Question			Answer	Mark	Guidance
1	(a)	(i)	**W ;** **Z ;** **X ;** **W ;**	**4**	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
1	(a)	(ii)	**1** some ATP used to (actively) transport pyruvate (into the mitochondrion) **;** **2** some ATP used to (actively) transport $H^{(+)}$ from (reduced) NAD **,** formed in glycolysis / into the mitochondrion **;** **3** some energy released in ETC **,** is not used to transport H^+ (across inner membrane) / is released as heat **;** **4** not all the H^+ movement (back across membrane) **,** is used to generate ATP / is through ATP synth(et)ase **;** **5** not all the, reduced NAD / red NAD / NADH , is used to feed into the ETC **;**	**2 max**	**IGNORE** ref to phosphorylation of glucose as this is taken into account in estimate. **2** **DO NOT CREDIT** transport of (reduced) NAD **3** **ACCEPT** in context of oxidative phosphorylation **4** **ACCEPT** ref to H^+ leaking (back into matrix or out into cytoplasm) resulting in less ATP generated **5** **CREDIT** use of (some of) the red NAD for other purpose

Question			Answer	Mark	Guidance
1	(b)		*in anaerobic respiration* **1** **glycolysis** / conversion of glucose into **pyruvate ,** occurs **;** **2** produces 2 molecules of ATP (net) **;** **3** (only) substrate level phosphorylation (occurs) **;** **4** **oxygen** not available as final **electron acceptor ;** **5** pyruvate / ethanal **,** used to regenerate NAD for glycolysis (to continue) **;** **6** (Krebs cycle and) electron transport chain / **chemiosmosis** / **oxidative phosphorylation ,** do not occur **;**	**4 max**	**2** **IGNORE** little / less / not much **4** **CREDIT** oxygen is available as the final electron acceptor in aerobic **IGNORE** ref to hydrogen acceptor **5** pyruvate refers to lactate pathway, ethanal refers to fermentation **6** ETC (etc.) ***only*** occur(s) in aerobic
			QWC ;	**1**	Award if **3** of the following terms have been used in a correct context with correct spelling: **glycolysis** **pyruvate** **substrate level phosphorylation** **oxygen** **electron acceptor** **chemiosmosis / chemiosmotic** **oxidative phosphorylation** ***Please insert a QWC symbol next to the pencil icon, followed by a tick (✓) if QWC has been awarded or a cross (✗) if QWC has not been awarded.*** ***You should use the green dot to identify the QWC terms that you are crediting.***
			Total	**11**	

Question			Answer	Mark	Guidance
2	(a)	(i)		2 max	**Only credit answers that refer to an increase in temperature – no ora**
			1 (as the temperature increases) the respiration rate increases **;**		**1** **Clear statement required – cannot be inferred from figures quoted.** **ACCEPT** positive correlation between temperature and respiration rate **IGNORE** ref to directly proportional
			2 respiration rate doubles with a 10°C temperature increase **;**		**2** **Clear statement required – cannot be inferred from figures quoted.** **CREDIT** $Q_{10} = 2$
			3 **comparative** figures with **correct units** (units once for respiration and once for temperature) in the context of either mp **;**		**3** e.g. ● between 0 and 20°C the respiration goes from 17 to 69 mg CO_2 kg^{-1} h^{-1} ● between 5 and 10°C the rate changes by 13 mg CO_2 kg^{-1} h^{-1} e.g. ● between 0 and 10°C the rate goes from 17 to 34 mg CO_2 kg^{-1} h^{-1} ● between 10 and 20°C the respiration goes from 34 to 69 mg CO_2 kg^{-1} h^{-1}

0 °C	5 °C	10 °C	15 °C	20 °C
17	21	34	44	69

Note: 'between 0 and 20°C the respiration rate increased from 17 to 69 mg CO_2 kg^{-1} h^{-1}' = **2 marks** (mps 1 & 3)

