Question			Answer	Marks	Guidance
1	(a)	(i)	(thermoregulatory centre in) hypothalamus **;**	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** hyperthalamus
1	(a)	(ii)	thermoreceptor / peripheral temperature receptor **;**	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** 'heat' / 'sensory cell'
1	(a)	(iii)	negative feedback / thermoregulation **;**	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** homeostasis
1	(b)	(i)	**M and N and P ;**	1	If the answer is correct and an additional letter is given that is incorrect then = **0 marks** **All 3** correct letters required for one mark **IGNORE J**
1	(b)	(ii)	**K and O ;**	1	If the answer is correct and an additional letter is given then = **0 marks** **Both** correct letters required for one mark
1	(b)	(iii)	**L ;**	1	**Mark the first answer.** If the answer is correct and an additional letter is given that is incorrect then = **0 marks** **ACCEPT J**

Question			Answer	Marks	Guidance
1	(b)	(iv)	**N ;**	1	**Mark the first answer.** If the answer is correct and an additional letter is given then = **0 marks**
1	(c)	(i)	**Look for ref to , heat loss / cooling , at any point in the answer before awarding any marks** large surface area (to lose heat) **;** (thin) so **,** blood flows / (named) blood vessel are **,** close to the (skin) surface (to lose heat) **;** (movement) increases air movement over **,** skin / surface (to lose heat) **;**	2 max	**DO NOT CREDIT** evaporation of heat **IGNORE** ref to sweating **ACCEPT** SA:Vol
1	(c)	(ii)	**Needs to be in the context of reducing heat loss from the blood** blood loses less heat because **,** less <u>blood</u> flows to feet / warm <u>blood</u> diverted from arterioles to veins **or** less <u>blood</u> flows to feet so core body temperature maintained **;**	1	**DO NOT CREDIT** prevents / stops **,** blood flowing to feet **ACCEPT** 'extremities' for 'feet' **IGNORE** ref to vasoconstriction of peripheral arterioles **DO NOT CREDIT** vasoconstriction of shunt vessels **IGNORE** ref to countercurrent (as not answering Q)
			Total	10	

Question			Answer	Mark	Guidance
2	(a)	(i)	mitosis ;	1	**CREDIT** correct spelling only **ACCEPT** binary fission
		(ii)	in the grex / 3 ;	1	
	(b)	(i)	cell signalling ;	1	
		(ii)	1 attraction of cell(s) to folic acid from bacteria ; 2 attraction of cells to each other by cAMP ; 3 coordinated movement in grex ; 4 differentiation / described, of (grex / slime mould) cells in response to DIF ;	2 max	**NOTE** must name the chemical involved for description (except mp 3 coordinated movement) **ACCEPT** attraction of cells to bacteria by folic acid **IGNORE** makes cells stick together
		(iii)	contains , receptors / glycoproteins / glycolipids / glycocalyx ; for , folic acid / cAMP / DIF ;	2	**DO NOT CREDIT** *consists* of receptors
	(c)		17 (hours) ;	1	
			Total	**8**	

Question			Answer	Marks	Guidance
3	(a)	(	**1** *idea of* maintaining (relatively) stable internal **,** environment / state **;** **2** within (narrow) limits / within (narrow) range / about a set point **;** **3** even though environment is changing **;**	**2 max**	**1** Need the idea of 'constant' or 'steady' **and** 'regulation' or 'keeping' **and** in the body **2 ACCEPT** about the 'norm' **IGNORE** ref to negative feedback (as mechanism rather than definition) / optimum conditions **CREDIT** mps 2 & 3 (only) if response is in terms of example(s) e.g. temperature / blood glucose ***Note*** 'maintaining a stable body temperature' = 0 'keeping your body temperature at 37^{o}C' = 1 (mp 2) 'even though it is getting cold' = 1 (mp 3)

Question			answer	Marks	Guidance
3	(a)	(i	1 β cells / α cells / **receptors** , detect , change / increased / decreased , in blood glucose (concentration) ; 2 if high(er) glucose (concentration) , **beta** / β , cells (in pancreas) release **insulin** ; 3 (increased) uptake / absorption , of glucose by , liver / muscle / **effector** , cells ; 4 enters through glucose transport proteins (in cell surface membrane) ; 5 glucose converted to **glycogen** / **glycogenesis** ; 6 increased (use of glucose in) , respiration / ATP production ; 7 if low(er) glucose (concentration) , **alpha** / α , (in pancreas) cells release **glucagon** ; 8 (increased) conversion of glycogen to glucose / **glycogenolysis** ; 9 (increased) conversion of other compounds (amino acids / lipids) to glucose / **gluconeogenesis** ; 10 glucose leaves cells , by **facilitated diffusion** / through glucose channels ; 11 AVP ;	5 max	1 **CREDIT** correct ref to detection by α/a (low) or β/b (high) **IGNORE** monitor / stimulate / figures quoted 2 **CCEPT** 'produce' rather than release **DO NOT CREDIT** B cells 3 **CREDIT** increased permeability of named cell to glucose **IGNORE** 'use' / target cell 4 **CREDI** GLUT channels 5 unambiguous spelling only of glycogen and glycogenesis 6 **DO NOT CREDIT** in context of α and β cells **ACCEPT** 'increased respiration by body' 7 unambiguous spelling only of glucagon **ACCEPT** 'produce' rather than release 8 unambiguous spelling only of glycogen and glycogenolysis 9 unambiguous spelling only of gluconeogenesis 11 e.g. correct cellular detail for insulin release or in effector cells … • insulin binds to receptor on plasma membrane of hepatocytes • correct ref to secondary messenger (cAMP) e.g. ref to inhibitory effect(s) of hormone … • conversion in cells / secretion of antagonist
			QWC – technical terms used appropriately and spelt correctly ;	1	Use of **three** terms from: **receptor**, **beta**, **insulin**, **effector**, **glycogen**, **glycogenesis**, **alpha**, **glucagon**, **glycogenolysis**, **gluconeogenesis**, **facilitated diffusion** **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)	(	requires (daily) **,** insulin / hormone **,** injections **;** is not affected by dietary changes **;**	**1 max**	**ACCEPT** insulin is not being produced in sufficient quantities
3	(b)	(i	*idea that* has developed in **,** an old(er) person / middle age / a 55 year old **;**	**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** **DO NOT CREDIT** references to diet, as this was ineffective **but use NBOD icon to indicate this**
			Total	**10**	

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

Question				Expected Answer	Mark	Additional Guidance
4	(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 hydrolysis ;		*2* $ATP \rightarrow ADP + P_{(i)}$ by hydrolysis **or** $ATP + H_2O \rightarrow ADP + P_{(i)}$ (must include water)
			3	to , release / provide , 30kJ (mol^{-1}) energy ;		*3* **ACCEPT** 28 – 32 kJ **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
4	(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'
4	(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)
4	(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
4	(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 , **thermoreceptors** / (heat) receptors , stimulated (by decrease in external temp) ; **2** (impulses sent to / blood temperature monitored in) **hypothalamus** / sensory **cortex** ; **3** **vasoconstriction** of , arterioles / small arteries , to reduce heat loss ; **4** (prevents heat loss by) **radiation** / **conduction** / **convection** ; **5** increased , **metabolic rate** / **metabolism** / 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** '<u>pre</u>-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, vasoconstriction, metabolic rate / metabolism, adrenaline, thyroxine, erector radiation / conduction / convection** **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]**	