1. Cell Membrane and Transport

An experiment was conducted to determine the concentration of molecules in the cytoplasm of potato cells. The following steps were taken:

1. Five different sugar solutions were added to five numbered test tubes as shown in the data table below.
2. Five potato discs (cut from the same potato) were weighed and one disc was added to each test tube.
3. After 24 hours, the potato discs were removed, blotted dry, and weighed again.

<table>
<thead>
<tr>
<th>TEST TUBE</th>
<th>CONCENTRATION OF SUGAR SOLUTION (%)</th>
<th>INITIAL POTATO MASS (grams)</th>
<th>FINAL POTATO MASS (grams)</th>
<th>CHANGE IN MASS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.0</td>
<td>5.0</td>
<td>4.0</td>
<td>– 20</td>
</tr>
<tr>
<td>2</td>
<td>20.0</td>
<td>4.8</td>
<td>4.3</td>
<td>– 10</td>
</tr>
<tr>
<td>3</td>
<td>10.0</td>
<td>5.2</td>
<td>5.5</td>
<td>+ 6</td>
</tr>
<tr>
<td>4</td>
<td>5.0</td>
<td>4.7</td>
<td>5.4</td>
<td>+ 15</td>
</tr>
<tr>
<td>5</td>
<td>0.0 (distilled water only)</td>
<td>5.1</td>
<td>6.1</td>
<td>+ 20</td>
</tr>
</tbody>
</table>

a) Name and describe the process that allowed the potato cells to gain and lose mass when placed in the sugar solutions. (2 marks: 1 mark for name; 1 mark for description)

**osmosis** – the movement of water molecules from high concentration to lower concentration across a selectively permeable membrane

b) Explain the change in mass of the potato disc in test tube 1. (2 marks)

The cells in the potato lost mass due to the process of osmosis. This is because they were placed in a hypertonic environment.

c) Draw a graph that compares the concentration of sugar solution (%) to the change in mass (%) of the potato discs. Label the x-axis as the concentration of sugar solution (%). (2 marks)

![Graph](image)

Change in Mass (%) vs. Sugar Concentration (%)

Change in Mass of Potato Cells as a Result of Various Sugar Concentrations

d) Use your graph to determine the concentration of sugar solution (%) that would be isotonic to the cytoplasm of the potato cells. (1 mark) ≈ 13.5 % sugar solution
2. Which of the following cells is the most efficient in terms of diffusion of wastes out of the cell?

<table>
<thead>
<tr>
<th>CELL</th>
<th>SURFACE AREA (μ²)</th>
<th>VOLUME (μ³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

3. The diagram above shows a thistle tube suspended in a solution. The initial concentrations of the solutions inside and outside the thistle tube are indicated. What will happen to the concentration of the salt solution surrounding the thistle tube?
A. It will decrease as salt moves into the thistle tube.
B. It will increase as salt moves out of the thistle tube.
C. It will increase as water moves into the thistle tube.
D. It will decrease as water and glucose move out of the thistle tube.

4. The diagram shows a white blood cell ingesting a bacterium. The bacterium enters the white blood cell by

Molecules in the cell membrane that function as receptors are

5. a) Which of the following will be affected directly if the mitochondria in a cell are not functioning properly?
A. Absorption of alcohol by the cell.
B. The movement of water into and out of the cell.
C. The movement of oxygen across the cell membrane.
D. The movement of sugar from a low to a high concentration.

b) A slice of potato placed in distilled water becomes firm after several hours because
A. salt has passed into the potato cells.
B. cellulose synthesis in the cell wall has been stimulated.
C. water has passed into the potato cells causing the cells to swell.
D. water has passed out of the potato cells causing the cells to shrink.

c) Which of these substances cannot pass through cell membranes?

6. Which of the following processes is represented in the diagram?
A. Osmosis.
B. Diffusion.
C. Hydrolysis.
D. Endocytosis.
7. Simple diffusion of molecules would occur most rapidly in which of the cells above?
A. Cell X, because it has a smaller volume.
B. Cell X, because it synthesizes proteins at a faster rate.
C. Cell Y, because it can move around more quickly.
D. Cell Y, because it has a larger surface area.

8. Two identical red blood cell samples were prepared for an experiment. The samples were placed in two different solutions and the percent change in mass was recorded and graphed over an eight hour period as shown below.

a) Account for the change in mass of the cells in Solution A during the first four hours. (2 marks)

The red blood cells gained mass due to the process of osmosis. This is because it was placed in a hypotonic environment.

b) What happened to the cells in Solution A after four hours? (1 mark)

The cell burst (lysis)

c) Give one reason for the results obtained from the cells placed in Solution B between three and eight hours. (1 mark)

The red blood cell lost water by osmosis and became isotonic to its surrounding environment.

9. In the situation shown in the diagram above,
A. water will enter A and the concentration of the protein solution will increase.
B. water will enter A and the concentration of the protein solution will decrease.
C. water will enter B and the concentration of the protein solution will increase.
D. water will enter B and the concentration of the protein solution will decrease.
10. The diagram below is a student drawing of an onion cell before and after it was placed in a solution.

The solution

A. caused the cell to gain water by osmosis.
B. increased the rate of active transport of ions.
C. resulted in a hypertonic environment for the cell.
D. ruptured the cell membrane, releasing cytoplasm.

11. Identify molecules X and Y in the diagram above. For each molecule, give one function and name its unit molecules (building blocks). (6 marks: 1 mark each)

X - phospholipid – makes up the cell membrane that separates the cell’s contents from its surrounding environment - made up of fatty acids, glycerol and a phosphate group
Y - Protein - creates a channel that allows specific molecules to enter or exit the cell – made up of amino acids

12. Materials can enter cells by several different mechanisms. List four of these mechanisms. Explain the processes involved in two of the mechanisms that require energy. (6 marks)

Facilitated Transport
Diffusion
Active Transport
Phagocytosis
Pinocytosis
Receptor-mediated endocytosis

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13. A plant cell is placed in an unknown salt solution. The cell membrane is impermeable to salt. The graph represents the change in salt concentration within the cell. (4 marks)

a) Explain the results shown on the graph between 0.5 hours and 2.0 hours (2 marks)
During this time the concentration of the salt in the cell is going down that means water must be moving in by the process of osmosis. Therefore the cell must be in a hypotonic solution.

b) Explain the results shown on the graph between 2.0 hours and 4.0 hours (2 mark)
The cell gains enough water that the cell becomes isotonic to its environment. Thus the net movement of water into the cell equals the net movement of water out of the cell.

OR
The cell gains water in the hypotonic solution until the point that the cell wall creates turgor pressure which opposes the osmotic pressure from osmosis. The surrounding environment is still hypotonic but the net movement of water into the cell equals the net movement of water out of the cell due to the opposing pressures.