But 'at 0 °C the respiration is 17 mg CO_2 kg^{-1} h^{-1}' and at 20°C it is 69' = **1 mark** (mp 3)

Question			Answer	Mark	Guidance
2	(a)	(ii)	**1** *best conditions are* low(er) temperatures because respiration rate low **;** **2** 0 °C / freezing **,** could be / is **,** best **;** **3** *idea that* 0 °C might be too low as (the food cells) might be damaged at 0 °C **;** **4** *idea that* for some (named) food(s) (storage) temperature doesn't seem to matter **;** **5** *idea that* data is incomplete for **,** potato / parsnip **,** so **,** only limited / no **,** conclusions can be made **;** **6** *idea that* if product needs to ripen during storage then a higher temperature (not above 20 °C) will be ideal **;**	2 max	**1** 5 °C or below **IGNORE** statements that simply describe a trend **3** **ACCEPT** ref to freezing instead of 0 °C **4** **NOT** asparagus, blackberry or cauliflower **6** **IGNORE** ref to ethene **Note:** '0 °C is best as the respiration rate is low' = **2 marks** (mps 1 & 2)
2	(a)	(iii)	**1** onion **;** **2** has low(est) respiration rate **;** **3** across all temperatures (in the investigation / up to 20 °C) **or** temperature has **,** the least / little **,** effect on respiration rate **;** **4** can be **,** stored / kept **,** at **,** higher temperatures / room temperature / at 20 °C **;**	3	**1** **DO NOT CREDIT** if an additional suggestion is made **3** **DO NOT CREDIT** 'temperature has **no** effect on respiration rate' **4** **CREDIT** *idea that* no need to store in fridge

Question			Answer	Mark	Guidance
2	(a)	(iv)	asparagus **and** has a high respiration rate across all temperatures / has the highest respiration rate (of the foods) **;**	1	**Both parts of the mark point required for the mark to be awarded** **DO NOT CREDIT** 'asparagus' without a supporting reason **ACCEPT** 'has a high respiration rate even at low temperature(s)'
2	(b)	(i)	**1** *idea that* parasites have little access to oxygen **;** **2** (inaccessible because) little oxygen dissolved in plasma / oxygen not very soluble (in plasma) **;** **3** (inaccessible because) *idea that* oxygen is **,** combined with haemoglobin / contained in red blood cells **;** 4 *idea that* haemoglobin has greater affinity for oxygen than parasite (pigment) **;**	2 max	**1** **DO NOT CREDIT 'no** oxygen accessible' clearly stated **DO NOT CREDIT** in the context of **,** the mammal respiring anaerobically / deoxygenated blood / temporary lack of oxygen **3** **ACCEPT** in context of saturation **Note:** 'because the oxygen is bound to haemoglobin, the parasite is unable to use it' = **2 marks** (mps 3 & 1)

Question			Answer	Mark	Guidance
2	(b)	(ii)	*in animals* **A1** **pyruvate** is **,** converted / reduced , to **,** **lactate** / lactic acid **;** **A2** can be reversed as no **,** atoms lost / other product formed **;** **A3** **lactate dehydrogenase** available to reverse the reaction **;** *in yeast* **Y1** pyruvate converted to **ethanol** (in 2 steps) **and** **carbon dioxide** / CO_2 **;** **Y2** cannot be reversed as **,** carbon dioxide is / atoms are **,** lost **;** **Y3** (de)**carboxylase** enzyme cannot reverse the reaction **;**	3 max	**Only award 3 content marks if A mark(s) plus Y mark(s) awarded** **A1** **Cannot be inferred** from awarding of **A2 or A3** **A2** e.g. pyruvate and lactate are both 3C compounds so reaction can be reversed **Y1** **CREDIT** pyruvate decarboxylated to ethanol **Y2** e.g. pyruvate is 3C and **,** ethanol / ethanal **,** is 2C so reaction cannot be reversed
			QWC – technical terms used appropriately and spelled correctly **;**	1	Use of **three** terms from: **pyruvate**, **lactate**, **lactate dehydrogenase** **carbon dioxide**, **ethanol** **(de)carboxylase / (de)carboxylation** (or derived term) **Please insert a QWC symbol next to the pencil icon, followed by** **a tick (✓) if QWC has been awarded** **or a cross (×) if QWC has not been awarded** **You should use the green dot to identify the QWC terms that you are crediting.**
			Total	**14**	

