Mark scheme - Biological Membranes

17		i	particles have (their own) kinetic energy (1) (movement) down concentration gradient (1)	2	**ALLOW** glucose for particles **ALLOW** from high(er) concentration to low(er) concentration
		ii	ATP	1	**ALLOW** adenosine triphosphate
		iii	phospholipids act as a barrier (1) (glucose) molecules too large (1)	2	**ALLOW** (glucose) not soluble in phospholipid bilayer because of polar –OH groups for 2 marks
			Total	**5**	
18		i	***property*** hydrophobic (region / fatty acid tails) ✓ ***explanation*** (helps to) form	2 max	**IGNORE** stability for explanations ***property*** MUST be linked to its ***explanation*** **Examiner's Comments** Good responses identified region A as the tail of the phospholipid and correctly described its property as being hydrophobic. Credit was also given to candidates who stated that the region could contain

			bilayer / separates two aqueous regions ✓ ***property*** (region) contains cholesterol ✓ ***explanation*** regulates (membrane) fluidity / AW✓		cholesterol. It is important for candidates to look at diagrams carefully as there were a number of responses in which the candidates described region A as the whole phospholipid bilayer which could not be credited.
		ii	compartmentalisation **OR** form / surround , (named) organelles ✓ purpose of / need for , compartments / separation ✓ sites of , chemical reactions / electron carriers / photophosphorylation / chemiosmosis / oxidative phosphorylation ✓ provide attachment sites for , enzymes / pigments ✓ allow formation of concentration gradients ✓	2 max	e.g. separating organelles from cytoplasm e.g. form vesicles for transport is **MP1** and **MP2** **ALLOW** ETC for electron carriers **ALLOW** correctly named enzyme e.g. ATP synthase **Examiner's Comments** Many candidates gained credit for demonstrating knowledge of compartmentalisation as separating organelles and their contents from the cytoplasm. Weaker candidates gave confused statements which referenced the plasma or cell surface membranes rather than focus their response on the membranes **within** cells. Some good responses included reference to the specific roles of membrane-bound organelles such as lysosomes and vesicles.
			Total	**4**	
19			1 compartmentalisation / maintain different conditions from	2 max (AO2.1)	**1 ALLOW** keeps specific conditions needed in RER **ALLOW** controls what enters RER

			cell cytoplasm ✓ 2 separating proteins (synthesised) from cell cytoplasm ✓ 3 hold, ribosomes / enzymes, in place ✓ 4 AVP ✓–		**ALLOW** for attachment of ribosomes e.g. packaging proteins into transport vesicles / labelling proteins (on vesicle membranes)
			Total	**2**	
20		i	too large / not fat soluble	1	**IGNORE** 'no channels'
		ii	water / H_2O, **and**, lactase / enzyme	1	**Mark the first two answers.** If they are correct and any other word is written that is incorrect or contradicts the correct answer then **0 marks.** **DO NOT ALLOW** H_2O with incorrect case or subscript **IGNORE** refs to pH, buffers, hydrocarbonate etc.
			Total	**2**	
21		i	ruled lines and a border **and** correct numbers in each column **and** absorbance **and** pH **and** mean in headings ✓ pH in left hand column ✓ units (%) in headings and not within table ✓ means recorded to one decimal place ✓	4(AO3.3 3.4)	**ALLOW** means recorded as whole numbers **<u>Examiner's Comments</u>** Candidates were presented with some raw data in an inappropriate format and were asked to present the data in an appropriate table. Most candidates constructed a table with ruled lines but very few achieved full marks. The numbers that candidates were given were recorded to various, and often too many decimal places. Only a few candidates presented the numbers with consistent decimal places or to an appropriate number of decimal places, given the precision of the raw data. Most responses correctly put 'pH' in the left-hand column but many wrote 'pH' next to every value, rather than in a heading. It was also more common to see 'Average' in the final column heading, rather than the more precise 'Mean'.

					OCR support **Practical skills handbook**
		ii	(low pH) denatures / changes tertiary structure of , (membrane) proteins ✓ <u>therefore</u> membrane permeability (to pigment) is increased ✓	2 max(AO 2.1)	**CREDIT** only in the context of membrane protein structure having been changed
		iii	use pH buffer range with narrower intervals ✓ pH (buffers) , close to pH6 / between pH5 and pH6 / between pH5 and pH7 ✓	2(AO3.3)	**ALLOW** stated values (must be more than one) at interval of less than 1 **ALLOW** stated value of buffer within the range pH5 to pH7 'test more values between pH5 and pH6' = 2 marks. 'test at pH 6.5' = 1 mark (mp2)
			Total	**8**	
22	a	i	progesterone is) hydrophobic / fat soluble / lipid (molecule) ✓ (so) dissolves in / diffuses through / is not repelled by, the <u>phospholipid</u> (bilayer) / <u>hydrophobic</u> tails / <u>fatty acid</u> tails ✓	**2**	**ACCEPT** non-polar / uncharged **IGNORE** small **IGNORE passes / moves,** through / across **DO NOT ACCEPT** diffuses through gaps, in the phospholipid bilayer / between the phospholipids **Examiner's Comments** Most commonly candidates stated that the progesterone molecule was small enough to squeeze through gaps in the phospholipid bilayer, which did not gain any credit. However many did refer to the non-polar nature of the molecule, and even that it was lipid soluble, but often did not go on to explain that this meant that the progesterone would not be repelled by the hydrophobic tails of the bilayer and would be able to diffuse through. Some candidates failed to use the correct terminology, e.g. instead of

