PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 5: ENERGY FOR BIOLOGICAL PROCESSES

CORE PRACTICALS

SCORE	PERCENTAGE
/122	%

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Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • drying evaporates the solvent (1) • so that a small concentrated spot of extract can build up (1) • in order to prevent extract spreading out (1)		**(3)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: • add {extract / pigment} to (start) line (1) • (concentrate spot by) dry and repeat (1) • place paper in named solvent (1) • obtain solvent front / place paper so line or spot above solvent / until reaches near top (1)	**e.g.** propanone / ethanol / petroleum ether **DO NOT ACCEPT** water	**(3)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: • use same light intensity (1) • use red filter (1) • use tube {with clean sides / no scratches / holding opaque side} (1) • use a control tube with water to {calibrate / obtain zero absorbance} (1) • same {concentration / volume} of {chloroplasts / DCPIP} (1)	**DO NOT ACCEPT** same lamp / same bulb / same power / same distance	**(4)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • with herbicide DCPIP not {decolourised / reduced / stays blue} (1) • no electrons available / reduced electron transport (1) • less {reduced NADP / NADPH} (1) • therefore less ATP (1) • because the {Calvin cycle / light independent stage} are affected (1)	**ACCEPT** converse **DO NOT ACCEPT** absorbance does not change **DO NOT ACCEPT** if from ETC implies respiration	**(4)**

Q4.

	Answer	Mark
(i)		(2)

Investigation	Type of respiration	Potassium hydroxide solution absent or present	Coloured liquid moved to the left	Coloured liquid moved to the right	Coloured liquid did not move
1	Anaerobic	Absent	☒	☒	☒
2	Aerobic	Absent	☒	☒	☒ ;
3	Aerobic	Present	☒ ;	☒	☒

Question Number	Answer	Additional Guidance	Mark
(ii)	1. (as anaerobic) no O_2 absorbed / eq ; 2. no CO_2 produced / eq ; 3. so no change in {volume/pressure} (so liquid does not move) ; 4. since for each 6C glucose respired, 2x3C lactate formed / eq ;	1. **ACCEPT** No oxygen used	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	1. (reduced NAD from glycolysis) enters mitochondria/ moves through outer mitochondrial membrane / eq ; 2. moves to inner membrane of mitochondrion / eq ; 3. becomes {oxidised /NAD / NAD^+} ; 4. as {electrons / eq} transferred to {electron transport chain / eq} / eq ; 5. fate of hydrogen ions described e.g. pumped into membrane space ; 6. (NAD) returns to {Krebs cycle/ matrix / eq} ;	**2. ACCEPT** crista for inner mitochondrial membrane **6. ACCEPT** cytoplasm, glycolysis	**(4)**

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • (as) wavelength of light decreases, rate of photosynthesis increases (1) • because the data show a greater colour change at shorter wavelengths of light, indicating faster CO_2 uptake (by alga) (1)	ACCEPT converse throughout	**(2)**

Question Number	Indicative content
* **(ii)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • the trend of the results is opposite in the two repeats: results are not reliable • variables such as organism and indicator are controlled whereas variables such as temperature and light intensity are not controlled • colour changes judged by eye are qualitative and not precise • fastest rate is seen with the last filter used, therefore temperature may be responsible for change in rate • experiment left for 30 minutes, other additional times would give extra information about the rate • coloured indicator may affect the wavelengths of light reaching the algae • the algae will be respiring and producing CO_2, which complicates measurement of the rate of photosynthesis • rate of respiration is assumed to be constant, but this may not be the case • changes in temperature or pH may alter the activity of the enzymes responsible for photosynthesis • conclusion that the experiment is invalid / not measuring effect of wavelength on photosynthesis

Level	Marks	Descriptor
Level 0	**0**	No awardable content
Level 1	**1-3**	Limited scientific judgement made with a focus on mainly one aspect. A few strengths or weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but supported with limited evidence.
Level 2	**4-6**	Scientific judgements are made through the application of relevant evidence, referring to both methods and trends in results. Both strengths and weaknesses are identified. A conclusion is made with reference to more than one piece of evidence, demonstrating links to biological knowledge and understanding.
Level 3	**7-9**	Scientific judgements are made through detailed analysis and interpretation of relevant evidence including trends in results and several aspects of methodology. Both strengths and weaknesses are identified in both methods and results. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding and drawing upon several strands of evidence.