Question			Answer	Marks	Guidance
3	(a)	(i)	cytoplasm (of cell) **;**	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** cytosol
3	(a)	(ii)	**1** **phosphorylation** of **glucose** **;** **2** so forming **hexose** (1,6) **bisphosphate** **;** **3** (then) splitting into / formation of **,** two / 2 **, triose phosphate**(s) / TP **;** **4** (for formation of pyruvate) **dehydrogenation** / **oxidation** / formation of reduced NAD **;** **5** **yruvate** produced (from **,** TP / (3C) intermediate) **;** **6** total production 4 ATP / net production of 2 ATP **;**	3 max	**Marks can be awarded from a diagram** **1** **DO NOT CREDIT** substrate level phosphorylation **2** **IGNORE** glucose-6-phosphate / fructose-6-phosphate **CREDIT** fructose(-1,6-)bisphosphate **ACCEPT** hexose biphosphate **DO NOT CREDIT** hexose diphosphate **3** **IGNORE** hydrolysis **DO NOT CREDIT** if ATP or NAD or red NAD involved in conversion of hexose bisphosphate to TP **4** **ACC PT** formation of **,** $NADH_2$ / NADH ($+H^+$) / red NAD **DO NOT CREDIT** $NADPH_2$ / NADPH ($+H^+$) **DO NOT CREDIT** hydrogen ion without electron / H_2 **6** Needs to be a clear statement
			QWC – technical terms used appropriately **and** spelled correctly **;**	1	Use of **three** terms (including from a flow chart) from: **phosphorylation** (or derived term) **glucose** **hexose** (1,6) **bisphosphate** **triose phosphate** **dehydrogenation OR oxidation** (or derived terms) **pyruvate** **Please insert a QWC symbol next to the pencil icon, followed by** **a tick (✓) if QWC has been awarded** **or a cross (×) if QWC has not been awarded** **You should use the green dot to identify the QWC terms that you are crediting.**

Question			Answer	Marks	Guidance
3	(b)		**W** ethanal **;** **X** carbon dioxide / CO_2 **;** **Y** reduced NAD **;** **Z** $NAD^{(+)}$ **;**	4	**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** **W** Correct spelling only **DO NOT CREDIT** ethanol **X** **DO NOT CREDIT** CO^2 / CO **Y** **ACC PT** $NADH_2$ / $NADH^{(+)}$ $(+H^+)$ / red NAD **DO NOT CREDIT** $NADPH_2$ / $NADPH^{(+)}$ $(+H^+)$ / red NADP **Z** **DO NOT CREDIT** NADP
3	(c)	(i)	**1** / alkaline **,** produced less alcohol (than the control) at all times **;** **2** **V** / *Vateria* **,** produced less alcohol (than the control) **,** at 30 **and** 45 **and** 60 hours / from 30 hours / after 15 hours **or** **V** / *Vateria* had the same alcohol as the control at 15 hours **;** **3** **C** / *Careya* **,** produced less alcohol (than the control) at 30 **and** 45 hours **or** **C** / *Careya* **,** produced more alcohol (than the control) at 15 **and** 60 hours **;**	2	**CREDIT ora** for all mark points **ora** e.g. control always produced more alcohol than **A**