					'diffusing through' the molecules were 'moving or passing through the membrane' which was given in the question. Several candidates suggested that since progesterone was a hormone it required a channel protein to get through the membrane.
		ii	water / oxygen / carbon dioxide ✓	**1**	***Mark the first answer only. If additional incorrect answer given, then 0 marks*** **ACCEPT** correct formulae **DO NOT ACCEPT** incorrect formulae **ACCEPT** (named) alcohol / (other) named steroid hormone / triglyceride / glucose / vitamins / proteins / enzymes / (named) amino acid / anabolic steroid(s) etc (all of which are molecules and can cross the membrane by a passive or active method) **DO NOT ACCEPT** elemental ions (e.g. K^+ / Na^+ / Ca^{2+} etc) element (e.g. sodium / potassium etc) **Examiner's Comments** This question was well answered by most candidates. A varied range of examples of molecules that could cross the plasma membrane were seen. Water, oxygen and glucose were common answers, and several candidates continued the theme and stated a steroid hormone such as oestrogen.
	b	i	channel / carrier / transport / cotransporter**,** proteins ✓	**2**	**ACCEPT** sodium potassium pump / Na^+ K^+ pump **Examiner's Comments** The vast majority of candidates answered this question with the correct responses of either 'channel' or 'carrier' protein, although a few either omitted reference to 'proteins' or simply described the proteins as being 'intrinsic'.
		ii	adenine ✓ ribose ✓	**2**	*In any order* **IGNORE** A **DO NOT ACCEPT** adenosine / other named base **DO NOT ACCEPT** deoxyribose / other named pentose **ACCEPT FOR 1 MARK :** nitrogenous base **and** pentose / 5C sugar **Examiner's Comments**

					Surprisingly few candidates gained full marks for this question, with many not knowing the components of ATP, as an example of a nucleotide. The majority of candidates correctly identified adenine as one of the molecules. Few candidates correctly identified ribose, preferring to call it a 5 carbon sugar or pentose. There were many 'adenosine' responses and also those candidates who got a single mark from the imprecise combination of '5 carbon sugar' with 'nitrogenous base'. There was a wide variety of other incorrect answers including other named organic bases, DNA, RNA, triglycerides, nitrogen, carbon, water, and glucose to name but a few.
	c		**1** phospholipid bilayer ✓ **2** hydrophilic / phosphate (containing)**, heads facing,** outwards / towards external enviro nment **AND** hydrophobic / fatty acid**, tails facing,** inwards / away from external environment ✓ **3** proteins / phospholipids**,** free to move (in membrane) ✓ **4** proteins, scattered / randomly arranged / spread throughout / here and there (between the phospholipids) ✓	**2 max**	**ACCEPT** mark points 1 and 2 from a clearly labelled diagram **3** **ACCEPT** membrane components / molecules**,** free to move **IGNORE** fluid **4** **NOTE** 'embedded proteins' is not enough without the random arrangement indicated **IGNORE** mosaic **Examiner's Comments** Most candidates answered this question as a straightforward description of structure of the membrane rather than emphasising the 'fluid' and 'mosaic' aspects of the model. Candidate descriptions of the plasma membrane structure referred to the phospholipid bilayer but did not often elaborate on the orientation of the phospholipid molecules within the bilayer. It was surprising to note the number of candidates who talked about hydrophobic heads and hydrophilic tails. Few candidates talked about the components of the membrane, i.e. phospholipids or proteins, moving within the membrane, merely stating that the bilayer moves as a whole or 'is fluid'. The mosaic pattern created by the randomly scattered arrangement of the proteins was not well described, often only simple comments about the proteins being arranged in a mosaic pattern were offered.
			Total	**8**	
23			phosphate (on head), is hydrophilic /	3(AO2.1 2.5)	**DO NOT CREDIT** reference to incorrect bond, e.g. covalent

			bonds with water (molecules) ✓ (two) fatty acid tails are hydrophobic ✓ heads orientate towards water / tails orientate towards other fatty acids / tails orientate away from water , (so a bilayer forms)✓		This point is for a description of why a bilayer forms and key terms are not required **Examiner's Comments** Most candidates were clearly familiar with aspects of membrane structure but may merely attempted to describe the structure of membranes rather than explaining why the structure of phospholipid molecules facilitates the formation of membranes.
			Total	**3**	
24			phospholipid (molecules form) bilayer ✓ (forming) cisternae / network of membranes / flattened sacs ✓ covered (on outside) with ribosomes / AW ✓ membrane continuous with nuclear envelope ✓	3 max (AO2.1/ 1.1)	**IGNORE** fluid filled **IGNORE** contains / lined with / has a lot of, ribosomes
			Total	**3**	
25		i	initial / AW, glucose concentration (on both sides on the membrane) (1) volume of solution (1) length / diameter, of dialysis tubing (1) type / brand, of dialysis tubing (1)	2	

