Osmosis practical Questions

**Q1.**A group of students carried out an investigation to find the water potential of potato tissue.

The students were each given a potato and 50 cm3 of a 1.0 mol dm−3 solution of sucrose.

•        They used the 1.0 mol dm−3 solution of sucrose to make a series of different concentrations.

•        They cut and weighed discs of potato tissue and left them in the sucrose solutions for a set time.

•        They then removed the discs of potato tissue and reweighed them.

The table below shows how one student presented his processed results.

|  |  |  |
| --- | --- | --- |
|   | **Concentration of sucrose solution / mol dm−3** | **Percentage change in mass of potato tissue** |
|   | 0.15 | +4.7 |
|   | 0.20 | +4.1 |
|   | 0.25 | +3.0 |
|   | 0.30 | +1.9 |
|   | 0.35 | −0.9 |
|   | 0.40 | −3.8 |

(a)     Explain why the data in the table above are described as **processed** results.

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**(1)**

(b)     Describe how you would use a 1.0 mol dm−3 solution of sucrose to produce 30 cm3 of a 0.15 mol dm−3 solution of sucrose.

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**(2)**

(c)     Explain the change in mass of potato tissue in the 0.40 mol dm−3 solution of sucrose.

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**(2)**

(d)     Describe how you would use the student’s results in the table above to find the water potential of the potato tissue.

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(Extra space) .................................................................................................

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**(3)**

**(Total 8 marks)**

 **Q2.**          A student investigated the effect of putting cylinders cut from a potato into sodium chloride solutions of different concentration. He cut cylinders from a potato and weighed each cylinder. He then placed each cylinder in a test tube. Each test tube contained a different concentration of sodium chloride solution. The tubes were left overnight. He then removed the cylinders from the solutions and reweighed them.

(a)     Before reweighing, the student blotted dry the outside of each cylinder. Explain why.

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**(2)**

The student repeated the experiment several times at each concentration of sodium chloride solution. His results are shown in the graph.



(b)     The student made up all the sodium chloride solutions using a 1.0 mol dm–3 sodium chloride solution and distilled water.

Complete the table to show how he made 20 cm3 of a 0.2 mol dm–3 sodium chloride solution.

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| --- | --- | --- |
|   | **Volume of 1.0 mol dm–3 sodium chloride solution** | **Volume of distilled water** |
|   |   |   |

**(1)**

(c)     The student calculated the *percentage* change in mass rather than the change in mass. Explain the advantage of this.

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**(2)**

(d)     The student carried out several repeats at each concentration of sodium chloride solution. Explain why the repeats were important.

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**(2)**

(e)     Use the graph to find the concentration of sodium chloride solution that has the same water potential as the potato cylinders.

.............................. mol dm–3

**(1)**

**(Total 8 marks)**

**Q3.**          The diagram shows a carrot.



A group of students investigated the effect of sucrose concentration on the length of cylinders cut from a carrot.

(a)     The students used a cork borer to cut cylinders from the carrot. Describe how the students should cut these cylinders to make sure that this was a fair test and would produce reliable results.

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**(2)**

(b)     They measured the initial length of each cylinder then placed the cylinders into test tubes containing different concentrations of sucrose solution. Bungs were placed in the tubes and the tubes were left overnight. Explain why the bungs were placed in the tubes.

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**(2)**

(c)     The students then measured the final lengths of the carrot cylinders. Their results are shown in the table.

|  |  |
| --- | --- |
| Concentration of sucrose / mol dm–3 |  |
| 0.0 | 1.4 |
| 0.2 | 1.4 |
| 0.4 | 1.2 |
| 0.6 | 1.1 |
| 0.8 | 0.9 |

(i)      The students used these results to find the concentration of sucrose that has the same water potential as the carrot cylinders. Describe how they could have done this.

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**(2)**

(ii)     Was it important in this investigation that the carrot cylinders had the same initial length? Explain your answer.

