Answers to examination-style questions

Answers			Marks	Examiner's tips
1	a)	matrix	1	
	b)	pyruvate; ADP; P / inorganic phosphate; reduced NAD (from glycolysis); oxygen	2 max.	The list could be significantly improved by including other substances used in aerobic respiration such as fatty acids.
	c)	oxidation of / removal of electrons/ removal of hydrogen from pyruvater / 6 or 5 carbon compound; production of reduced NAD / FAD; in matrix of mitochondria; electrons passed to electron transport chain / used in oxidative phosphorylation / description of electron transfer; on cristae / inner membrane; linked to ATP production; ATPase / stalked particles involved; electrons lose energy as passed along chain / electron carriers arranged in order of decreasing energy levels; substrate level production of ATP	7	This answer requires a description of the oxidative reactions which occur in Krebs cycle and an explanation of how ATP is produced via the electron transport chain. ATP is also produced via substrate level phosphorylation.
2	a)	X = carbon dioxide; Y = acetyl coenzyme A; Z = water	3	
	b)	i) cytoplasm	1	
		ii) mitochondrion	1	
	c)	i) between glucose and triose phosphate	1	
		ii) between triose phosphate and pyruvate; in Krebs cycle; from electron carriers	2 max.	During glycolysis, ATP is produced via substrate level phosphorylation. In Krebs cycle a small amount is produced by this method but most is generated by the electron transport system.

Answers			Marks	Examiner's tips
d)		forms lactate; use of reduced NAD / NADH; regenerates NAD; NAD can be re-used to oxidise more respiratory substrate / correct e.g. / allows glycolysis to continue; can still release energy / form ATP when oxygen in short supply / when no oxygen	4 max.	Reduced NAD is oxidised during anaerobic respiration to NAD. This NAD can subsequently be used in glycolysis.
3 a)	**i)**	glycolysis	1	
	ii)	reduced NAD is oxidised / donates hydrogen / donates electrons to pyruvate	2	Reduction involves the gain of electrons or hydrogen.
	iii)	allows NAD to be recycled / re-formed; so that glycolysis / described / candidates answer to (i) can proceed / so that (more) glucose can be converted to pyruvate / so that process X can continue	2	The oxidation of reduced NAD during this reaction is important as without NAD being continually recycled, glycolysis would eventually stop.
b)	**i)**	ATP formed / used; pyruvate formed / reduced; NAD / reduced NAD; glycolysis involved / two-stage process	2 max.	Remember that glycolysis is the first part of both aerobic and anaerobic respiration.
	ii)	ethanol / alcohol formed by yeast, lactate by muscle cell; CO_2 released by yeast but not by muscle cell	2	Need both parts of the comparison for the mark. A common error is to state that anaerobic respiration in muscles produces carbon dioxide.
c)	**i)**	allows anomalies to be identified / increases reliability (of means / averages / results); allows use of statistical test	2	
	ii)	$\frac{38.3 + 27.6 + 29.4}{3} = 31.8$ (or 31.76 or 31.77); $31.76 \div (5 \times 60) = 0.106$ (or 0.11 or 0.1)	2	Units not required. Correct answer scores two marks, however derived. Correct mean volume (31.8 cm^3) however derived scores 1 mark.
3 a)	**iii)**	volume(s) less / no gas evolved; aerobic respiration of glucose; so volume CO_2 evolved = volume of O_2 taken in	3	

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Answers	Marks	Examiner's tips
4 a)	2	One mark for each column fully correct. NAD is used in respiration. NADP is used in photosynthesis.

Statement	Glycolysis	Krebs cycle
NAD is reduced	✓	✓
NADP is reduced	×	×
ATP is produced	✓	✓
ATP is required	✓	×

b) i)	pyruvate / succinate / any suitable Krebs cycle substrate	1	A common error is to suggest glucose as a substrate. Mitochondria can only use glucose after it has been broken down to pyruvate.
ii)	ADP and phosphate forms ATP; oxygen used to form water / as the terminal acceptor	2	Remember it is the presence of oxygen as the terminal acceptor that enables the electron transport chain to generate ATP.
iii)	Y X W Z; order of carriers linked to sequence of reduction / reduced carriers cannot pass on electrons when inhibited	2	Look at the order in which the carriers are reduced to determine the sequence of carriers.
5 a)	6, 3 and 2 (glycolysis and link reaction); 6, 5 and 4 (Krebs cycle from right clockwise)	2	You should know that glucose has 6 carbons, triose phosphate has 3 carbons and that acetyl coenzyme A is effectively a 2-carbon compound in terms of the acetyl group.
b)	reduced NAD / NADH / $NADH_2$; reduced FAD / FADH / $FADH_2$; ATP	3	NAD and FAD are reduced as they accept hydrogen atoms removed during oxidation reactions in the Krebs cycle. ATP is generated by the electron transport chain and by substrate-level phosphorylation.