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|---|---|---|---|---|
| 1 **(a)** | (the ability to) detect / sense, changes in the environment / stimuli **;**<br>to respond / react (to those changes) **;** | | **[2** | |
| **(b)** | (voluntary action) involves (brain in) decision making / conscious **;**<br>(voluntary action) is slower **;**<br>(voluntary action) not reflex / automatic **;**<br>(voluntary action) can be learned **;**<br>(voluntary action) can give different responses to same stimulus **;** | | **[max 2]** | |
| **(c)** | sensory (neurone) **;** | | **[1]** | |
| **(d)** | 1st swimmer(s) slower (than rest) **;**<br>appropriate use of data, swimmer 1 v. 2 / 3 / 4 **;**<br>(mean) reaction times for swimmers 2 – 4 similar **;**<br>AVP **;** swimmer 3 team 2 is an anomaly / outlier | | **[max 3]** | |
| **(e)** | **1** | heart rate / pulse increase **;** | **[max 3]** | |
| | **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 **;** | | |

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

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

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

| | Answers | | Marks | Guidance for Examiners |
|---|---|---|---|---|
| 4 (a) | **1** eye, light ;<br>**2** ear, sound / noise ;<br>**3** ear, gravity / acceleration / movement ;<br>**4** tongue, taste / chemicals / flavours in food ;<br>**5** nose, smell / chemicals in the air / odours ;<br>**6** skin, touch / pressure ;<br>**7** skin, temperature ;<br>**8** skin, pain ; | | **[max 3]** | |
| (b) (i) | response / reaction , to stimulus ;<br>occurs without having to, think / use the brain / make decision ; | | **[2]** | **I** reflex<br>**A** not conscious of action until it has happened |
| (ii) | **1** receptor(s) / sensory cells / nerve ending , detects heat / stimulus ;<br>**2** (nervous / electrical) impulses ;<br>**3** generated by (skin) receptor ;<br>**4** travels to spinal cord along sensory neurone(s) ;<br>**5** within spinal nerve ;<br>**6** synapse ;<br>**7** relay / connector / inter–, neurone ;<br>**8** motor neurone to effector / biceps / muscle ;<br>**9** <u>biceps</u> contracts ; | | **[max 5]** | **R** messages, signals<br><br>**R** spinal cord |
| (iii) | fast ;<br>automatic ;<br>protective / defensive / avoid injury ;<br>removes (part of) body from source of danger ; | | **[2]** | |
| (c) | hormones / chemical messengers ;<br>secreted into the blood / which travels in blood ;<br>stimulate target , cells / tissues / organs ; | | **[max 2]** | **A** endocrines<br>**I** endocrine system |
| | | | **[Total:14]** | |