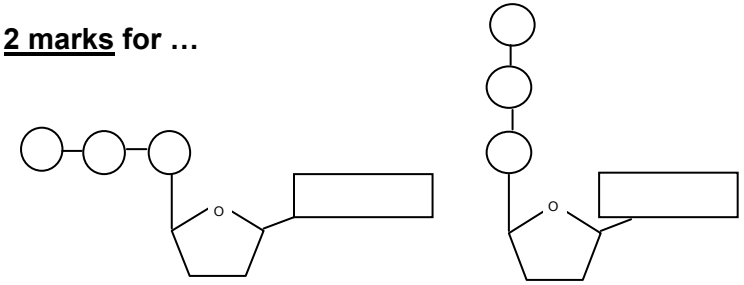
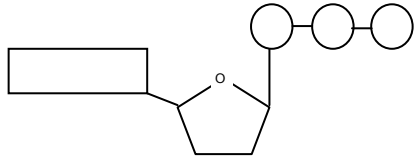
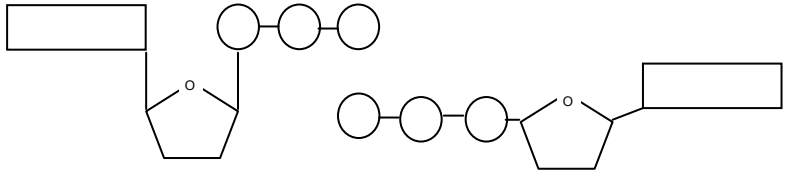
Question			Answer	Marks	Guidance
1	(a)	(i)	row of 3 phosphates joined to ribose **and** ribose joined to adenine **;** phosphates and adenine shown joined to correct place on ribose **or** stated that phosphate(s) joined to carbon 5 **and** adenine joined to carbon 1 **;**	2	**CREDIT** a written description that meets the requirements of the mark point **IGNORE** ribose drawn without an 'O' Phosphates must be attached to a vertical line from ribose Adenine must not be attached to a vertical line from ribose **2 marks for …**  **ALLOW 2** for reverse of above (as long as C atoms not numbered incorrectly) eg  **1 mark for …** (as implies that adenine is attached to carbon 5)  (as implies that phosphates are attached to carbon 4)

Question			Answer	Marks	Guidance
1	(a)	(ii)	hydrolysis ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** dephosphorylation **IGNORE** ref to phosphorylation in glycolysis (as, even if addition of phosphate to glucose is explained, this is not the type of reaction)
	(b)	(i)	1 ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
	(b)	(ii)	none ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
	(b)	(iii)	2 / 3 ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
			Total	6	

Question			Answer	Marks	Guidance
2	(a)		crista(e) / inner mitochondrial membrane **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** thylakoid membrane / lamella(e) (of chloroplast)
	(b)	(i)	**A** has more stain than **B** **and** **C** has none **;**	1	All 3 seeds must be mentioned Staining ref. could relate to area or intensity of stain. **DO NOT CREDIT** implication that C has any staining **ACCEPT** 'shading' instead of 'staining' **IGNORE** ref to presence or absence of TTC (as it is present in all regions of all seedlings and it is the *staining* that is important)
	(b)	(ii)	**1** *idea that* shaded areas in **A** are respiring **;** **2** *idea that* 22^{o}C is suitable temperature for respiration **;** **3** reduced **,** NAD / FAD / coenzymes **,** produced in **,** glycolysis / link reaction / Krebs cycle **;** **4** lots of / more **,** electron transfer (to TTC) / (oxidative) phosphorylation / chemiosmosis **;**	2 max	***1*** **ACCEPT** a description of the respiring area(s) eg the outer regions of the seed are respiring ***3*** **ACCEPT** NADH / $NADH^{+}$ / $NADH + H^{+}$ / $NADH_2$ / FADH / $FADH^{+}$ / $FADH + H^{+}$ / $FADH_2$

Question			Answer	Marks	Guidance
2	(b)	(iii)	(named stage of) respiration uses **,** enzymes / proteins in ETC / electron carriers **;** *group B* not enough <u>kinetic</u> energy for **,** ESC formation / substrates and enzymes to collide (successfully) **;** *group C* enzymes / proteins in ETC / electron carriers **,** <u>denatur</u>ed by **,** high temperature / (almost) boiling water **;**	2 max	**IGNORE** coenzymes ***Note** that a statement reading:* 'the respiratory enzymes are denatured by 90^{o}C in C' **= 2 marks** (mps 1 and 3)
	(c)	(i)	ethan<u>al</u> **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** acetaldehyde **IGNORE** formulae (as name asked for in Q)
	(c)	(ii)	ethan<u>al</u> **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** acetaldehyde **IGNORE** formulae (as name asked for in Q)