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: divide energy in producers by energy in sunlight (1) multiply by 100 (1)	 85 000 ÷ 7 000 000 × 100 = 1.21 Correct answer gains full marks, with no working shown.	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to one of the following: • light reflected (from leaf) (1) • light misses {chloroplast / chlorophyll} (1) • only certain wavelengths absorbed (1)	 Accept transmitted / not absorbed by {chloroplast / chlorophyll} Accept limiting factors eg lack of CO_2, water etc may reduce rate	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • because some of the energy is lost through {respiration / heat / movement} (1) • some of the producers not eaten (1) • some of the producers not digested (1)		(2)

Q7.

Question Number	Answer	Mark
	An explanation that makes reference to four of the following: • use {soda lime / KOH / NaOH} to absorb carbon dioxide (1) • put {water / dye / ink} (1) • use ruler / scale to measure distance (1) • use {syringe / cross sectional area multiplied by distance / use $\pi r^2 d$} to measure volume of oxygen (1) • use {syringe / 3-way tap} to reset / do repeats (1) • control temperature using water bath (1)	**(4)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	1. same mass of each tissue / eq ; 2. idea of time being recorded for {a set distance travelled by coloured liquid OR distance coloured liquid travelled in a set time} ;	**1. IGNORE** amount	**(2)**

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that includes the following: • tube with no gel beads (tube containing hydrogencarbonate indicator in light) (1) • tube (containing hydrogencarbonate indicator and gel beads) in light-proof cover (1)	Accept tube containing gel beads without algae (tube containing hydrogencarbonate indicator in light) / no algae Accept tube (containing hydrogencarbonate indicator and gel beads) in the dark	**Exp (2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that includes three of the following: • {at 5cm and 15cm / at high light intensity / close to lamp} (indicator is purple) there is more photosynthesis, so carbon dioxide being taken in (1) • (at 5 and 15cm) more photosynthesis than respiration so net uptake of carbon dioxide (1) • at 25cm (indicator is red) the carbon dioxide used in photosynthesis equals the carbon dioxide produced in respiration (1) • {at 35 or 45cm / at low light intensity / far from lamp} (indicator is orange) there is more respiration than photosynthesis, so carbon dioxide released (1)	Allow ref to LDR or carbon fixation for photosynthesis Accept at 5 and 15 cm light is not a limiting factor for photosynthesis, so carbon dioxide is taken in. Accept converse Mp2 may also get mp1 Accept reference to compensation point Accept rate of photosynthesis equals rate of respiration Accept there is less light for photosynthesis so less carbon dioxide is used than is produced in respiration Accept net increase in carbon dioxide	**Exp (3)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	An answer that includes three of the following: • **two examples** of standardisation (2) **and a maximum of two from**: • set up a reference set of solutions at different carbon dioxide concentrations (1) • compare by {colour matching / using a colorimeter} (1) • time taken for algal balls to rise {a known distance / to the surface of the tube} (as oxygen is being produced in photosynthesis) (1)	eg equal volume of sodium hydrogen carbonate indicator / equal number of algal balls in each tube / mass of algae / mass or volume of beads / same temperature Accept measurement of position of / distance moved by algal beads in tube	**Exp (3)**

Q11.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to six of the following: • grass taken from in or near clover and from an areawithout clover (1) • standardised mass of grass plants collected (1) • use of known volume of (named) solvent to extract pigment from (known mass of) grass (1) • absorbance measured in colorimeter (1) • red filter used to measure absorbance of green chlorophyll(1) • colorimeter zeroed with solvent (1) • replicates taken and means calculated (1) • t test used to look for significant difference (1) • other relevant factor monitored (1)	Allow lab-based experiment where grass is grown with and without clover Allow use of {sand / pestle and mortar/food mixer} to grind up grass Allow extract filtered Allow details of chromatography if carried out as an alternative with areaor intensity of green spots measured Allow compare standard deviation	**(6)**

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • because different types of lipid are found in the mitochondria and chloroplasts **(1)** • because mitochondria are associated with { respiration / oxidative phosphorylation} whereas chloroplasts are associated with {photosynthesis / light-dependent reactions / photophosphorylation} **(1)** • because mitochondria contain {electron transport proteins / cytochromes / cristae / stalked particles} whereas chloroplasts contain {grana / chlorophyll / photosystems / carotenoids} **(1)**	**Accept** a description of the differences e.g. a lipid high in mitochondria is low in chloroplast, only two of the lipids are found in both organelles **Do not accept** a list of values from the table without some sort of comparison **Accept** any other membrane difference	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	A diagram that shows the following: • a glycosidic bond between C 1 on galactose and C 6 on MGDG **(1)** • rest of molecules complete **(1)** • water molecule **(1)**	 ecf if glycosidic bond drawn between C1 and C 4 **Accept** H_20 / water	**(3)**