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**(1)**

**(Total 7 marks)**

**Q4.**          Tradescantia is a house plant. There are small hairs on its flowers. These hairs are made of cells. **Figure 1** shows the appearance of cells from one of these hairs after 20 minutes in distilled water. **Figure 2** shows cells from another hair after 20 minutes in a solution of potassium nitrate.

**Figure 1** (in distilled water)



**Figure 2** (in potassium nitrate solution)



(a)     What does **Figure 2** suggest about the permeability of the plasma membranes surrounding these cells?

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**(1)**

(b)     What is present in the space labelled **F**? Explain your answer.

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**(2)**

(c)     How would the water potential of the sap in the vacuole of cell **E** differ from the water potential of the sap in the vacuole of cell **D**? Explain your answer.

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**(3)**

**(Total 6 marks)**

**M1.**(a)     Calculations made (from raw data) / raw data would have recorded initial and final masses;

**1**

(b)     Add 4.5 cm3 of (1.0 mol dm–3) solution to 25.5 cm3 (distilled) water;

*If incorrect, allow 1 mark for solution to water in a proportion of 0.15:0.85*

**2**

(c)     1.      Water potential of solution is less than / more negative than that of potato tissue;

*Allow Ψ as equivalent to water potential*

2.      Tissue loses water by osmosis;

**2**

(d)     1.      Plot a graph with concentration on the *x*-axis and percentage change in mass on the *y*-axis;

2.      Find concentration where curve crosses the *x*-axis / where percentage change is zero;

3.      Use (another) resource to find water potential of sucrose concentration (where curve crosses *x*-axis);

**3**

**[8]**

**M2.**          (a)     Water will affect the mass / only want to measure water taken up or lost;

Amount of water on cylinders varies / ensures same amount of water on outside;

*Neutral: removes water*

*Accept: ‘(sodium chloride) solution’ for water*

*Do not accept ‘sodium chloride’*

*Neutral: refs. to fair testing*

**2**

(b)     4 cm3 (of 1.0 mol dm–3 sodium chloride solution) and 16 cm3 (of distilled water);

*Reject: factors and multiples of these figures e.g. 2 cm3 and 8 cm3, as final volume should be 20 cm3*

**1**

(c)     Allows comparison / shows proportional change;

Idea that cylinders have different starting masses / weights;

*Reject: if comparison is in context of the start and final mass of the same cylinder*

*Neutral: different masses*

*Neutral: different starting sizes*

**2**

(d)     (Allows) anomalies to be identified / ignored / effect of anomalies to be reduced / effect of variation in data to be minimised;

Makes the average / mean / line of best fit more reliable / allows concordant results;

*Accept: ‘outliers’ instead of anomalies*

***Q*** *Reject: abnormalities*

*Reject: idea of not recording anomalies / preventing anomalies from occurring*

*Accept: ‘cancels out anomalies’ as bottom line response*

***Q*** *Reject: makes the average / mean more accurate*

*Neutral: makes the average / mean more valid*

*Neutral: makes ‘it’ / results / conclusion more reliable*

**2**

(e)     0.35 (mol dm–3)

**1**

**[8]**

**M3.**          (a)     Lengthways / down the root;

Through one tissue only / through same part / same proportion of tissues;

**2**

(b)     To prevent the water from evaporating / prevent evaporation;

Changing the concentrations / water potential (of solution);

**2**

(c)     (i)      Plot data on a graph;

Find (sucrose concentration) from the graph where the ratio is 1;

**2**

(ii)     No, because the results are given as a ratio / as a proportion of initial length;

**1**

**[7]**

**M4.**          (a)     partially / selectively permeable *accept semi-permeable*allows water to pass through but not potassium nitrate / solute;

**1**

(b)     potassium nitrate (solution);
cell wall permeable;

**2**

(c)     water potential more negative / lower in cell E; water removed;
greater solute / sap concentration (in cell);

**3**

**[6]**

**E2.**          (a)     60% of candidates gained one mark for the idea that water on the outside of the cylinders would affect the mass, or that only the water taken up or lost should be measured. Only the very best candidates were aware that the amount of water on the cylinders would vary. A common response by weaker candidates was that water on the outside of the cylinders would allow further osmosis before reweighing. This was not credited. Vague responses that referred to greater reliability or accuracy were common.