		ii	*alpha glucose* H above ring / OH below ring, on, carbon 1 / C1 **ORA** (1)	1	**ALLOW** a suitable annotated diagram
		iii	*(less reabsorption because)* *idea of* fewer H^+ ions in PCT cells (1) less / no, co-transport / facilitated diffusion, of Na^+ ions, into cells / from lumen (1) less / no, active transport of Na^+ ions into, blood (1)	3	
			Total	**6**	
26		i	DNA / RNA / nucleic acid	1	
		ii	lower / reduce / make more negative	1	
		iii	*two from* **1** strip is impervious to, water / solutions (1) **2** forces water / solutions, to pass through, plasma / cell surface, membrane (1) **3** phospholipid (bilayer), repels / AW, ions / charged particles (1)	2	**1** **IGNORE** ref to suberin. **3** The idea of charge / ion impermeability is wanted here. **ALLOW** answer in terms of ions / charged particles needing channels because phospholipid bilayer does not allow charged particles through.
			Total	**4**	
27	a	i	3 **OR** 2 ✓ 5 ✓ 2 ✓	3	**Examiner's Comments** Many candidates correctly selected the steps that relied upon

					assumptions **A** and **B**. For assumption **C** many chose step 1 i.e. the stage when the beetroot is sliced rather than the correct response i.e. step 2.
		ii	variety / type / age / colour, of beetroot ✓ length / surface area / volume , of beetroot pieces ✓ pieces taken from same part of beetroot / skin removed from beetroot ✓ time taken to wash slices ✓ volume (of samples) removed from solution ✓ pH ✓ use same colorimeter filter / same blank ✓	2 max	**List Rule** If **both** prompt lines used and more than one variable is on the line mark the **first** one on each line. If only **one** line used but there is more than one variable listed mark first two written. **IGNORE** temperature / time / concentration of ethanol **ALLOW** same beetroot / same species **ALLOW** same SA :V / mass **IGNORE** size of beetroot **Examiner's Comments** AO3 was being assessed in this part of the question. There were some excellent responses from candidates who understood the importance of specifying an appropriate measurement for the beetroot pieces; such as length, surface area or volume. There were also many good responses which included ideas such as time taken to wash the beetroot pieces and pH. Low attaining responses were often those in which candidates had suggested variables that had already been stated in the question as being controlled, such as the volume of ethanol or the time the beetroot was left in the ethanol.
	b	i	*x* axis / concentration of ethanol , has no units ✓ should be a line graph (as	3 max	**List Rule** If all **three** prompt lines used and more than one criticism is on the line mark the **first** one on each line. If only **one** or **two** lines used but there is more than one criticism listed mark as continuous prose. **ALLOW** bar graph not appropriate for continuous data **Examiner's Comments** This part of the question was generally well-answered with marking points accessible across the ability range.

			continuous data) ✓ *x* axis / concentration (of ethanol) , has incorrect scale / 0.6 not included ✓ no title ✓		
		ii	(so) can calculate a mean ✓ allows anomalies to be identified ✓ improves repeatability ✓ allows statistical test to be completed ✓	2 max	**IGNORE** average **DO NOT ALLOW** prevents anomalies **IGNORE** remove anomalies **ALLOW** reproducibility **IGNORE** reliability / validity / accuracy **ALLOW** can complete , standard deviation / t-test **Examiner's Comments** Candidates who gained full marks generally considered the potential to identify anomalies and calculate means. Marks were lost due to incorrect use of terms such as averages and validity or reference to removing or preventing anomalies. Few candidates used the correct terms, **reproducibility** or **repeatability**, in their responses.
			Total	**10**	
28	a	i	3.83 ✓✓✓	**3**	***Mark answer on answer line.*** ***If no answer on answer line then look for a clear 'final' answer in the working.*** ***Correct answer = 3 marks (indicated by 3 ticks) even if no working shown*** **IGNORE** minus sign **AWARD max 2 for correct answer not to 2dp or for 3 5/6** ***If answer is incorrect*** **AWARD** 1 mark for (calculating difference between means): 0.44 - 0.21 = 0.23 **OR** 0.21 - 0.44 = - 0.23 **AWARD** 1 mark for: $\sqrt{\frac{0.06^2}{10}+\frac{0.18^2}{10}}$

					OR $\sqrt{\frac{0.0036}{10} + \frac{0.0324}{10}}$ **OR** $\sqrt{0.00036 + 0.00324}$ **Examiner's Comments** It was pleasing to see that the majority of candidates could calculate the value for the *t* test correctly, though as it was an unfamiliar test many ended up with a negative value which still gained credit. Those who gave an incorrect answer but who nevertheless showed working (which candidates should be strongly advised to always include in calculations), frequently picked up one or two marks for correct substitutions in the top or bottom parts of the equation. The most common mistake made by candidates was omitting to square the standard deviation in the given formula for calculating *t*.

		ii	***If answer to (d)(i) is greater than 2.10 then***
			
			rejected because value of t is higher than critical value ✓
			
			(H_o is rejected so) the difference (between the means), is significant / not due to chance ✓
			
			If answer to (d)(i) is less than 2.10 (including negative numbers) then
			
			accepted because value of t is lower than critical value ✓
				2	**If no answer for (d)(i), then allow 1 max for correctly stating when to, accept / reject, H_0**
					
					ACCEPT H_o is rejected because 3.83 is greater than 2.10
					
					ACCEPT H_o is accepted because 't value' is less than 2.10
					
					Examiner's Comments
					
					Candidates were often incorrect in their interpretation as to whether to accept or reject the null hypothesis by comparing the calculated value with the critical value. Some failed to realise that if they calculated a negative value of *t* it would be lower than the critical value and so should accept the null hypothesis. Those who did answer correctly often omitted to go on to comment on whether the difference was significant or not, or just stated whether the value of *t* meant that the 'results' were significant or not rather than refer to the 'difference' (between the means at the two temperature levels).

