Question			Expected Answer	Mark	Additional Guidance
1	(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**
			X adenine **;**		***X*** **IGNORE** nitrogenous base / base / A **DO NOT CREDIT** adenosine
			Y ribose **;**		***Y*** **IGNORE** pentose / sugar **DO NOT CREDIT** ribulose / hexose
			Z (tri / 3) phosphate(s) **;**	**3**	***Z*** **IGNORE** chemical formulae (as Q asks for name) **DO NOT CREDIT** phosphorus / phosphoryl (PO)

Question				Expected Answer	Mark	Additional Guidance
1	(a)	(ii)	1	transfers energy / energy 'currency' / releases energy / universal energy molecule / energy intermediate / (immediate) source of energy ;		*1* **IGNORE** contains energy **DO NOT CREDIT** produce energy
			2	phosphate(s) can be removed by <u>hydrolysis</u> ;		*2* $ATP \rightarrow ADP + P_{(i)}$ by <u>hydrolysis</u> **or** $ATP + H_2O \rightarrow ADP + P_{(i)}$ (must include water)
			3	to , release / provide , 30<u>kJ</u> (mol^{-1}) energy ;		*3* **ACCEPT** 28 – 32 <u>kJ</u> **DO NOT CREDIT** produce energy
			4	(energy released for) metabolism / appropriate named reaction / appropriate reaction described ;		*4* e.g. • muscle contraction • active transport • phosphorylation • glycolysis • during movement binding to proteins to change their shape **IGNORE** respiration / photosynthesis unqualified
			5	ADP can attach a phosphate (forming ATP) during , respiration / photosynthesis ;		*5* **CREDIT** during, oxidative phosphorylation / chemiosmosis / substrate level phosphorylation / photophosphorylation
			6	energy released in , small 'packets' (to prevent cell damage) / suitable quantity ;		**NOTE** **'it releases 30kJ of energy when a phosphate is removed by hydrolysis'** = 3 marks (mps 3, 1 and 2)
					3 max	

Question			Expected Answer		Mark	Additional Guidance
1	(b)	(i)	crista **;**		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** 'cristae' / **'**inner mitochondrial membrane' **IGNORE** 'stalked particles'
1	(b)	(ii)	chemiosmosis / 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** **IGNORE** description of chemiosmosis [e.g. • 'ATP synthesis' • 'electron flow along electron carriers'] **IGNORE** **'**aerobic respiration' **IGNORE** 'electron transport chain' alone (as this is not a process)
1	(c)	(i)	**1**	<u>substrate</u> respired changes over time **;**	3 max	***1*** Needs to be a clear statement and not just names and not inferred from candidate's complete answer
			2	initially respires (mostly) **,** glucose / carbohydrate **;**		***2*** **IGNORE** respiring protein
			3	lower / decrease in / 0.75 **,** RQ indicates (more) **,** fat / lipid **,** as substrate ***or*** as time goes by (more) lipid is respired **;**		***3*** **IGNORE** respiring protein
			4	glucose / carbohydrate **,** used up / decreases (over time) **;**		
			5	protein not likely to be used as substrate / protein only used as a last resort **;**		***5*** 'Less protein respired' isn't quite enough for this mp

