sampling techniques~~
	b		*any three from* sample or look at different areas of coral (where algae dead and alive); measure / change temperature; measure / change UV / light; record amount of living / dead algae; ref. to correlation between either factor and dead algae;		e.g. more UV, less algae **Examiner's Comments** Only the best candidates gained full marks here. Candidates were asked to describe how scientists could show whether light or temperature is the cause of algae dying in their natural habitat. Many did not appreciate this and described a laboratory experiment, but credit was also available for answers along these lines. Few described a field investigation where temperature and UV were measured and related to the amount of living and dead coral in a number of areas, and references to sampling techniques were rarely seen. Where a laboratory experiment was suggested, ideas of control of variables were missing.

© OCR 2019.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	c	i	Algae give carbon dioxide to the coral ☐ Algae give chlorophyll to the coral ☐ Algae give glucose to the coral ✓ Algae give oxygen to the coral ✓ Coral gives carbon dioxide to the algae ✓ Coral gives chlorophyll to the algae ☐ Coral gives glucose to the algae ☐ Coral gives oxygen to the algae ☐	3	remove one mark for each additional incorrect answer **Examiner's Comments** In this question aspects of the role of symbiotic algae in coral were explored. In this part, the benefits to both organisms were required. Although most candidates scored, few gained all three marks available.
		ii	cellulose (1) starch (1)	2	**Examiner's Comments** Most candidates were able to give at least one substance which the algae can make from glucose produced in photosynthesis. Starch was better known than cellulose, and calcium was a common incorrect answer.
			Total	**14**	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
8	a		carbon dioxide (1) glucose (1)	2	responses must be in the correct order **accept** correct formulae ie (6)CO_2 $C_6H_{12}O_6$ if formula must be subscript **accept** starch, sugar or any named carbohydrate on RHS Examiner's Comments This question was well attempted and those who knew the equation for photosynthesis knew both answers. Candidates who attempted this but failed to score tended to write the answers the wrong way around.
	b	i	10.8 (1)	1	Examiner's Comments This question was attempted by most candidates with most correctly calculating the mean value as 10.8
		ii	C(1)	1	**accept** correct references to value if A given as response then check mean value of high and if between 14.8–15.2 then accept answer Examiner's Comments Most candidates were able to correctly identify the species as C.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		iii	*(confident because):* the (mean) values are the same / similar / very close / closest (1) the results were repeated (ten times) (1) (repeats mean) results are repeatable / reliable / valid (1) *(not confident because):* size of bubbles vary (1) difficult to count bubbles (1) size of pondweed might be different (in the two tubes) (1) the temperature might be different (in the two tubes) (1) need more data / tests (to be sure) (1)	2	**mark whole answer crediting any two points** must imply both values **ignore** accurate **ignore** ref to different species of pondweed (as given in the question) **allow** any other reasonable difference in variables **ignore** idea of human error **ignore** idea that data is wrong / inaccurate **ignore** amount
		iv	*any two from:* control the (water) temperature (in the test tubes) (1) control the pH (using the buffer) (1) use the same (mass of) pondweed (in each test tube) (1)	2	**accept** any other feasible improvement **accept** use more replicates
			Total	**8**	

Examiner's Comments

In this question there were 2 marks available for 2 reasons as to why the candidate would be confident or not about their answer to (ii). Most candidates gave only one reason in their answer limiting their mark to 1.

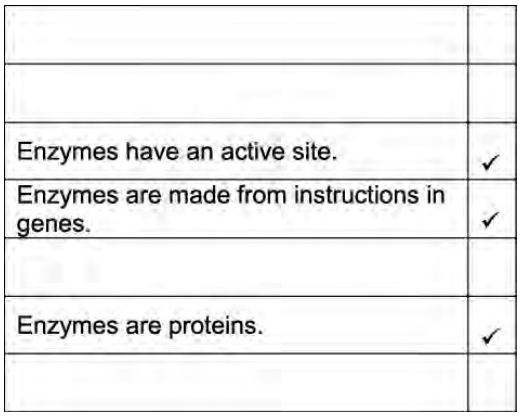
Examiner's Comments

Here candidates were asked to suggest 2 improvements to the experiment. Most failed to follow the rubric command explaining one improvement in detail rather than 2 and therefore limiting their answer to 1 mark.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
9			[Level 3] Correct description or correct word equation AND suggestion why rate is fast. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Description or correct word equation OR partial description and suggestion why rate is fast. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Product / reactant / light / chlorophyll OR suggestion why rate is fast. 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	• chlorophyll / pigment / green used • takes place in leaf • needs light • uses carbon dioxide • uses water • makes oxygen • makes glucose This question is targeted at grades up to E Indicated a link between a suggested feature of the plant and photosynthesis and rapid growth e.g. idea that photosynthesis is more efficient more chloroplasts / leaves darker green leaves spread out to catch a lot of light / lots of leaves good roots Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This was a well answered question by those who coupled a clear description of photosynthesis with features of the plant which could account for the rapid growth. The very best used an equation to summarise photosynthesis. Far from all responses showed a clear or complete description of photosynthesis, and this greatly limited the marks they could score.
			Total	6	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
10	a			3	minus 1 mark for each additional incorrect tick. **Examiner's Comments** The answer called for three ticks, which most candidates did offer. It was most common for marks to be scored for “active site” and “enzymes are proteins”. Only the most successful candidates were able to link this to “made from instructions in genes”.
	b	i	Break down (stains);	1	**accept** makes stains soluble / digests stains **ignore** removes / destroys / eats stains **Examiner's Comments** The question was best answered by those who used technical vocabulary e.g. 'digests'. Some responses which did not score were couched in vague terms which often restated the question.
		ii	**30°C** optimum temperature; enzymes will not work / denatured at 90°C / at high temperatures;	2	**accept** “works best at 30°C” **Examiner's Comments** Those who did score a mark most often did so for the idea of the enzyme denaturing at high temperature. It was much less common for candidates to score the optimum temperature marking point, and many were explicit in giving 37°C or body temperature as the optimum, showing that their thinking was limited to the context of the human body.

© OCR 2019.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	c		works best at pH6; works over a range of pH3 to pH9; does not work at all below pH3 / above pH9;	3	**accept** (pH6) is optimum **accept** range of pH4 to pH8 **ignore** reference to “temperature” **Examiner's Comments** This question was often well answered in terms of giving pH6 as the optimum, and some were able to score a further mark for describing the range. Few went on to explain that the enzyme does not work below pH3 or above pH9 clearly enough for a mark to be awarded.
			Total	9	

© OCR 2019.

STEMUP.CO.UK