Question			Answer	Marks	Guidance
2	(c)	(iii)	ethanol **and** carbon dioxide ;	1	**Mark the first 2 answers.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** formulae **IGNORE** alcohol unless specified as 'ethyl alcohol' **IGNORE** (oxidised) NAD **DO NOT CREDIT** NADP / reduced NAD / ATP
	(c)	(iv)	**1** releases NAD , to accept more H / to be reduced again / so glycolysis can continue **or** allows (some) ATP to be generated (in glycolysis) ; **2** (some ATP available) for named cellular process ; **3** AVP ;	2 max	***1*** the idea that cells can still respire is not quite enough ***2*** eg • active transport • endocytosis / exocytosis / pinocytosis • mitosis / meiosis • protein synthesis • DNA replication • Calvin cycle / light-independent stage of photosynthesis ***3*** eg • stated situation where oxygen is in short supply (e.g. waterlogging / compacted soil / roots situated very deep in soil) **IGNORE** can respire in low oxygen conditions (as stated in Q)
			Total	**11**	

Question			Answer	Marks	Guidance
3	(a)	(	link reaction **and** Krebs cycle **;**	**1**	**Mark the first 2 answers.** If they are correct and an additional answer is given that is incorrect or contradicts the correct answer then **= 0 marks**
3	(a)	(i	oxidative phosphorylation **;**	**1**	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then **= 0 marks** **ACCEPT** electron transport chain / electron transport system / electron carrier chain **IGNORE** chemiosmosis **DO NOT CREDIT** photorespiration
3	(b)	(	**1** to make the volume of **,** contents / 'peas' **,** the same (in the respirometers) **;** **2** *idea that because* the volume of peas in **A** is greater than the volume of peas in **B** **or** the peas in **A ,** are bigger / take up more space **or** the peas in **A** have absorbed water **or** the peas in **B ,** are smaller / take up less space **;** **3** as without the beads there would be more **,** air / gas / oxygen **,** in **B** than in **A ;**	**2 max**	**1 IGNORE** ref to mass / weight **2 IGNORE** ref to mass / weight must refer to A / soaked / germinating **and/or** B / dry / dormant **3 CREDIT** idea that with the presence of beads the volume of gas would be the same

Question			answer	Marks	Guidance
3	(b)	(i	**1** (determined by) finding difference in volume between (30) soaked **,** seeds / peas and (30) dry **,** seeds / peas **;** **2** the difference represents the volume of glass beads required **or** add the quantity of glass beads necessary to make the volumes (of respirometer contents) equal **;** **3** calculate / knowing **,** volume of 1 bead to determine number of beads equivalent to volume required **;**	**2 max**	**ACCEPT** ref to mass/weight instead of volume throughout **(ii)** as an error carried forward (ecf) **3** **CREDIT** any suitable *method* of determining the volume of beads required e.g. ● displacement ● put soaked peas in tube and measure volume; mark; then put dry peas in and add glass beads into tube and top up to mark
3	(c)	(i)	0.014 **; ;**	**2**	Correct answer = 2 marks, even if no working If answer incorrect **,** not rounded correctly or given to more than 3 dp then **ALLOW** 1 mark for seeing • $\frac{0.27}{20}$ **or** • 0.0135 Only if there is no answer on the dotted answer line, should you look for the answer in the working or in the appropriate place in the table.

Question			Answer	Marks	Guidance
3	(c)	(i	*at, higher temperature / 25^0C* increased <u>kinetic</u> energy **;** (named respiratory) enzymes / decarboxylases / dehydrogenases **,** involved **;**	**2**	**CREDIT** ora for lower temperature **IGNORE** more collisions / ESCs Needs a clear statement that they are involved in <u>respiration</u> **IGNORE** (named) co-enzymes
3	(c)	(ii	**1** reactions require aqueous medium / reactions need to take place in water / reactions need to take place in solution **;** **2** enzymes and substrates can move (to collide) in soaked seeds **or** movement (of reactants) **,** prevented / limited **,** in dry seeds **;** **3** soaked seeds need more **,** ATP / energy **or** dry seeds need less **,** ATP / energy **;** **4** for **,** protein synthesis / mitosis / other (named) metabolic reaction **;**	**2 max**	**ACCEPT** **'**germinating' for 'soaked', 'peas' for 'seeds', 'dormant' for 'dry' throughout **1** **IGNORE** ref to reactants dissolving **2** **IGNORE** ref to ESC as the mp is for the idea of mobility **3** **DO NOT CREDIT** 'no' ATP / energy **4** **CREDIT** soaked peas have increased metabolism **IGNORE** growth / respiration **DO NOT CREDIT** ref to photosynthesis
			Total	**12**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)		***Award 1 mark per correct row***		**Mark the first answer in each box.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** phonetic spelling **except for** ethanal and ethanol
			name of hydrogen acceptor after glycolysis: *mammal* = pyruvate; *yeast* = ethanal ;		**ACCEPT** pyruvic acid (instead of pyruvate) **ACCEPT** acetaldehyde (instead of ethanal) **IGNORE** formulae The spelling of ethanal must be unambiguous
			is CO_2 produced?: *mammal* = no / ✗ / none / no molecules; *yeast* = yes / ✓ / some / one molecule ;		**ACCEPT** 2 molecules for yeast (from 1 glucose molecule)
			name of final product: *mammal* = lactate; *yeast* = ethanol ;	3	**ACCEPT** lactic acid (instead of lactate) **ACCEPT** ethyl alcohol (instead of ethanol) **IGNORE** alcohol **IGNORE** formulae The spelling of ethanol must be unambiguous