Question			Expected Answer	Mark	Additional Guidance
1	(c)	(ii)	***This is a QWC question***		**Only CREDIT** answers that refer to **preventing a decrease** in body temperature – no **ora** **IGNORE** negative feedback (Q only about preventing decrease)
			1 **peripheral** / skin **,** **thermoreceptor**s / (heat) receptors **,** stimulated (by decrease in external temp) **;** **2** (impulses sent to / blood temperature monitored in) **hypothalamus** / sensory **cortex** **;** **3** **vasoconstrict**ion of **,** arterioles / small arteries **,** to reduce heat loss **;** **4** (prevents heat loss by) **radiat**ion / **conduct**ion / **convect**ion **;** **5** increased **,** **metabolic rate** / **metaboli**sm / respiration **,** to generate heat (energy) **;** **6** (release of) **adrenaline** / **thyroxine** **;** **7** shivering / (involuntary) muscle spasms **,** to generate heat (energy) **;** **8** **erector** / hair **,** muscles raise **,** (skin) hair / fur **,** to trap **,** air / heat **;** **9** AVP **;**	**4 max**	***3*** **ACCEPT** **'**pre-capillary sphincter' instead of 'arterioles' **DO NOT CREDIT** other blood vessels **but allow QWC** ***5*** Emphasis needs to be on increase / higher rate / more ***7*** Needs the idea of generating heat not just 'to keep warm ' ***9*** e.g. • specific behavioural response (such as huddling / increased exercise / move to find sun) • involvement of sympathetic nervous system • reduce sweating / reduce panting / stop panting **DO NOT CREDIT** 'stop sweating'
			QWC - technical terms used appropriately and spelt correctly **;**	**1**	Use of **three** terms from: **peripheral,** **thermoreceptor(s),** **hypothalamus,** **cortex,** **vasoconstrict**ion**,** **metabolic rate / metaboli**sm**,** **adrenaline,** **thyroxine,** **erector** **radiat**ion **/ conduct**ion **/ convect**ion **Please insert a QWC symbol next to the mark total bracket, 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	**[16]**	

Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)	vein / venule **;**	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** **IGNORE** further qualification (e.g. central / hepatic) **but** **DO NOT CREDIT** inappropriate name (e.g. renal vein / hepatic portal vein)
2	(a)	(ii)	hepatocyte(s) / hepatic cells **;**	1	**IGNORE** 'liver cells' (as given in Q) and 'sinusoid cells' A list must include 'hepatocytes' or 'hepatic cells' and not include an incorrect cell e.g. hepatocytes and Kupffer cells = 1 hepatocytes and α cells = 0 liver cells and Kupffer cells = 0
2	(b)		<u>deamination</u> **;** carbon dioxide / CO_2 **;** urea / $CO(NH_2)_2$ **;** water / H_2O **;**	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** If a formula is given for compounds D, E and F then the formula given must be correct in order to be awarded the mark e.g. **E** 'urea ($CONH_2$)' = 0 as the formula is incorrect

Question			Expected Answer	Mark	Additional Guidance
2	(c)	(i)	***This is a QWC question***		**Max 2 (instead of 3) for content if use the term , receptor / antigen / enzyme , *throughout* instead of antibody**
			1 (testing for) **human chorionic gonadotrophin** / hCG **;**		***1*** **ACCEPT** HCG This mark can be awarded for hCG but the name must be given in full for QWC
			2 hormone small so can pass from blood into **filtrate** (at Bowman's capsule) **;**		
			3 **monoclonal** / **immobilised , antibodies** / immunoglobulin **,** on stick **;**		***3*** **ALLOW** 'strip' instead of stick
			4 antibodies attached to **,** marker / dye **;**		
			5 hormone **,** binds / **complementary ,** to antibody **;**		***5*** **IGNORE** specificity
			6 (triggers) appearance of colour / line becomes visible **;**		
			7 AVP **;**	**3 max**	***7*** e.g. • reference to the second line to validate test • different antibody for second line • 2 coloured lines = pregnant
			QWC - technical terms used appropriately and spelt correctly **;**	**1**	Use of **three** terms from: **human chorionic gonadotrophin, filtrate, monoclonal, immobilised, antibody(ies), complementary**

Question			Expected Answer		Mark	Additional Guidance
2	(c)	(ii)				**IGNORE** enhances performance (as given in Q)
			1	fairness / giving unfair advantage / does not give an 'even playing field' **;**		***1*** **ACCEPT** comment about cheating **IGNORE** idea of should be available to all
			2	*idea of* health risks / dangerous / unhealthy / fatal / side effects **;**		***2*** **IGNORE** 'has an effect on health' as must imply negative effect
			3	specified health risk **;**		***3*** e.g. • depression • aggression • liver **,** damage / failure • heart attack • masculinisation of female athletes • feminisation of male athletes • infertility
			4	*idea of* distrust of 'outstanding' performances / does not reflect athlete's natural talent / sport should reflect athlete's natural talent **;**		
			5	*idea of* pressure to keep up with rival competitors **;**		
			6	*idea that* can train for longer (without tiring) / can respire longer (without tiring) / can recover from injury quicker / can build up muscle mass **;**		
			7	AVP **;**	**3 max**	***7*** e.g. • up to the individual to decide • idea that athletes should be role models
				Total	**[13]**	

