Question			Answer	Marks	Guidance
1	(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
1	(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
1	(b)	(	requires (daily) **,** insulin / hormone **,** injections **;** is not affected by dietary changes **;**	**1 max**	**ACCEPT** insulin is not being produced in sufficient quantities
1	(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
2	(a)		1 less ventilation / *Idea of* difficulty in exhaling due to less recoil / small surface area for gaseous exchange / less oxygen entering capillaries / less oxygen entering blood ; 2 less oxygen (reaching cells) for , (aerobic) respiration / oxidative phosphorylation ; 3 (so) less ATP produced ; 4 *idea of* increased acidity (as CO_2 / lactate builds up) interfering with / affects , enzymes / respiratory metabolism ;	2 max	**IGNORE** 'produces' energy in any mark point *1* **DO NOT CREDIT no** oxygen *2* **DO NOT CREDIT no** respiration *3* **DO NOT CREDIT no** ATP
2	(b)		1 not enough / less , glucose uptake into <u>cells</u> ; 2 not enough / less , glucose / substrate , for , respiration / ATP production ; 3 glucose not , stored as / converted to , glycogen ;	2 max	**ACCEPT** 'sugar' for glucose **IGNORE** (excess) glucose lost in urine (as does not answer the Q) **Only CREDIT ora** if candidate clearly states that the sequence of events does **not** happen in this case *1* **DO NOT CREDIT no** glucose uptake *2* **IGNORE** produces energy **DO NOT CREDIT no** respiration / **no** ATP / **no** glucose

Question			Expected Answer	Mark	Additional Guidance
2	(c)		1 *idea of* slow rate of / sluggish , blood flow **or** low(er) blood pressure ; 2 less / irregular amount of , oxygen (reaching cells) for , (aerobic) respiration / oxidative phosphorylation ; 3 less glucose (reaching cells) for respiration ; 4 (so) less ATP produced ; 5 *idea of* increased acidity (as CO_2 / lactate builds up) interfering with / affects , enzymes / respiratory metabolism ;	2 max	**IGNORE** 'produces' energy in any mark point *1* **IGNORE** 'heart doesn't beat strongly enough' or 'heart beat is inefficient' **IGNORE** ref to volume of blood without time/rate *2* **DO NOT CREDIT** **no** oxygen / **no** respiration *3* **IGNORE** sugar **DO NOT CREDIT** **no** glucose / **no** respiration *4* **DO NOT CREDIT** **no** ATP

Question			Expected Answer	Mark	Additional Guidance
2	(d)	(i)	1 less pyruvate for , link reaction / Krebs cycle **or** link reaction / Krebs cycle , cannot take place / reduced **or** only / mainly , glycolysis takes place ; 2 no / little , oxidative phosphorylation ; 3 less , energy / ATP , for muscle contraction / resulting in muscle weakness / for mental processes ; 4 <u>anaerobic</u> respiration takes place ; 5 lactate / decrease in pH , causing aching muscles ;	3 max	*2* **IGNORE** produces energy *3* **DO NOT CREDIT no** ATP **IGNORE** produces energy **IGNORE** muscle fatigue *5* **CREDIT** 'lactic acid' instead of 'lactate' **ACCEPT** muscle cramps
2	(d)	(ii)	1 *idea that* B lymphocytes do not respond to cytokines (that have been produced) ; 2 little , energy / ATP , for B cell , mitosis / clonal expansion ; 3 little , energy / ATP , for , production / release , of antibodies ;	1 max	
			Total	**10**	

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)	islet(s) of Langerhans ;	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** α and β cells in islets of Langerhans **DO NOT CREDIT** α cells in islets of Langerhans **DO NOT CREDIT** β cells in islets of Langerhans