Question			Answer	Marks	Guidance
3	(c)	(ii)	*at 60 hours* **V** has fewer yeast cells (which would ferment the sugar) **or** **C** has more yeast cells **;** only a small number of bacteria in **V** are **,** fermenting the sugar / producing alcohol **or** the **,** type / species **,** of bacteria in **V** are not **,** fermenting the sugar / producing alcohol **or** most / all / type of **,** bacteria in **C** are **,** fermenting the sugar / producing alcohol **;**	**1**	**IGNORE** ref to a compound inhibiting production of alcohol in **V** **Must be clear statements, not implied by the use of figs** **IGNORE** '**V** has fewer bacteria' without ref to fermentation **IGNORE** '**C** has more bacteria' without ref to fermentation
3	(c)	(iii)	**A** / (weak) alkaline (solution) **;** (**A** has the least contamination as) it has very few bacteria **<u>and</u>** little alcohol **;**	**2**	 **ONLY CREDIT** in context of treatment **A**
			Total	**14**	

Question			Answer	Marks	Guidance
4	(a)	(i)	*product* urea **;** *organ transported to* kidney **;**	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** bladder
4	(a)	(ii)	**1** hepatocytes can tolerate **,** lactate / low pH (which would otherwise be toxic) **;** **2** hepatocytes have / (other) cells do not have **,** enzymes to **,** metabolise lactate / catalyse this reaction **;** **3** (conversion of lactate) requires oxygen and **,** muscle cells do not have enough oxygen / O_2 is not available during anaerobic respiration / O_2 is sufficient in hepatocytes **;**	1 max	**2** **ACCEPT** ref to hepatocytes having the **,** correct / necessary **,** enzyme(s)

Question			Answer	Mark	Guidance
4	(b)		**1** blood glucose (concentration) would fall **,** too low / below normal level **;** **2** *idea that* glucose would continue to be taken up by **,** cells / liver / muscle (results in low blood glucose) **or** *idea that* glucose is continually converted into glycogen / would store too much glucose as glycogen **;** **3** (mitochondria eventually) cannot **,** release enough energy / generate enough ATP (as less available glucose in blood) **;** **4** coma / death **;** **5** AVP **;**	**2 max**	**1** **CREDIT** causes <u>hypoglyc</u>aemia **2** Needs to convey the idea of ***continued / too much*** uptake rather than 'more'. **IGNORE** 'glucose taken up by cells' / 'glucose converted to glycogen' unless suitably qualified **ACCEPT** 'too much glucose is taken up by cells' **3** **CREDIT** ref to use of alternative respiratory substrate **4** **IGNORE** fatigue / tiredness / fainting **5** e.g. ● receptor (on hepatocyte) becomes desensitised ● triggering of glucagon release

Question			Answer	Mark	Guidance
4	(c)	(i)	**1** build-up of lactate / prevention of pathway S **,** poisons / kills **,** (liver) cells **;** **2** disruption of enzymes as a result of low pH **;** **3** *idea that* lack of substrate / fatty acids not available **,** for respiration **;** **4** lack of (oxidised) NAD for (metabolic) reactions **;** **5** (some) deamination / ornithine cycle / pathway P / breakdown of (named) hormones / pathway R **,** cannot occur **;** **6** build-up of fatty acids / more fatty acids present **,** resulting in **,** fat deposits in (liver) cells / fatty liver / cirrhosis **;**	**2 max**	**1** **IGNORE** ref to ethanal **2** **IGNORE** 'affects enzymes' without qualification **4** e.g. ● 'less NAD is available for oxidation of fatty acids' ● 'lack of NAD for respiration' when referring to conversion of lactate to pyruvate the emphasis must be on the lack of available NAD to accept hydrogen from the lactate (and so inhibiting the conversion of lactate to pyruvate) **6** **IGNORE** 'fatty acids build up in liver' without qualification **IGNORE** repetition of bulleted statements without ref to build up **IGNORE** ref to fat deposited around the liver
4	(c)	(ii)	crista(e) / inner mitochondrial membrane **;**	**1**	**Mark the first answer.** if the answer if correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** (at) electron transport chain **DO NOT CREDIT** inter mitochondrial membrane
			Total	**8**	