Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			**Level 3 (5−6 marks)** Describes in detail the regulation of the water content of blood with reference to action of ADH **AND** role of receptors **AND** (posterior) pituitary *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3−4 marks)** Describes the regulation of the water content of blood with reference to action of ADH **AND** receptors **OR** Describes the regulation of the water content of blood with reference to receptors **AND** (posterior) pituitary **OR** Describes the regulation of the water content of blood with reference to action of ADH **AND** (posterior) pituitary *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1−2 marks)** Describes the regulation of water content of blood with reference to the action of ADH **OR** receptors **OR** (posterior) pituitary *There is an attempt at a logical structure with a line*	6	**Loss of mark for communication statement if incorrect science / terminology used** **e.g anterior pituitary rather than (posterior) pituitary / ADH secreted by adrenal gland** **OR give details of setting up a water potential gradient** **OR** **if no ref to homeostatic mechanism e.g. returning water potential of blood to normal value / ref to negative feedback** **Indicative scientific points may include:** ***Mechanism of ADH action*** • ADH targets / binds to cells of collecting duct • release of second messenger • vesicles with aquaporins fuse with plasma membrane • increase in permeability of collecting duct wall • more water moves down water potential gradient into cells ***Role of Receptors*** *Sensory receptors* • sensory receptors located in the hypothalamus • osmoreceptors • detect changes in osmotic pressure / water potential of blood • respond to effects of osmosis by shrinking or swelling *Receptors in collecting duct* • receptors located on cells of collecting duct ***(Posterior) pituitary*** • ADH made in hypothalamus

			of reasoning. The information is in the most part relevant. **0 mark** *No response or no response worthy of credit.*		• moves down axon to posterior pituitary • stored in vesicles • action potentials in neurosecretory cells • ADH released by posterior pituitary • by exocytosis • from neurosecretory cells **Examiner's Comments** There were some excellent Level 3 responses to this Level of Response question showing that many candidates had a good knowledge and understanding of the homeostatic mechanisms involved and could describe osmoregulation in detail. Responses given Level 2 most commonly did not mention the role of the (posterior) pituitary gland or gave incorrect accounts of ADH production and release. Other indicative points e.g. movement down axon to posterior pituitary, being stored in vesicles, action potentials causing release from neurosecretory cells by exocytosis, were very rarely seen. Lower level responses were seen where candidates included vague ideas of ADH acting on the collecting ducts but no relevant detail and so there were omissions or errors in their accounts. Exemplar 2  If there is low water potential in the blood it is detected by the osmoreceptors in the hypothalamus. This then causes the secretion of ADH released from the pituitary gland and it travels in the blood to the collecting duct. The ADH binds to the receptors on the collecting duct which release vesicles of aquaporins making the duct more permeable. So more water is reabsorbed into the capillaries. If the water potential in the blood is high then the osmoreceptors detect it and stop the release of ADH to ~~either~~ mean less water is reabsorbed ~~over~~ so it leaves in the urine. This is an example [1] of negative feedback as the body is responding to oppose the change it has detected This Level 3 response makes reference to the role of receptors, both osmoreceptors in the hypothalamus and receptors on the walls of collecting ducts in the nephron. They state that ADH is released from the

					pituitary gland and describe the action of ADH clearly, including a description of vesicles of aquaporins. There are no science errors, and they refer to negative feedback in their response.
			Total	**6**	
2	a	i	(endotherm) uses heat produced , within / internally , to maintain body temperature ✓	1 (AO1.1)	**ALLOW** uses heat from metabolic processes to maintain body temperature **IGNORE** control **Examiner's Comments** Most responses only included part of the definition for an endotherm with few responses mentioning 'heat'. **Assessment for learning** Definitions are an important part of the specification and candidates should be encouraged to learn these in full.
		ii	*advantage **one from:*** 1 less , food / energy , used / needed ✓ 2 more , energy / nutrients , can be used for , growth / reproduction ✓ 3 less time spent , feeding / finding food ✓ *disadvantage **one** from:* 4 metabolism slows / less active , at low(er) (environmental) temperatures ✓ 5 can be at risk from predators when body temperature is low ✓ 6 less able / unable to , hunt for / find , food when body temperature is low ✓	max 2 (AO1.1)	**MP2 IGNORE** food **MP2 ALLOW** named nutrients e.g. glucose **MP3 ALLOW** able to survive in habitats with low availability of food **MP4 ALLOW** less able / unable , to live in cold climates **MP4 ALLOW** susceptible to freezing **Examiner's Comments** Many good responses suggested that the advantage would be that they required less energy or food. Some also recognised that the organisms would have more energy for growth. Candidates who gained a mark for a disadvantage identified that ectotherms would be at a greater risk from predators when their body temperature was too low. Some candidates focused on the ectotherms' inability to control their body temperature without external sources but did not relate this, to how it can be a disadvantage.

	b		***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • **The science content determines the level.** • **The Communication Statement determines the mark within a level.** **Level 3 (5–6 marks)** A detailed discussion of **both** statements **and** uses appropriate example(s) for **both** ectotherms and endotherms to support points made.	6 (AO2.5) (AO3.1)	**Loss of mark for communication statement if incorrect science used** e.g endotherms use the mainly behaviour to control body temperature **or more than 50% irrelevant information** **Indicative scientific content** *Statement 1 points-ectotherms* • **ectotherms** control body temperature less well than endotherms • **ectotherm** temperature varies with environment • **ectotherms** can control body temperature using behaviour • **ectotherms** use mostly behavioural but some physiological • **ectotherms** can increase or reduce absorption of heat using external sources e.g. sun *Suitable examples could include…* ○ move to cooler / warmer placesl ○ basking ○ laying on (hot rocks) *Statement 2 points- endotherms* • **endotherms** use mostly physiological / metabolic methods, but some behavioural • **endotherms** generally use physiological responses to control temperature *Suitable examples could include…* ○ use of metabolic heat ○ sweating ○ vasoconstriction/vasodilation ○ hairs standing on end ○ shivering ○ large surface area for cooling e.g. elephant ears • **endotherms** can use behaviour to control body temperature. *Suitable examples could include…* ○ dormancy during periods of high (aestivation) or low temperatures (hibernation) ○ use of burrows / houses / shade