			(H_o is accepted so) the difference (between the means), is not significant / is due to chance ✓		
	b		**E1** an increase in pigment (leaking out of cells) increases <u>absorbance</u> ✓ *at low(er) temperature* **D2 there is, little / no,** change in <u>absorbance</u> ✓ **E2 membrane is,** (still) intact / undamaged ✓ *at high(er) temperature* **D3** there is a (steep) increase in <u>absorbance</u> ✓ **E3** (pigment, leaves cells / leaks out when)	**3 max**	***Award marks from any D or E statements but max 2 explain marks (E)*** ***Put just a tick for D marks and green blob by the tick for E marks to ensure max 2 E marks awarded*** **IGNORE** 'as temperature increases' unqualified **E1 ACCEPT** as clearly linked ideas ***For D2 and E2*** if temperatures are quoted without 'low(er)' then ^oC must be used at least once *any range starting at 0 and ending between 20 and 40^oC* ***For D3 and E3*** if temperatures are quoted without 'high(er)' then ^oC must be used at least once *above 30/40^oC* **IGNORE** enzymes denature **Examiner's Comments** This question proved to be a good discriminator. Many candidates scored poorly on this question, mainly due to a lack of precision in describing the graph and a lack of understanding of the experimental technique involved. A general description of an increase in absorbance as temperature increased was incorrect and failed to gain credit. This was very often all that lower ability candidates offered.

			membrane becomes more permeable / membrane is damaged / membrane disrupted / phospholipids melt / phospholipids move further apart / proteins denature (or described) ✓		Some candidates correctly gained credit for describing that there was no change in absorbance between 0 - 20°C, but fewer correctly noted that the absorbance did not start to increase until above 30°C. Few candidates understood that the membrane remained intact at these low temperatures. Students should be encouraged to describe data in as much detail as possible and at all relevant points, in order to gain full marks in such questions. Some candidates omitted to use full units (degrees 'C') for temperature quotes and thereby failed to gain credit for otherwise correct answers. Several candidates correctly described the increase in absorption at high temperatures and most went on to link this to an increase in membrane permeability or membrane disruption. However, few linked this to more betalain pigment leaking out and causing the increased absorbance. Marks for explanations were less common than for descriptions. There seemed to be misunderstanding of the term 'absorbance' at times with candidates believing that higher temperatures led to more pigment being 'absorbed by the cells'. These candidates may well have never used colorimeters. Candidates who had carried out this or a similar experiment were at an advantage.
			Total	**8**	
29		i	*one from* volume of ethanol not given (1) same onion / size of onion epidermis / position of epidermis in onion not stated (1)		
		ii	20–30% (1) lowest concentration must be between 20 and 30% (1)	2	*idea that* 100% blue nuclei is not reached at 20% but is reached at 30%
		iii	*idea of* more accurate determination of permeability	1	
			Total	**4**	
30			because it is , charged / polar / hydrophilic ✓	2 max (AO2.1)	**ALLOW** repelled by phospholipid bilayer **ALLOW** hydrophobic centre / fatty acid tails for phospholipid bilayer **IGNORE** cell membrane

			(so) cannot pass through the phospholipid bilayer / will need correct transport proteins✓ **OR** because it is (too) large ✓ (so) cannot pass through the phospholipid bilayer / will need correct transport proteins✓		**IGNORE** cell membrane
			Total	**2**	
3 1		i	*Substance A* **1** for (substance) **A** the, graph is a straight line / rate of uptake depends on concentration ✓ **2** (so substance) **A** is (absorbed by simple) diffusion ✓ *Substance B* **3** for (substance) **B** the curve, reaches a plateau / levels off ✓ **4** (so substance) **B** could be (absorbed by), facilitated diffusion / active transport ✓ **5** (because) if facilitated diffusion channels / carrier proteins, become saturated **OR**	4 max (AO3.1) (AO3.2)	**ALLOW** rate is (directly) proportional to concentration **ALLOW** as concentration increases rate increases **DO NOT ALLOW** facilitated diffusion **ALLOW** rate becomes constant **DO NOT ALLOW** rate slows **IGNORE** stops increasing **ALLOW** channels / carriers working at maximum capacity **ALLOW** transport proteins for either in **MP5** **DO NOT ALLOW** channel proteins for active transport