Question			Expected Answers		Marks	Additional Guidance
4	(b)					**IGNORE** ref to specific metabolic reactions other than glycolysis (mp 3) **IGNORE** ref to respiration without oxygen
			1	*idea that* ATP produced / energy released ;		*1* **DO NOT CREDIT** this mark point with any ref to energy , generated / produced / made [eg energy made in the form of ATP = 0 ATP (energy) is produced = 0]
			2	*idea that* recycles NAD / NAD can be used again ;		*2* **ACCEPT** 'reoxidises red NAD' (as implies recycling) **CREDIT** NADH / $NADH^+$ / $NADH_2$ for red NAD **DO NOT CREDIT** 'oxidises red NAD' without further qualification
			3	allows , **glyco**lysis / description of glycolysis , to take place / to continue ;	1 max	*3* If glycolysis used as a term, the spelling of 'glyco' must be correct.
				TOTAL	4	

Question			Expected Answers		Marks	Additional Guidance	
5	(a)	(i)				**Mark the first answer for each letter.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**	
			W	**glycol**ysis ;		***W***	**CREDIT** glycolytic pathway **ACCEPT** phonetic spelling but must have 'glycol' **IGNORE** respiration
			X	Calvin cycle / light-independent stage (of photosynthesis) ;		***X***	**IGNORE** dark reaction / photosynthesis **ACCEPT** phonetic spelling
			Y	Krebs cycle ;		***Y***	**ACCEPT** citric acid cycle / TCA cycle / (tri)carboxylic acid cycle **ACCEPT** phonetic spelling **IGNORE** respiration / link reaction
					3		
	(a)	**(ii)**	**1**	take place in different , parts / organelles , of the cell **or** compartmentalisation / reactions separated by membranes ;		***1***	Must be a clear statement and not implied from others. **DO NOT CREDIT** different parts of the leaf **DO NOT CREDIT** no interference between pathways (as rephrasing the Q)
			2	W / glycolysis , in cytoplasm ;		***2***	
			3	X / Calvin cycle , in , chloroplast / stroma (of chloroplast) ;		***3***	**DO NOT CREDIT** if thylakoid / membranes stated or implied
			4	Y / Krebs cycle , in , mitochondrion / matrix (of mitochondrion) ;		***4***	**DO NOT CREDIT** if cristae / membranes stated or implied
			5	AVP ;		***5***	eg • different enzymes for each pathway • different conditions for each pathway
					3 max		

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(iii)	X ; W **and** Y ;	**2**	**IGNORE** names. The question has asked for letters. *photosynthesis* **Mark the first answer.** If the answer is correct and an additional letter is given then = **0 marks** *aerobic respiration* **Mark the first two answers.** If these answers are correct and an additional letter (ie 3rd etc) is given then = **0 marks** **Both letters required for this mark, in any order.**
5	(a)	(iv)	ATP / adenosine triphosphate ; water / H_2O ; (oxidised) NAD / FAD ;	**2**	**If any answer(s) incorrect then Max 1** **IGNORE** energy / heat **IGNORE** numbers eg oxygen (×) and ATP (✓) and water = max 1 oxygen (×) and energy (*ignore*) = 0 ATP (✓) and energy (*ignore*) and H_2O (✓) = 2 reduced NAD (×) and ATP (✓) and energy (*ignore*) and H_2O = max 1

Question			Expected Answers		Marks	Additional Guidance	
5	(b)		1	NAD / FAD / NADP , can , accept hydrogen / accept H / be reduced ;		*1*	**DO NOT CREDIT** hydrogen ions / protons , unless there is an electron as well **DO NOT CREDIT** accepts hydrogen molecules / H_2 **CREDIT** equation showing the reduction **ACCEPT** eg NAD converted to NADH **IGNORE** 'carries hydrogen'
			2	reduced , NAD / FAD , supplies / carries , electrons , to the electron transport chain / for oxidative phosphorylation ;		*2*	Must refer to *reduced* NAD **or** *reduced* FAD **or** NADH / $NADH^+$ / $NADH_2$ / FADH / $FADH^+$ / $FADH_2$
			3	reduced , NAD / FAD , supplies / carries , hydrogen ions for , chemiosmosis / oxidative phosphorylation ;		*3*	Must refer to *reduced* NAD **or** *reduced* FAD **or** NADH / $NADH^+$ / $NADH_2$ / FADH / $FADH^+$ / $FADH_2$
			4	reduced NADP , supplies / carries , hydrogen to , light independent stage / Calvin cycle / X ;		*4*	Must refer to *reduced* NADP **or** NADPH / $NADPH^+$ / $NADPH_2$
			5	coenzyme A / CoA , carries , acetate / ethanoate / acetyl group , to , Krebs cycle / Y ;		*5*	**DO NOT CREDIT** acetyl CoA carries acetate
			6	AVP ;		*6*	eg • co-enzyme(s) / cytochrome(s) , transfer / accept and release , electrons along the electron transport chain • can be , recycled / oxidised **and** reduced
					3 max		
				TOTAL	13		