			There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. **Level 2 (3–4 marks)** A discussion of **both** statements **and** uses appropriate example(s) for **either** ectotherms **or** endotherms to support points made. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A discussion of **either** statement that uses an appropriate example(s) to support points made. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 mark** No response or no response worthy of credit.		○ methods to warm or cool burrows / houses ○ gaping/wrist licking ○ humans wear clothes dependent on weather ○ migration ○ huddling **Examiner's Comments** Overall, this was a high scoring Level of Response question. Candidates who were familiar with the differences between endotherms and ectotherms were able to achieve Level 3 and 6 marks. Examples given in support of their comments, were well-chosen and clearly described. Typical examples used were lizards basking to increase body temperature, penguins huddling when cold and elephants splashing water when hot. Some candidates confused ectotherms and endotherms in their responses.
	c	i	(increase in set point) will result in fever ✓ raised body temperatures help to , kill / prevent increase in number of , pathogens ✓ causes an increase in antibody production / faster immune response ✓ high body temperature can	max 2 (AO2.1)	**ALLOW** viruses / bacteria for pathogens **IGNORE** affects enzyme activity **Examiner's Comments** This question proved challenging. Some candidates identified that a fever would occur but other marking points were rarely included in responses. Most candidates

			result in organ , damage / failure ✓		mentioned enzyme activity and didn't make the link between increased temperature and the body's response to pathogens.
		ii	(membrane acts in) cell signalling ✓ (membrane) controls , entry / exit , to cell ✓	2 (AO1.2) (AO2.5)	**ALLOW** cell communication **ALLOW** is partially permeable / selectively permeable / acts as a barrier **Examiner's Comments** Good responses gained both marks for recognising that the functions illustrated in the question stem were those of cell signalling and control of substances into and out of the cell.
			Total	**13**	
3			B ✓	1 (AO1.1)	
			Total	**1**	
4		i	(X) (T or B) lymphocyte ✓ (Y) neutrophil ✓	2(AO2.3)	**ALLOW** T cell / B cell / T helper cell / T killer cell / T regulator cell **ALLOW** phagocyte **Examiner's Comments** Most candidates only got 1 mark for correctly naming Y as a neutrophil. The most common errors were incorrectly naming X as a macrophage or monocyte, with few candidates correctly identifying it as a lymphocyte.
		ii	flattened / biconcave (shape), to increase surface area (to volume ratio) ✓ no, nucleus / organelles, to give (more) space for haemoglobin ✓ flexible, to increase surface area in contact with capillary wall / to squeeze through capillaries ✓ small, for short diffusion pathway / to fit through capillaries ✓	2 max(AO1.1)(AO2.1)	**IGNORE** concave **ALLOW** few organelles so more haemoglobin can be in the cell **IGNORE** to give (more) space for oxygen 'cells are small and flexible to fit through capillaries' = 2 marks **Examiner's Comments** This question was generally answered well by a wide range of candidates. Common errors included omitting 'bi' from 'biconcave' and describing the lack of a nucleus as giving more space for oxygen (rather than haemoglobin). Some candidates lost marks for linking an

			transport proteins in plasma membrane, to allow chloride shift ✓ high concentrations of carbonic anhydrase (inside cells), to allow transport of carbon dioxide / described ✓		adaptation to the wrong benefit, especially biconcave with being able to fit through capillaries, rather than increasing surface area.
		iii	**FIRST CHECK ON ANSWER LINE** **If answer = 13 award 2 marks** 10 mm / 800 (= 0.0125mm) ✓ 0.0125mm × 1 000 (= 12.5μm) ✓	2(AO2.8)	**ALLOW** 12.5 for 2 marks **ALLOW** answer to more than 3 s.f. for 1 mark **ALLOW ECF** if incorrect measurement of cell W **with units** used but divided by 800 for 1 mark **or** measurement of cell W **with units** correctly converted to μm for 1 mark **ALLOW** 0.01m / 800 (= 0.0000125m) **and** 0.0000125m x 1 000 000 (= 12.5μm) **ALLOW** 1cm / 800 (= 0.00125cm) **and** 0.00125 × 10 000 = (12.5μm) **If candidate measures cell W as 9.5 mm** **ALLOW 12 /11.9 for 2 marks and 11.88/11.875 for 1 mark** **If candidate measures cell W as 10.5 mm** **ALLOW 13 /13.1 for 2 marks and 13.13 / 13.125 for 1 mark** **<u>Examiner's Comments</u>** About half of candidates gained the full 2 marks for this question. Marks were most often lost for measuring in cm then an incorrect conversion to micrometres – most multiplying by 1000 rather than 10,000. Candidates who showed working, including the measurement of the diameter with units divided by 800, could access 1 mark even if their final answer was incorrect.
			Total	**6**	
5			**B**	1 (AO2.1)	
			Total	**1**	

6			**B**	1 (AO1.2)	
			Total	**1**	