			(because) if active transport carrier proteins /carriers, become saturated ✓		
		ii	***Substance A*** *effect* (uptake) unaffected / no change ✓ *explanation* (simple) diffusion, does not require ATP / is a passive process ✓ ***Substance B*** *effect if active transport* slower / little / reduced / no (uptake) ✓ *explanation* active transport, requires ATP / is an active process ✓ **OR** *effect if facilitated diffusion* (uptake) unaffected / no change ✓ *explanation* facilitated diffusion, does not require ATP / is a passive process ✓	max 4 (AO3.1) (AO2.5)	**CHECK answer to (b)(i) ALLOW ECF** if answer to part (i) suggests candidate thinks substance A is taken up by active transport and Substance B is taken up entirely by diffusion. **ALLOW** does not require energy **ALLOW** does not require energy
			Total	**8**	
3 2	a	i	repeats and calculate mean (at each temperature) ✓ use a biosensor (to measure glucose	1 max (AO3.4)	**IGNORE** different temperatures

			concentration) ✓ (test at) more / smaller, temperature intervals ✓ (test at) more / smaller / shorter, time intervals ✓		
		ii	concentration of glucose (solution in bag / tubing) ✓ volume of the glucose solution (in bag / tubing) ✓ volume of (distilled) water (in beaker) ✓ volume of sample, removed / tested ✓ volume of Benedict's reagent used ✓ length of, Visking tubing / artificial cell ✓ time in water bath for Benedict's test ✓	1 max (AO3.4)	**IGNORE** amount for volume throughout **ALLOW** surface area to volume ratio of Visking tubing
	b	i	*hypothesis:* as temperature increases, movement of glucose into the (distilled) water / concentration of glucose (in samples), increases ✓ *scientific process:* diffusion ✓	2 (AO3.4)	**IGNORE** null hypothesis **ALLOW** as temperature increases diffusion rate increases **ALLOW** particles, move faster / have more kinetic energy
		ii	as temperature increases, more glucose is found in the water / diffusion rate is faster ✓	2 (AO3.1) (AO3.2)	**ECF** from wrong hypothesis in 5 (b)(i). **ALLOW** 1 max for no when supported with a reference to the anomaly at 60 seconds at 20^{o}C

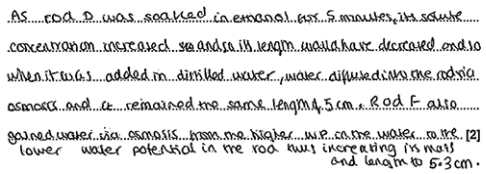
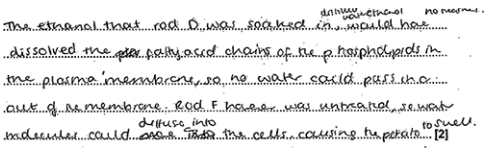
			result for 60 seconds at 20oC, anomalous / does not support ✓		
	c		use one / control, temperature ✓ use two / more, layers of, Visking / dialysis, tubing ✓	2 (AO3.4)	**CREDIT** keep temperature, the same / constant **IGNORE** make Visking tubing thicker **ALLOW** fold / layer, Visking tubing **Examiner's Comments** This question also provide a model for testing transferable skills. Doing the paper and going through the mark scheme could be followed up by applying the same questions and skills to new microscope drawings and descriptions of experiments.
			Total	**8**	
33	a		detect the presence of acid / H^+ (1) measure end-point / dependent variable (1)	1	
	b	i	surface area to volume ratio on x-axis **and** time on y-axis (1) plotted points occupy at least half of available area **and** linear scale on both axes **and** line of best fit drawn (1) axes labelled time (min) **and** surface area to volume ratio / AW (1) all points plotted correctly (to +/− half a 2 mm grid square) (1)	4	**DO NOT ALLOW** if units given for x-axis **ALLOW** ecf for correctly plotted points on incorrectly-scaled graph

		ii	time taken for diffusion (to centre of cube), increases as surface area to volume ratio decreases, ORA	1	Answer must mention surface area to volume ratio **DO NOT ALLOW** if colour change is discussed in place of diffusion **IGNORE** rate **ALLOW** a description consistent with the graph the candidate has drawn
		iii	0.44	1	**ALLOW** answer in the range of 0.40 – 0.48 depending on candidate's plotted graph Answer must be reported to 2 decimal places
		iv	test cubes of (known) length between 10 and 20 mm	1	
	c		0.35 / 0.347 (1) (1) mm min^{-1}	3	**ALLOW** 0.69 / 0.694 for 1 mark **ALLOW** 0.3 or 0.3472 for 1 mark **ALLOW** mm/min
	d	i	*cube **A**, because…* time for test 2 different from others (1) use of processed figures to support (1)	2	**ALLOW** calculated rates for cube **A** - **E** **ALLOW** calculated range compared with that of cubes **B** - **E**
		ii	*Limitation* inconsistency in surface area (1) cube **A** (1) *Because* It is the smallest cube so small error in cutting will have proportionately larger effect in a small cube / *idea that* error is a bigger proportion of total time (1) *Limitation* using human eye and judgement to determine end point (1) cube **E** (1)	3	**ALLOW** mark only if one of the other two marks is awarded **ALLOW** mark only if one of the other two marks is awarded

