Question		Marks	Guidance Notes
1 **(a)**	movement / diffusion, of water (molecules) **;** from high water potential to low water potential / down water potential gradient **;** across a partially permeable membrane **;**	[3]	
(b) (i)	1.0 (mol dm ^{3} sodium chloride solution) **;**	[1]	
(ii)	(to remove) excess / surface / AW, water / AW, on potato sticks **;** to measure the mass of the potato (stick) only **;**	[max 1]	**I** inaccurate unqualified **R** dry mass
(c)	cells / potato sticks, have lost water (by osmosis) **;** from high water potential to low water potential / down water potential gradient **;** (cells / tissue / potato) were, plasmolysed / flaccid **;** loss of turgor (pressure) **;** not enough pressure of water pushing on cell walls **;**	[max 3]	**I** water concentration **I** incipient (plasmolysis) **A** reduced turgidity / description
(d)	protein denatured (when cooked) **;** cell membrane, damaged / destroyed (when cooked) **;** no osmosis will occur **;**	[max 2]	**R** killed proteins **I** killed / denatured, cells **I** damaged cell wall
		[Total: 10]	

Question		Mark	Guidance
2 **(a (i)**	iodine solution diffused, into the bag / through the (Visking) tubing **;** iodine molecules <u>small</u> (enough to pass through the membrane) **;** iodine solution stains starch **ora ;** no starch diffused, out of the bag / through the (Visking) tubing **;** starch molecules too <u>large</u> (to pass through the membrane) **;** ref to pore / AW, size **;**	[max 4]	**I** osmosis
(ii)	temperature **;** (surface) area **;** concentration (gradient) / water <u>potential</u> **;** size / type, of molecule **;** thickness / distance, across membrane / permeability (of membrane) **;** pressure **;** (number of) protein, channels / pumps / AW **;** energy / number of mitochondria **;**	[max 3]	**I** distance / thickness unqualified
(b) (i)	*from muscle cell* (produced in) mitochondrion **;** diffused **;** (diffused) in cytoplasm / tissue fluid / (blood) plasma **;** through membrane **;** through capillary wall **;** *from blood:* vein / vena cava / pulmonary artery / heart **;** travels to lungs **;** into alveoli **;** exhaled / breathed out / excreted **;**	[3]	**A** red blood cell **I** exit the body unqualified

Question		Mark	Guidance
2 (ii)	thin, wall / epithelium ; for efficient, diffusion / gas exchange ; small, diameter / lumen ; idea that many capillaries can fit into tissues / capillaries reach (every cell) throughout the body / relative size to red blood cell ; extensive network ; large surface for diffusion ; capillary cells have pores ; to allow substances to pass in and out of the blood easily ;	[max 3]	adaptations must be linked to correct feature max 2 for features only **A** one cell thick **R** 'thin cell wall'
(c)	diffusion ; down concentration gradient ; (diffuses) through stoma / stomata ; (through) (intercellular) air space / (between) spongy mesophyll ; into / reached, palisade, mesophyll / cell ; chloroplast ; AVP ; e.g. dissolve / diffuse, through cell wall / cell membrane / cytoplasm	[max 4]	**A** lower concentration of carbon dioxide inside leaf / **ora** ; **A** into guard cell / spongy, mesophyll / cell **I** chlorophyll
		[Total: 17]	

Question	E	Answers	Marks	Additional Guidance
3 (a) (i)		passive / does not require energy ; substances move down a concentration gradient ; does not have to occur across a membrane ; occurs with gases ; no need for protein, carrier / channels / pumps ;	[max 2]	
(ii)		root hair (cells) ; through carrier molecules / AW ; large / increased, (surface) area (for absorption) ; roots grow continually (to find new sources of ions) ; AVP ; e.g. extensive root network / branching roots ;	[max 2]	
(b) (i)		*two marks for the correct answer – if no answer, an incorrect answer or an answer without the minus sign award one mark for the correct working* 183 – 175 = 8 ; $\frac{8}{183} \times 100 = -4.4$;	[2]	**A** – 4.37
(ii)		start mass of the onions is, different / not all the same ; (idea that) allows for (valid / fair) comparison ; to determine water potential of the onion ;	[max 2]	
(c) (i)		line finished to - 4.4 / **A** ecf from (b)(i) ;	[1]	**R** extrapolation past 200 g dm ^{3}
(ii)		44 ± 1 ; g dm ^{3} ;	[2]	
(d)	**1** **2** **3** **4** **5**	movement of water ; by osmosis ; through partially permeable membrane(s) ; *gain* – onion has lower water potential / solution has higher water potential ; *loss* – onion has higher water potential / solution has lower water potential ;	[max 4]	**A** 'down a water potential gradient' if direction is correct and clear **ignore** references to 'concentrations of water'

4 **(a) (i)**	*award two marks if the answer is correct – 12* *if there is no answer or it is incorrect, award one mark for correct working* 6 s – 1s = 5 seconds for 1 breath ; 60 / 5 = 12 (breaths per minute) ;	max [2]	Alternative: 4 s – 9 s = 5 s for 1 breath Allow 10 s for 2 breaths for working mark.
(ii)	slower breathing rate before match ; **ora** deeper breathing during match ; **ora** during the match breaths are different from each other ; **ora** pressure (in lungs) increases during the match ;	max [3]	
(b)	external intercostal muscles contract ; internal intercostal muscles relax ; lifts ribs, upwards / outwards ; diaphragm contracts ; diaphragm, flattens / drops ; volume of, thorax / lungs / chest, increases ; pressure in, thorax / lungs / chest, decreases ; air flows in down a pressure gradient / description ;	max [4]	Note: internal and external must be stated
(c) (i)	(CO_2) is metabolic / AW, waste ; (CO_2) is toxic ;	max [1]	**ignore** – from body (in question stem)

Question	Answer	Marks	Additional Guidance
4 (ii)	(blood) plasma ;	[1]	
(iii)	pH decreases / becomes acidic ;	[1]	
(d)	more, (aerobic) respiration ; steeper concentration gradient ;	[2]	**A** description of gradient.
		[Total: 14]	