

1 (a)	(the ability to) detect / sense, changes in the environment / stimuli ; to respond / react (to those changes) ;	[2]	
(b)	(voluntary action) involves (brain in) decision making / conscious ; (voluntary action) is slower ; (voluntary action) not reflex / automatic ; (voluntary action) can be learned ; (voluntary action) can give different responses to same stimulus ;	[max 2]	
(c)	sensory (neurone) ;	[1]	
(d)	1st swimmer(s) slower (than rest) ; appropriate use of data, swimmer 1 v. 2 / 3 / 4 ; (mean) reaction times for swimmers 2 – 4 similar ; AVP ; swimmer 3 team 2 is an anomaly / outlier	[max 3]	
(e)	1 heart rate / pulse increase ; 2 increase in breathing rate / depth ; 3 heighten alertness / faster reaction time / AW ; 4 vasodilation in muscle ; 5 vasoconstriction in digestive system ; 6 diverts blood to muscles / away from digestive system ; 7 (leads to) glycogen to glucose (in liver) ; 8 increased blood glucose (concentration) ; 9 airways expand / increased ventilation ; 10 more respiration for more energy for muscle contraction ; 11 enables faster swimming / enhanced physical performance ;	[max 3]	

2	(a)	(i)	Cornea / aqueous humour / vitreous humour / conjunctiva ;	[1]	
		(ii)	retina / fovea / yellow spot / rods <u>and</u> cones ;	[1]	
	(b)	(i)	D indicating any position along the bottom line of the plot ;	[1]	R ambiguous placing on slopes near bottom line
		(ii)	<i>ciliary muscles</i> contracts ; <i>suspensory ligaments</i> slacken / less taut / loosen / AW ;	[2]	R relax
	(c)	1	cones (in context of colour vision) ; <i>and two from</i>		
		2	three different types ;		
		3	respond to, different wavelengths / red, green and blue ;		
		4	convert light into electrical impulses / signals ;		
		5	optic nerve ;		
		6	brain interprets impulses in terms of, colours / red, green and blue ;	[max 3]	R messages for impulses
				[Total:8]	

3 (a)	<p>A – controls the cell / contains DNA / contains genes ;</p> <p>B – makes protein / makes insulin / respiration / storage / contains the insulin (that will be released) ;</p> <p>C – controls movement of (named) substance(s), in / out, of cell ;</p>	[3]	<p>A contains code for insulin / controls cell development ignore just ... provides protein</p>
(b)	<p>glucose is soluble, glycogen is insoluble ; glucose in blood would, lower water potential / AW e.g. (cause) hyperglycemia ;</p> <p>water leaves cells ; by osmosis ;</p> <p>much larger quantities can be stored ; can be stored for (much) longer ;</p> <p>glucose would not be reabsorbed in the kidney ; (and would be) excreted / lost, in the urine ;</p> <p>AVP ;</p>	max [2]	<p>A affect water potential / affect blood glucose concentration / AW</p> <p>A urinated</p>
(c) (i)	<p><i>stimulates liver cells</i> to break down glycogen <u>and</u> release glucose ;</p>	[1]	<p>A glycogen → glucose <i>for breakdown</i></p>
(ii)	<p>(in the) blood / plasma / circulatory system ;</p>	[1]	<p>A via hepatic portal vein</p>
(d)	<p>oestrogen ; progesterone ; testosterone ;</p>	max [2]	

3 (e) (i)	grow faster so keep animals for shorter time ; can provide less food (for animals); better economic return ; <i>however expressed</i> less waste / described ; fewer problems with waste disposal / described / example ;	[2]	R more meat (in Q)
(ii)	cattle produce, methane / carbon dioxide (greenhouse gases) ; (if more food converted to meat), less is excreted / egested / less waste / less carbon dioxide / less methane ; if eat less food, then less emissions ; if growth rate is higher, do not to keep them for as long ; fewer cattle means that less methane is released ;	max [2]	if 'less methane' award mp1 too
(f)	health risk / hormones may have adverse effect, in humans ; any e.g. ; faster growth rate / early puberty / cancer ref to animal welfare / kill animals ; harm to animals of fast growth rates ; any likely health issue in animals ; AVP ; e.g. protect European farmers	max [2]	A ill / sickness / increased mass A men's gender effect R bacteria (that make the hormone) making cattle / humans ill
[Total:15]			

	Answers	Marks	Guidance for Examiners
4 (a)	<ol style="list-style-type: none"> 1 eye, light ; 2 ear, sound / noise ; 3 ear, gravity / acceleration / movement ; 4 tongue, taste / chemicals / flavours in food ; 5 nose, smell / chemicals in the air / odours ; 6 skin, touch / pressure ; 7 skin, temperature ; 8 skin, pain ; 	[max 3]	
(b) (i)	response / reaction , to stimulus ; occurs without having to, think / use the brain / make decision ;	[2]	I reflex A not conscious of action until it has happened
(ii)	<ol style="list-style-type: none"> 1 receptor(s) / sensory cells / nerve ending , detects heat / stimulus ; 2 (nervous / electrical) impulses ; 3 generated by (skin) receptor ; 4 travels to spinal cord along sensory neurone(s) ; 5 within spinal nerve ; 6 synapse ; 7 relay / connector / inter-, neurone ; 8 motor neurone to effector / biceps / muscle ; 9 <u>biceps</u> contracts ; 	[max 5]	R messages, signals R spinal cord
(iii)	fast ; automatic ; protective / defensive / avoid injury ; removes (part of) body from source of danger ;	[2]	
(c)	hormones / chemical messengers ; secreted into the blood / which travels in blood ; stimulate target , cells / tissues / organs ;	[max 2]	A endocrines I endocrine system
		[Total:14]	