			Because largest cube so harder to see through 2cm of jelly / AW (1)		
	e		*idea of* involvement of cytoskeleton / vesicles (1)	1	**IGNORE** reference to different diffusion resistance
			Total	**17**	
34	a	i	*-28.77 is incorrect* -19.19 ✓✓✓	3	**IGNORE** units (would not be written into table) 2 marks **maximum** if answer is not to 2 d.p. (so it is in the same format as the table) If incorrect, **ALLOW** 1 mark for evidence of: $\frac{2.78 - 3.44}{2.78} \times 100$
		ii	(any value from) 1.1 - 1.5 (inclusive) mol dm^{-3} ✓	1	**DO NOT ALLOW** if units not included **ALLOW** any range within this range (inclusive)
		iii	water potential ✓	1	
	b		line graph ✓ (because) both variables are continuous ✓ concentration on *x* / horizontal axis, because it is independent variable **AND** (%) change in mass on *y* / vertical axis, because it is dependent	3 max	**ALLOW** scatter graph / scattergram

			variable ✓ separate line plotted for each vegetable (with key) ✓		
	c		*improvement:* at least, two repeats / three replicates ✓ *explanation:* allows for (named) statistical test / identify anomalies / improves repeatability ✓ *improvement:* more intermediate values (of sucrose solution) ✓ *explanation:* allows trend to be identified more clearly / allows solute concentration of cells to be identified more accurately ✓ *improvement:* keep pieces (of vegetable) the same size ✓ *explanation:* reduces effect of	6	**ALLOW** reproducibility **ALLOW** stated examples of intermediate values

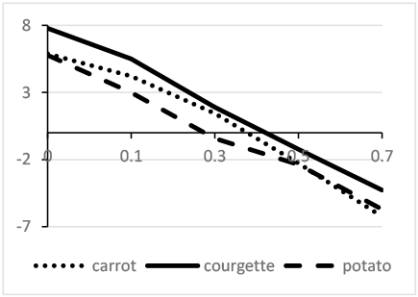
			surface area (on osmosis) ✓		
			Total	**14**	
35	a		table with correct results entered ✓ LH column records letter of rod OR treatment and liquid / described ✓ RH column records final length ✓ correct headings (LH & RH column) with units (cm or mm) ✓	max 3	**DO NOT ALLOW** if number of decimal points wrong **IGNORE** column with % change / change in length to right **DO NOT ALLOW** if units in body of table. **IGNORE** graphical presentation **Examiner's Comments** This question may have confused some candidates who felt that the results had already been recorded in an appropriate format. Most candidates displayed the results in an acceptable table format, correctly placing the independent variable (potato rod) in the left hand column and dependent variable (final length) in the right hand column. A few drew row tables and hybrid row/column tables were seen. Common errors included not recording the results to the correct number of decimal points and recording processed results (change in length) rather than the original results. Results should be recorded in a table according to the guidelines found in the Practical skills handbook. Some candidates used a graphical presentation but this approach was not considered adequate. **OCR support** OCR support includes the Practical skills handbook and the student guidance sheet 'Graphs, tables and drawings: student checklist'. https:/www.ocr.org.uk/Images/346170-graphs-tables-and-drawings-student-checklists.doc https:/ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf
	b	i	boiling, damages / AW, plasma / cell surface, membrane ✓ (therefore) no, osmosis / (net) movement of	2	Examples of AW: disrupts / destroys / melts / denatures proteins in Note: needs a comment about both A & E for this mark

			water, out of A, but water moves out of E **OR** AW ✓		
		ii	ethanol dissolves phospholipid (bilayer) ✓ (therefore) no, osmosis / (net) movement of water into D, but water moves into F **OR** AW ✓	2	Note: needs a comment about both D & F for this mark **Examiner's Comments** part (i) & (ii) were, the least well answered questions in the examination. It appeared that few candidates had carried out this experiment or similar experiments investigating the effect of temperature on cell surface membranes. Lower ability candidates simply repeated the treatments or described the results with little or no attempt at an explanation. Those who did attempt an explanation often believed that water moved in one direction during the boiling process or while being soaked in ethanol only to reverse that direction of movement when placed in sucrose solution or distilled water. Few candidates discussed the effect of temperature or ethanol on membrane structure and the explanation was often incorrect; did not include the correct direction of water movement. **Exemplar 1**  As rod D was soaked in ethanol for 5 minutes, the solute concentration increased so and so its length would have decreased and so when it was added in distilled water, water diffused into the rod via osmosis and it remained the same length 4.5 cm. Rod F also gained water via osmosis from the higher water potential to the lower water potential in the rod thus increasing in mass and length to 5.3 cm. [2] This is a typical response for Q 21 (b) (ii) in which no attempt has been made to explain what has happened to the cell surface membrane and the reasons why one potato piece changed in length and the other did not are confused but show some basic knowledge of water potentials. **Exemplar 2**  The ethanol that rod D was soaked in, dissolved the phospholipid bilayer as no water could pass out of the membrane. Rod F however was untreated, so water molecules could diffuse into the cells causing the potato to swell. [2] This was one of the better responses to Q 21 (b) (ii) in which the candidate correctly states how the ethanol has damaged the plasma membrane. The candidate goes on to explain the difference in the final length of the potato rods stating that water does not move into rod D but can still move into rod F increasing its length. The explanation is not entirely correct but enough correct information was provided to allow the marks to be given.