Question Number	Answer	Mark
(iii)	**The only correct answer is B** ***A*** *is not correct because DGDG is larger than MGDG so will not travel as far and sulfolipid is the smallest quantity so will be the smallest spot* ***C*** *is not correct because DGDG is larger than MGDG so will not travel as far and sulfolipid is the smallest quantity so will be the smallest spot* ***D*** *is not correct because sulfolipid is the smallest quantity so will be the smallest spot*	**(1)**

Q13.

Question Number	Correct Answer	Additional guidance	Mark
(a)	An answer that makes reference to the following: • measure volume by use of {formula / three way tap and syringe} (1)		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: • the indicator fluid movement would move to the left (1) • because there is lower pressure (1) • because there is respiration but no photosynthesis (1) • therefore the pressure is reduced because the carbon dioxide produced is absorbed (1)		**(4)**

Question Number	Correct Answer	Additional guidance	Mark
(c)(i)	An explanation that makes reference to five of the following: • use of a larger container because mice are bigger (1) • need to use more carbon dioxide absorber to ensure all carbon dioxide is absorbed (1) • convert readings into units per gram for each animal (1) • attach a syringe to enable {repeat measurements / volume measurements}(1) • abiotic variables such as light / temperature to be same as in the woodlouse experiment (1) • barrier to protect mouse from carbon dioxide absorber / do not leave mouse in the container for a long time (1)		**(5)**

Question Number	Correct Answer	Additional guidance	Mark
(c)(ii)	An answer that makes reference to the following: • mouse rate of respiration greater than woodlouse (1) • because mice are endotherms / metabolic rate greater / need to maintain body temperature because of heat loss (1)		**(2)**

Q14.

Question Number	Indicative content
*	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. <u>Modify:</u> - uses yeast - provide glucose to yeast - remove potassium hydroxide / remove gauze - coloured liquid put into tubing - scale / ruler - add oil on top of yeast / glucose mixture / use boiled glucose solution <u>'Use' Method:</u> - use apparatus to measure the carbon dioxide released - use range concentrations of fluoride / plus and minus fluoride - replication carried out - use of control - control species of yeast / mass of yeast / volume of mixture / temperature - allow yeast to acclimatise with the three-way tap open - wait for lag phase to finish before measuring rate of reaction <u>'Significant' - Analysis:</u> - use statistical analysis - t test - volume divided by time / distance divided by time - calculate volume from tube diameter - plot graph of respiration against fluoride concentration - use error bars / calculate standard deviation - calculate mean

Level	Marks	
0	0	No awardable content
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. **Covers up to 3 ideas with no analysis** **Uses woodlice means Level 1 max**
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. **Covers from 4 to 6 ideas including at least 1 analysis** **Inappropriate method eg. yeast and photosynthesis / aerobic respiration / Benedict's / keeping KOH means Level 2 and maximum of 5 marks**
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. **Covers 7 or more ideas including at least 2 analysis** **Max 8 if no statistical analysis**

Q15.

Question Number	Answer	Additional guidance	Mark
(a)	1. Idea an enzyme converts a named substrate into named product e.g. enzyme 1 converts P to Q ; 2. idea that this product becomes the substrate of next step ; 3. idea of specificity ; 4. {controls / eq} the conversion / eq ; 5. speeds up the conversion / eq ; 6. by reducing activation energy / eq ; 7. credit reference to control of whole process ;	ACCEPT answers in context of respiration ACCEPT 1 - ref to an enzyme converting one named intermediate to the next e.g.{enzyme/ named enzyme} used to convert hexose to phosphorylated hexose ACCEPT 3 - description of specificity e.g. active site of enzyme 1 only accepts substance P or in context of named respiratory intermediate ACCEPT 4 – regulates ACCEPT 5 - catalysis / enzyme acts as a catalyst ACCEPT 7 - end product inhibition or description	**(4)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. W = {NAD / NAD^+ / NAD_{ox} / eq} ; Any two of the following: 2. (due to) reduced NAD {releasing/eq} {electrons / eq} ; 3. Idea of electrons go to {carrier A / ETC / eq} ; 4. idea of H^+ moved into inter-membranal space ;	ACCEPT 2 – being oxidized Releasing hydrogen (atoms), H^+/protons ACCEPT 3 – 1st electron carrier/correctly named carrier	**(3)**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. substance **X** is ATP ; Any two of the following : 2. due to H^+ pass through {stalked particle / ATP synthase} ; 3. (H^+ passes) down an electrochemical gradient ; 4. (sufficient) energy is {released / eq} ; 5. to join ADP and {Pi / eq} ; 6. reference to chemiosmosis ;	ACCEPT 2 –ATPase ACCEPT 3 - description of electrochemical gradient ACCEPT 5 – phosphorylation of ADP	**(3)**