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(ii)	use ✓1 *endocrine* **H1** **hormone**(s) released directly into blood ; **H2** **beta** / β , cells , secrete / produce / release , insulin ; **H3** **alpha** / α , cells , secrete / produce / release , **glucagon** ; **H4** **islet /** α and β , cells , detect / monitor , blood glucose concentration ; **3 max** use ✓2 *exocrine* **E1** fluid / juice / secretion / enzymes , released into duct ; **E2** (release triggered by) nervous / hormonal , stimulation ; **E3** **pancreatic** secretions into , gut / small intestine / **duodenum** ; **E4** alkaline / pH 8 / (sodium) hydrogen carbonate ; **E5** containing **2** named **enzyme**(s) ; **3 max**	**4 max**	**If endocrine and exocrine terms are muddled, then ignore endocrine and exocrine refs but only award max 2 for both sections and do not award the QWC mark.** ***H1*** **DO NOT CREDIT** carried / transported , in ***H2*** **ACCEPT** b cells ***H3*** **ACCEPT** a cells **DO NOT CREDIT** incorrect spelling of glucagon ***H4*** **ACCEPT** a and b cells α cells and β cells secrete glucagon and insulin = **2 marks** α cells and β cells secrete insulin and glucagon = **0 marks** ***E1*** **IGNORE** substances **DO NOT CREDIT** carried / transported , in ***E5*** **CREDIT** 2 enzymes but no more than 1 enzyme from each bullet point • lipase • **amylase** / carbohydrase • **trypsin** / **chymotrypsin** / protease / trypsinogen / chymotrypsinogen
			QWC – technical terms used appropriately with correct spelling ;	**1**	**Do not award if endocrine & exocrine are muddled.** Use of **3** terms from: **hormone**(s), **beta**, **alpha**, **glucagon**, **islet**(s), **pancreatic**, **duodenum**, **enzyme**(s), **amylase**, **trypsin**(ogen) / **chymotrypsin**(ogen) **You should use the GREEN DOT to identify the QWC terms that you are crediting.** **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**

Question			Expected Answer	Mark	Additional Guidance
3	(b)		**D A G H C F ; ; ; ;**	4	All letters in correct sequence = 4 marks If letters are **not all** in the correct sequence, then mark as follows: **D** at the beginning and **F** at the end = 1 mark **A** somewhere before **G** = 1 mark **G** somewhere before **H** = 1 mark **H** somewhere before **C** = 1 mark
3	(c)	(i)	**1** *idea of* plentiful / dependable , supply ; **2** cheap ; **3** not cruel to pigs / more ethical ; **4** no religious objections / can be used by vegetarians ; **5** reliable , quality / standard ; **6** (exact match to) human insulin / no allergic reaction ;	2	**Mark the first <u>two</u> advantages** ***1*** e.g. can meet demand / can be mass produced **IGNORE** ref to speed ***6*** **ACCEPT** ref to not spreading prions **IGNORE** spread of disease from pigs / no rejection **DO NOT CREDIT** genetically identical insulin
3	(c)	(ii)	**1** (has the potential to) cure / do more than manage , the condition ; **2** long term effect / permanent / no need for repeated treatments ;	1 max	***1*** e.g. no need to restrict diet ***2*** e.g. no need to inject insulin (regularly)
			Total	13	

Question			Expected Answers		Marks	Additional Guidance	
4	(a)	(i)	*2nd messenger* cAMP / cyclic AMP / cyclic adenosine monophosphate **;** *1st messenger* adrenaline / adrenalin **;**		**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** CAMP / camp **DO NOT CREDIT** adenine monophosphate **IGNORE** chemicals not named in Fig. 5.1	
	(a)	(ii)	**1**	glycogen ⟶ glucose / glycogenolysis **;**	**1 max**	***1***	**DO NOT CREDIT** gluconeogenesis / glycogenesis
			2	by hydrolysis **;**		***2***	This term must be used, or a derived term.
			3	*correct ref to* protein kinase / glycogen phosphorylase kinase (activates glycogen phosphorylase) ***or*** glycogen phosphorylase (stimulates conversion of glycogen) ***or*** inhibition of glycogen synthase (preventing glucose conversion to glycogen) **;**		***3***	