					OCR support Practical work should be an integral part of the study of Biology. The practicals provided by OCR to support the practical endorsement include Practical Activity Group (PAG) 5 in which the first practical investigates membrane permeability. PAG 5 investigates aspects of osmosis and membrane permeability. These practicals include extension questions that can be used to help prepare students for questions of this type in the examination. PAG activities are available on OCR interchange: https:/interchange.ocr.org.uk/Modules/ControlledMaterials/ControlledMaterialsGCEFrom2015.aspx
	c		use more, accurate / precise apparatus / described **OR** use calipers / micrometer ✓	1	**Examiner's Comments** This question was not well answered as many candidates did not understand the word 'uncertainty'. Few candidates knew that to reduce uncertainty, you needed to use more precise or accurate apparatus. The most frequent answer referred to carrying out repeats and working out a mean, which gained no credit. Others suggested measuring mass instead of length or improving the accuracy of measuring volumes. Improving resolution and using statistics were also suggested by some candidates. **OCR support** The definitions of terms used in measurement can be found in the OCR practical skills handbook, Appendix 4: https:/ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf
			Total	**8**	
3 6	a	i	diffusion / net movement, of water across a, partially / selectively, permeable membrane ✓ down a, water potential / Ψ, gradient ✓	2 (AO 1.2)	**IGNORE** semi **ALLOW** from a high water potential to a more negative Ψ **IGNORE** water concentration **IGNORE** along **Examiner's Comments** Only a few responses achieved both available marks in this knowledge of isolation question. Many candidates gained 1 mark for correct reference to a water potential gradient, although candidates

					who misunderstood the meaning of gradient, often wrote 'from a high water potential gradient to a low water potential gradient', were not awarded the mark. Only a few candidates referred to diffusion or net movement. It is worth noting that use of the term 'water concentration' is not credited at A Level. References to a semi permeable, or simply 'cell' membrane, were also not credited.
		ii	water enters vacuole ✓ pressure against cell wall ✓ turgor (pressure) ✓ turgid cells (support plant) ✓	3 max (AO 1.2)	**Examiner's Comments** A fair amount of candidates scored at least 1 mark in this question. Most candidates did not fully appreciate the meaning of 'support' and appeared to interpret 'support' as 'benefit'. Most responses focussed only a small part of their answer on cell turgor, usually gaining a mark for reference to turgid cells, but many described the whole plant, or the xylem, as being turgid. Response that limited the turgidity to a single cell were also not credited as the question was about supporting plants. A lot of candidates referenced to photosynthesis and transport but were not credited. **Exemplar 1** when a plant cell is placed in a solution of higher water potential than the cytoplasm, water moves into the cell down a water potential gradient. This influx of water makes the cell contents e.g the vacuole and the cell membrane push against the cell wall making it turgid and this provides support for the plant and prevents it becoming flacid. [3] prevents the entry of any more water molecules This response has interpreted the question correctly, focussing on the role of osmosis in support and it is awarded the first marking point by the clear implication that water has entered the vacuole. However, it does not mention turgor and, while there is the idea of pressure against the cell wall, the word 'pressure' is not used. The key word 'turgid' has been used but 'it' appears to refer to the cell wall rather than to plant cells in general. Therefore, the answer scored only 1 mark.
	b	i	**FIRST CHECK ON ANSWER LINE** **If answer = 6.25 or 6.3 award 2 marks** ✓✓ *If answer is incorrect* **ALLOW** *1 mark max for any one of…* correct answer to 1 or >3 s.f.	2 (AO 2.8)	**Examiner's Comments** Only a few candidates knew exactly what to do here and gained both marks. A smaller number of candidates carried out a correct calculation but they only considered uncertainty at one end, so scored 1 mark. A number of candidates used an inappropriate number of significant figures and were therefore didn't score full marks for the calculation. **OCR support**

			3.125 ± 0.005 0.0625 or 0.063 (2 x 0.5) / (26.5 – 10.5) x 100 ✓		The 'Maths for Biology' website offers support on calculating uncertainties as well as the correct use of significant figures: https:/www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/
		ii	Y / solution outside bag, has higher, water potential / Ψ (than X) ✓ ora X / solution inside bag, has higher, solute / AW, concentration / potential (than Y) ✓ ora	2 (AO 3.1)	*Must be comparative statements* **IGNORE** water concentration **IGNORE** hypertonic / hypotonic **ALLOW** X has more sugar molecules **Examiner's Comments** Many candidates scored one mark for getting the water potentials the right way round. However, only a few candidates expanded their answer. Most candidates did address the issue of solute concentration but often did not express this with sufficient precision. For example, 'solution X is more concentrated' was not awarded a mark. A few candidates explained the processes that were happening, rather than answering the question being asked, which was to draw conclusions.
	c	i	different (starting) masses (of plant pieces) ✓ allows comparison (between plant pieces of different mass) ✓	2 (AO 3.4)	**ALLOW** different weights **IGNORE** to remove effect of starting mass **Examiner's Comments** A number of candidates gained both marks here and some well-expressed answers were seen. A minority of candidates referred, incorrectly, to a percentage being more precise, accurate or reliable. **OCR support** Appendix 4 of the Practical Skills Handbook, provides information on terms used in measurement and conventions for recording and processing experimental measurements. This is in line with the 'The Language of measurement' booklet: https:/www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf
		ii	inadequate drying ✓ (so) more mass / heavier (than other pieces) ✓	2 max (AO 3.4)	**IGNORE** references to measuring errors **CREDIT only** 1 limitation and corresponding explanation **Examiner's Comments** Most candidates identified the correct practical error. However, having identified a reasonable error, usually inadequate drying, most were