Question			Expected Answer		Mark	Additional Guidance
3	(a)	(i)	**Credit in either order** ATP **;** reduced NADP / NADPH / NADPH$_2$ / NADPH + H$^+$ **;**		**2**	**Mark the first two answers.** If either of the answers is correct and an additional answer (i.e. 3rd etc) is given that is incorrect or contradicts the correct answer then -1 for each additional incorrect answer **DO NOT CREDIT** reduced NAD / NADH / NADH$_2$ / NADH + H$^+$ **DO NOT CREDIT** oxygen / O_2 (as not used in Calvin cycle) e.g. ATP (✓) and NADPH (✓) and GP (-1) = 1 NADH (×) and ATP (✓) and oxygen (-1) = 0 GP (×) and H_2O (×) and ATP and NADPH = 0 ATP (✓) and NADPH (✓) and GP (-1) and H_2O (-1) = 0
3	(a)	(ii)	**1** **2** **3** **4** **5**	regenerates / produces **,** ribulose bisphosphate / RuBP **;** so cycle can continue / for (further) CO_2 fixation / to combine with CO_2 **;** formation of (named) **,** sugar / glucose / hexose / sucrose / starch / cellulose **;** formation of (named) **,** fat / triglyceride / lipid / fatty acids / glycerol / amino acids / protein / nucleic acids / nucleotides **;** 10x TP for RuBP and 2x TP for production **or** most TP used to produce RuBP and the rest for production **;**	**3 max**	***3*** **IGNORE** carbohydrate without qualification **but CREDIT** suitably named carbohydrate ***5*** Needs to refer to both **CREDIT** 5/6 regenerated and the rest for production

Question			Expected Answer		Mark	Additional Guidance
3	(b)	(i)	oxygen used and carbon dioxide **,** produced / excreted **;** (only) occurs in the light / light (energy) required **or** uses **,** (same) photosynthetic enzyme / Rubisco **or** involves Calvin cycle **;**		**2**	**DO NOT CREDIT** comments that categorically state 'it **is** respiration' **CREDIT** **'**sun' instead of 'light' **IGNORE** ref to light dependent stage [S & C x 2]
3	(b)	(ii)	**1**	reduces (rate of) photosynthesis / increases (rate of) photorespiration **;**	**3 max**	
			2	less Rubisco available for CO_2 / more oxygen competing with CO_2 for Rubisco / more O_2 binding to Rubisco / O_2 outcompetes CO_2 for Rubisco **;**		***2*** **ACCEPT** oxygen blocks active site of Rubisco **CREDIT** 'enzyme' instead of 'Rubisco' Needs to convey the idea that oxygen more successful / more oxygenase activity Be careful not to credit RuBP
			3	less CO_2 **,** fixation / for Calvin cycle **;**		
			4	CO_2 given off **;**		
			5	less **,** glycerate 3-phosphate / GP / TP **,** produced **;**		***5 & 6*** **IGNORE** number before name unless used to indicate more or less (compare flow charts) [S & C x 3]
			6	less RuBP **,** regenerated / formed **;**		

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(iii)	*idea that* oxygen **,** not a substrate for / cannot bind to / will not compete for **,** PEP carboxylase **or** PEP carboxylase **,** is only specific to carbon dioxide **;**	**1**	**ACCEPT** PEP carboxylase cannot 'fix' oxygen [S & C x 1]
			Total	**[11]**	