Question			Expected Answers		Marks	Additional Guidance
	(a)	(iii)				**IGNORE** reasons not related to adrenaline (as Q specifies 'how the adrenaline molecule can cause ...') **IGNORE** descriptions of stated effects in different tissues as Q asks *how* adrenaline causes these different effects
			1	different tissues have different (types of adrenaline) receptors **;**		***1***
			2	(causing) cAMP concentration to increase or decrease **;**		***2*** **ACCEPT** adenyl cyclase / cAMP **,** inhibited
			3	second messenger (may be) different **;**		***3***
			4	cAMP / second messenger **,** activates **,** different / other **,** enzymes / enzyme reactions (in different target cells) **;**	**2 max**	***4***

Question		Expected Answers	Marks	Additional Guidance
(b)	1	**adrenalin(e)** increases , heart rate / stroke volume / cardiac output ;		*1*
	2	**cardiovascular centre** in **medulla oblongata** ;		*2* **ACCEPT** 'cardiac' instead of cardiovascular but not for QWC
	3	*idea of* nervous connection to , SAN / **sino-atrial node** ;		*3* **ACCEPT** SAN for mp 3 but not for QWC
	4	(which) controls frequency of waves of , excitation / depolarisation ;		*4* **CREDIT** in relation to mp 2 or mp 3
	5	**vagus** / **parasympathetic** , nerve decreases heart rate ;		*5* **ONLY CREDIT** vagus ***or*** parasympathetic for QWC
	6	**accelerator** / **sympathetic** , nerve increases heart rate ;		*6* **ONLY CREDIT** accelerator ***or*** sympathetic for QWC **ACCEPT** phrenic nerve
	7	high blood pressure detected by , stretch receptors / baroreceptors ;		*7* **DO NOT CREDIT** proprioreceptor
	8	low blood pH / increased levels of blood CO_2 , detected by **chemoreceptors** ;		*8*
	9	(receptors) in , aorta / **carotid** sinus / carotid arteries ;	**4 max**	*9*
		QWC – technical terms used appropriately with correct spelling ;	**1**	Correct use of **adrenalin(e)** (**Identify using the tick 1** ✓1 AND MUST BE INCLUDED FOR QWC TO BE AWARDED) **plus** use of **2** terms from: **cardiovascular centre, medulla oblongata, sino-atrial node, vagus or parasympathetic, carotid, accelerator or sympathetic, chemoreceptor** **You should use the GREEN DOT to identify the remaining QWC terms that you are crediting.** **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**
		TOTAL	**10**	

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	starch contains (only) glucose **and** sucrose contains **,** 50% glucose ***or*** glucose and fructose **;** by hydrolysis **,** starch releases more glucose / sucrose releases less glucose **;**	**2**	
	(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**	
	(b)		**1** low / decrease **,** starch **;** **2** as starch has the greatest 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 **and** will make cells less responsive (to insulin) **;**	**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 **no** effect)

Question	Expected Answer	Mark	Additional Guidance
(c)			**Award one mark per row**

	glycogen	glucagon	
type of compound	carbohydrate **OR** polysaccharide	hormone **OR** polypeptide **OR** protein	;
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	;
site of production	liver **OR** hepatocytes	pancreas **OR** islets of Langerhans **OR** alpha / α , cells	;

Mark	Additional Guidance
	both glycogen and glucagon **IGNORE** polymer or macromolecule unless qualified *glycogen* **DO NOT CREDIT** complex sugar / sugar *both glycogen and glucagon* Look for ***qualification*** of glycogenolysis *glycogen* **ACCEPT** muscle / brain *glucagon* **ACCEPT** 'a cells' **IGNORE** pancrease **DO NOT CREDIT** beta / β , cells
3	
[10]	