			piece cut from different (part of) potato ✓ (so) cells might have different water potential (at start) ✓		unable to relate this to the data in the table and describe a potato mass being recorded as heavier than it really was. Most responses discussed errors such as reading the mass incorrectly or using the wrong solution, which didn't score any marks. Candidates are advised that answers to practical questions that cite avoidable human error are not likely to attract marks.
		ii i	**1** courgette / carrot or courgette ✓ **2** 0(%) mass change / *idea of* intercept, between 0.3 and 0.5 (mol dm^{-3}) ✓ **3** (courgette associated with) highest concentration at which there is no mass change ✓ **4** (courgette has) highest mass gain at 0 mol dm^{-3} / least mass loss at 0.7 mol dm^{-3} ✓ **5** change / AW, at, 0.3 (mol dm^{-3}) higher than carrot / 0.5 (mol dm^{-3}) lower than carrot ✓ **6** AVP calculated linear extrapolation (0.421) ✓	3 max (AO 3.1) (AO 3.2)	**2 ALLOW** (isotonic) sucrose concentration is between 0.3 and 0.5 (mol dm^{-3}) **4 ALLOW** units anywhere in answer **5 ALLOW** 0 change is closer to 0.5 than carrot  **Examiner's Comments** The vast majority of candidates correctly identified the courgette. Many candidates were able to justify this with reference to the highest mass gain (0mol dm^{-3}) and least mass loss (0.7 mol dm^{-3}). Some candidates were not successful because units, mol/dm^3, were omitted from their answers. Only a few candidates discussed the range of concentrations that were likely to be isotonic with the courgette cells and hence gained all 3 marks. Answers that discussed movement of sucrose revealed a fundamental misunderstanding about osmosis and were not credited.
			Total	**0**	
37		i		max 2	*Mark first **two** answers only, ignoring the numbered sections* **IGNORE** mass / balance used / soak time / repeats **IGNORE** a list of variables unqualified

			1 discs same, size / thickness / surface area / surface area to volume ratio / diameter ✓ 2 same (variety / part, of) potato ✓ 3 no skin on potato ✓ 4 *ref to* removing excess water before (re)weighing ✓ 5 same, number / amount, of discs (in each solution) ✓ 6 same volume (sucrose) solution ✓ 7 same temperature ✓ 8 cover the tubes ✓		1 **ACCEPT** same cork borer used **ACCEPT** 'pieces of potato' etc. for 'discs' **ACCEPT** 'length' as equivalent to 'diameter' **IGNORE** same shape/similar size etc 4 e.g. blotting / shaking 7 **ACCEPT** in context of room / environment / solution **Examiner's Comments** This question was relatively well answered but many candidates stated soak time as a factor, despite the question specifying four hours. Some candidates correctly named the variable but failed to keep it the same. A significant number of students did not appreciate that the question referred to the **validity** of the results and gave responses relating to ensuring the accuracy or reliability of results, e.g. using suitable measuring equipment for the volumes or to doing repeats. Candidates did not always use the term volume rather than 'amount', or refer to the discs rather than just the potato tuber.
		ii	1 *idea that* no change of mass occurs when the water potential of (sucrose) solution = water potential of potato (tissue) ✓ 2 ref. to no change in mass	max 3	**ACCEPT** Ψ for water potential throughout **IGNORE** ref to solute potential / isontonic 2 correct units must be stated once **ACCEPT** 'between 0.2 and 0.3 mol dm^{-3} the water potential of the solution and the potato will be the same' 3 x and y axes interchangeable When an axis has been identified it can be referred to by letter later.

			(of potato) between 0.2 and 0.3 mol dm^{-3} ✓ 3 plot graph of concentration of, sucrose / solution, against (%) change in mass **and** find which (sucrose) concentration gives no change in mass of potato **OR** carry out the experiment again with more (sucrose) concentration intervals between 0.2 and 0.3 mol dm^{-3} ✓ 4 look up the water potential of the (sucrose) solution (e.g. on		Needs some ref to the mass change being 0. If the change in mass axis has previously been identified, then ref to that axis value being 0 is equivalent to no change in mass e.g. '*Should draw a graph of sucrose concentration on the x axis and change in mass of potato discs on the y axis. The point where the line of best fit crosses the x axis (when the y axis = 0) is the concentration of sucrose in the potato discs.*' will get the mark '*Draw a graph with change in mass of potato discs on the y axis and concentration of sucrose solution on the x axis and draw a line of best fit. Where the line intercepts the x axis is where the change in mass of potato discs is zero.*' will get the mark 3 correct units must be stated once **Examiner's Comments** Most candidates did not read the question carefully enough and just described why the discs gained or lost mass in the various sucrose solutions. Typically they gave statements such as 'when the increase in mass is high then the water potential of the solution is higher than in the potato and when mass is lost the water potential of the solution is lower'. There was no indication they understood that the water potential of the potato tissue could be quantified from the results or the significance of the sucrose concentration where no mass change occurred. Several candidates appreciated that the mass difference changed from positive to negative between two stated sucrose solution concentrations, but did not develop the idea further. Candidates who, presumably, had done this as a practical exercise or had analysed similar data, knew that a graph of the results would yield an estimate but most of these said that the water potential could be obtained directly from the point where the line of best fit crossed the zero mass value (rather than the equivalent sucrose concentration).

			calibration curve or table), of that concentration / of the concentration which gives no mass change ✓		
			Total	**5**	