(b)     One third of candidates gave the correct volumes of 4cm3 and 16cm3.

(c)     It was encouraging to note that candidates did better on this question than they did on a comparable question in January 2010. One third of candidates gained full credit. Many were aware that expressing a change as a percentage allows a comparison to be made. However, it was usually only better candidates who wrote that the cylinders would have different starting masses. The stem of the question made it clear that both the starting and final masses of the cylinders were recorded. It therefore had to be clear to which of these the candidates was referring. Weaker candidates often referred to ‘different sizes’ or ‘different masses’. These responses were not credited.

(d)     Two thirds of candidates gained one mark for the idea that anomalies could be identified. However, some thought that repeats prevented anomalies from occurring or being recorded. It was only the very able candidates who wrote that repeats allow a more reliable mean to be calculated. Taking additional readings does not necessarily allow results to be closer to the true value. Hence, references to ‘a more accurate mean’ were not credited. Weaker candidates often referred to ‘the results’ being more reliable or more accurate without qualifying their answers.

(e)     70% of candidates correctly read off the intercept on the *x*-axis at 0.35 mol dm–3.

**E3.**          This unit requires practical work to be undertaken that includes the effect of solute concentration of water uptake by plant tissue. In this question, therefore, candidates were required to demonstrate their understanding of such prescribed practical techniques. It was evident from the responses to this question that although many candidates had some experience of related practical investigations, they had little understanding of the procedures involved. Many otherwise sound candidates gained very little credit on this question.

(a)     The diagram clearly showed two different tissues, but only the best candidates based their answers on this information and described cutting the cylinders in such a way as to ensure that they consisted of the same tissue. Many of the answers did little more than reiterate what have become standard responses in past practical assessments without attempting to apply general principles to a novel situation. In this particular case, references to the same cork borer or the same length were irrelevant. There were also a number of vague references to ensuring that this would be a fair test. Candidates would be well advised not to use this term without appropriate amplification.

(b)     It was immediately apparent from marking this question that many of the less able candidates had undertaken practical investigations without any understanding of what they were trying to do. Thus there were numerous responses that indicated confusion with investigations of enzyme activity or respiration. Where candidates did appreciate that the essential purpose of the bungs was to minimise evaporation, it was uncommon for them to refer to the evaporation of water evaporating resulting in a change in the concentration of the sucrose solution.

(c)     Candidates who read this question with sufficient care should have noted that it referred to the results provided in the table. Accounts, therefore based on repeating the investigation with other sucrose solutions were inappropriate and did not gain credit. The investigations carried out for assessment of practical skills at AS all require candidates to plot their data as appropriate graphs, and it was hoped that candidates would have applied a similar approach here. Relatively few did, and of these, even fewer appreciated that they should identify the concentration of sucrose in which the ratio of final length to initial length was 1. Few candidates displayed an understanding of the concept of a ratio in part (ii).

**E4.**          (a)     Candidates were usually able to gain credit where they confined their responses to appropriate terms such as “partially permeable”. They experienced difficulties, however, when they used less acceptable phrases such as “fairly permeable”, or attempted to explain what they meant in terms of “letting potassium nitrate through”.

(b)     Somewhat surprisingly many of the less able candidates appeared aware that potassium nitrate would be present in the space indicated, although they were unable to support this with a convincing explanation. Others had little idea, and there were frequent references to empty spaces, vacuums, cytoplasm and a variety of cell organelles. The examiners were of the opinion that although many candidates can reproduce the sequence of events associated with osmosis, they have little real understanding of plasmolysis.

(c)     Answers to this part of the question were much more convincing and the underlying principles were widely understood. Predictably, some candidates encountered difficulties over expressing comparisons between the negative values of different water potentials. Most of these arose where they attempted to use terminology relating to both more and less negative, and to higher and lower. Contradiction often resulted.