Question Number	Answer	Additional guidance	Mark
(c)	<table><tr><th rowspan="2">Situation</th><th colspan="3">Movement of coloured liquid</th></tr><tr><th>towards A</th><th>towards B</th><th>does not move</th></tr><tr><td>Screw clip is open</td><td></td><td></td><td>☒</td></tr><tr><td>Screw clip is closed</td><td>☒</td><td></td><td></td></tr><tr><td>Potassium hydroxide is replaced with water and screw clip is closed</td><td></td><td></td><td>☒</td></tr></table>		**(3)**

Q16.

Question Number	Answer	Additional Comments	Mark
(a)	1. idea of a different enzyme for each step ; 2. (which) converts one intermediate into the next e.g. enzyme 1 converts DHAP to 2-PG / eq ; 3. idea that this product becomes the substrate of the next {stage/enzyme} ; 4. Idea of specificity ; 5. {controls/regulates/ eq} the conversion / eq ; 6. {speeds up / catalyses} the conversion / eq ; 7. by lowering the activation energy / / eq ; 8. idea that pyruvate only produced if all enzymes active ;	**1. Accept** 3 enzymes are involved **2. Accept** correctly named enzyme **4. Accept** description of specificity	**(4)**

Question Number	Answer	Additional Comments	Mark
(b)(i)	1. direction of electron movement described / eq ; 2. reference to oxidation / reduction ; 3. idea of releasing energy ; 4. idea that this is used to pump the {H^+ / hydrogen ions/protons} ; 5. from the matrix / into the space between the inner and outer mitochondrial membrane ;	**1. Accept** electron picked up from A or passed on to C **2. Ignore** ref to energy lost **4. Not** hydrogen unqualified	**(3)**

Question Number	Answer	Additional Comments	Mark
(b)(ii)	1. structure X is { stalked particle / ATP synthase / eq} ; Any two of the following: 2. reference to {H^+ flows through {structure X / eq} / chemiosmosis} / eq ; 3. down electrochemical gradient / eq ; 4. (sufficient) energy is {released / eq} to ; 5. allow {ADP + Pi to join / ATP to form} ;	**1.Accept**, ATP synthetase , ATPase **3. Accept** H^+ concentration gradient **4. Not** energy produced **5. Accept** phosphorylation of ADP **Not** reference to phosphorus , P	(3)

Question Number	Answer	Additional Comments	Mark
(c)			(3)

Situation	Movement of coloured liquid		
	towards A	towards B	does not move
Syringe plunger pulled upwards	☒	☐	☐
Syringe plunger not moved	☒	☐	☐
Potassium hydroxide is replaced with water and syringe plunger not moved	☐	☐	☒

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	{mm/cm/mm^3/cm^3} min^{-1} g^{-1}		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • named factor (1) • how controlled (1)	 e.g. temperature, {size / mass / age} of insect e.g. thermostatically controlled water bath / water bath set at a constant temperature / ac room choose equal { size / mass / age} of insect	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • it has already absorbed the maximum amount of carbon dioxide / no more carbon dioxide can be absorbed (1) • (therefore) coloured liquid {would not move / would move less} / readings {are an underestimate / will not be valid} (1)	Accept it is able to absorb less carbon dioxide (for the second insect) Accept (it is replaced) so that coloured liquid will move / so that readings will be valid	**(2)**

Q18.

Question Number	Answer	Additional Guidance	Mark
(i)	• 2.0 / 1.9 / 1.93 (times / ×)	**DO NOT ACCEPT** 1.93 recurring	(1)
(ii)	An explanation that makes reference to three of the following: • water is more effective than culture media for washing (1) • {water is not the solvent / ethanol is the solvent} for fucoxanthin(1) • ethanol {increases permeability of / disrupts} (cell / vacuole)membrane (1) • more fucoxanthin extracted in method A (compared with methodB) because water enters the seaweed {by osmosis / causing the cells to burst} (1)	**ACCEPT** more fucoxanthin extracted in A becausewashed with water	(3)