Question			Expected Answer		Mark	Additional Guidance
4	(a)	(i)	starch contains (only) glucose **and** sucrose contains **,** 50% glucose ***or*** glucose and fructose **;** by <u>hydrolysis</u> **,** starch releases more glucose / sucrose releases less glucose **;**		**2**	
4	(a)	(ii)	both starch and cellulose are (only) made of glucose **;** starch **,** is digestible / can be broken down **and** cellulose **,** is indigestible / cannot be broken down **;** (named) enzyme present for starch digestion / no (named) enzyme present for cellulose digestion **;**		**2 max**	
4	(b)		**1**	low / decrease **,** starch **;**	**3 max**	***1*** **ACCEPT** 'no starch' ***2*** 'substantial' or 'high' or 'big' is not quite enough ***3*** **IGNORE** the idea that **,** fat / protein **,** increases insulin and could indirectly lower blood glucose (as this is not relevant to Type 2 diabetes) **DO NOT CREDIT** little effect / less effect (as table shows **<u>no</u>** effect)
			2	as starch has the <u>greatest</u> effect on blood glucose conc. **;**		
			3	increase / include **,** cellulose / fibre / roughage / fat / protein / meat **,** as no effect on blood glucose **;**		
			4	some / medium amount of **,** sugars / sucrose / lactose **;**		
			5	*idea of* limiting **,** sucrose / lactose / fat / protein **,** as causes an increase in insulin **<u>and</u>** will make cells less responsive (to insulin) **;**		

Question			Expected Answer			Mark	Additional Guidance
4	(c)			glycogen	glucagon	3	**Award one mark per row**
			type of compound	carbohydrate **OR** polysaccharide	hormone **OR** polypeptide **OR** protein ;		*both glycogen and glucagon* **IGNORE** polymer or macromolecule unless qualified *glycogen* **DO NOT CREDIT** complex sugar / sugar
			role of compound	storage **OR** to provide glucose (when blood glucose conc. falls) **OR** can undergo glycogenolysis	binds to cell receptor **OR** causes conversion of glycogen to glucose **OR** stimulates glycogenolysis **OR** increases (blood) glucose concentration ;		*both glycogen and glucagon* Look for ***qualification*** of glycogenolysis
			site of production	liver **OR** hepatocytes	pancreas **OR** islets of Langerhans **OR** alpha / α **,** cells ;		*glycogen* **ACCEPT** muscle / brain *glucagon* **ACCEPT** 'a cells' **IGNORE** pancrease **DO NOT CREDIT** beta / β **,** cells
					Total	**[10]**	

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	**E ;**	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**
5	(a)	(ii)	**A** and **F ;**	1	**Mark the first <u>two</u> answers for <u>one</u> mark.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
5	(a)	(iii)	**D ;**	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**
5	(a)	(iv)	**B ;**	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**
5	(b)	(i)	**B ;**	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**
5	(b)	(ii)	channel / receptor / ion **,** is different **;** AVP **;**	1 max	**IGNORE** has enzyme to break it down (as Q states that it is stored in body) **DO NOT CREDIT** ref to active site e.g. • *idea that* toxin confined to **,** organelle / organ / part of the body • toxin not **,** in general circulation / (circulated) in blood • toxin stored in inactive form • contains a compound that neutralises toxin [S & C x 1]

Question			Expected Answer		Mark	Additional Guidance
5	(c)	(i)	**1**	attacked by the body's (own) immune system **;**	**2 max**	***1*** Named parts of the immune system are credited in mp 3 – not in this mp
			2	(immune system) mistakes / treats / recognises **,** body cells / neurones / myelin **,** as **,** 'foreign' / non self **;**		
			3	correct ref. to **,** antibodies / (named) phagocytes / (named) B lymphocytes / (named) T lymphocytes **;**		
5	(c)	(ii)	**1**	(damage to) myelin / sheath / Schwann cell(s) **;**	**2 max**	***1*** **IGNORE** damaged neurone (as given in Q) **IGNORE** damaged axon
			2	removes / has less **,** insulation **;**		
			3	interferes with / slows / stops **,** conduction of **,** (nerve) impulse / action potential **or** slows / stops / prevents **,** saltatory conduction / described **;**		***3*** e.g. • more gaps where depolarisation needs to take place • shorter local **,** circuits / currents
			4	occurs **,** in sensory neurones / towards brain / towards CNS / from sensory organ / from receptor **;**		
				Total	**[10]**	

[END]