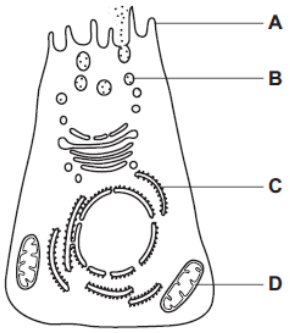
Name:_____ Period:_____

AICE Biology: Membranes and Transport Problem Set

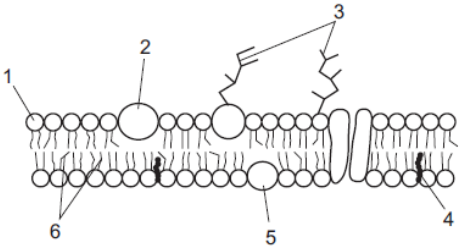
Answer the following questions to the best of your ability. This problem set is worth 20 points and is due Friday, September 14. Be sure to check your problem sets for accuracy when complete!

1. The diagram is a drawing from an electron micrograph of a cell.

Which structure indicates that this is a secretory cell?



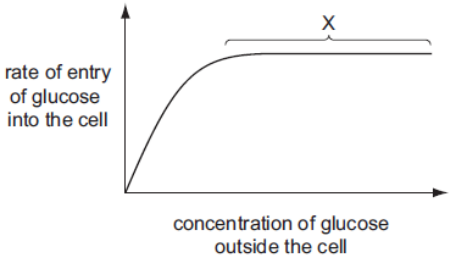
2. The diagram represents the fluid mosaic model of membrane structure.



Which two components contribute to the fluidity of the membrane?

A 1 and 3 **B** 2 and 4 **C** 3 and 5 **D** 4 and 6

3. The graph shows how the rate of entry of glucose into a cell changes as the concentration of glucose outside the cell changes.



What is the cause of the plateau at X?

A All the carrier proteins are saturated with glucose.

B The carrier proteins are denatured and no longer able to function.

C The cell has used up its supply of ATP.

D The concentrations of glucose inside and outside the cell are equal.

A molecule can enter a cell by two different passive processes.

4. Which process would increase the rate at which this molecule enters the cells?

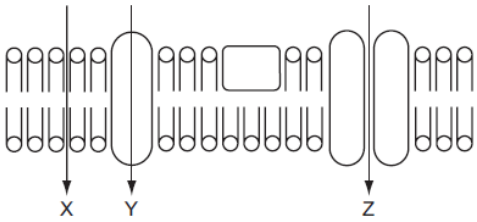
A diffusion

B endocytosis

C facilitated diffusion

D osmosis

5. The diagram shows three routes, X, Y and Z, through which substances can pass across a cell surface membrane.



Which correctly shows the routes for vitamin D, which is fat soluble, and vitamin C, which is water soluble?

	vitamin D	vitamin C
A	Y	X
B	X	Y
C	X	Z
D	Z	Y

6. In plants adapted to cold conditions, their cell surface membranes change as the weather gets colder, allowing the plants to carry out exocytosis.

Which change occurs in their cell surface membranes?

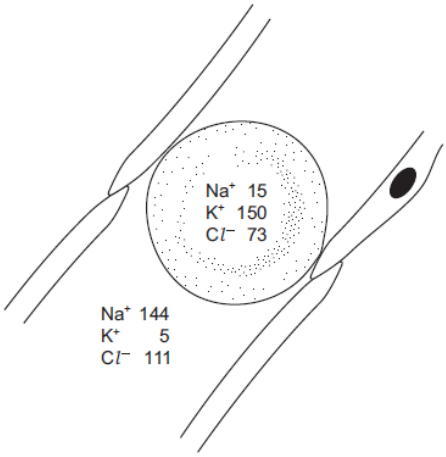
A a decrease in the ratio of proteins to saturated phospholipids

B a decrease in the ratio of unsaturated phospholipids to saturated phospholipids

C an increase in the ratio of proteins to unsaturated phospholipids

D an increase in the ratio of unsaturated phospholipids to saturated phospholipids

7. The diagram shows a red blood cell and the concentrations of ions, in mmol dm^{-3}, in the plasma and in the cell.



Which ions are actively transported into and out of the cell?

	into cell	out of cell
A	Cl^-	K^+
B	K^+	Na^+
C	Na^+	Cl^-
D	Na^+	K^+

8. Diagrams 1 and 2 show how the transverse section through a leaf changes when moved from one solution W to a different solution Y.

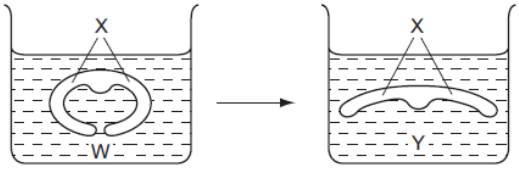


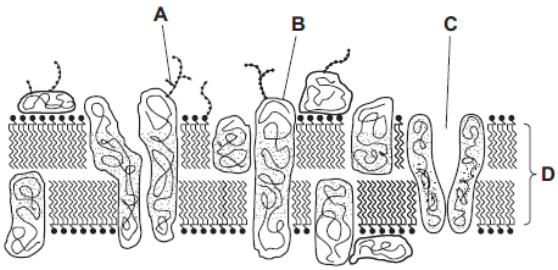
diagram 1 diagram 2

How has the water potential changed in diagram 2?

	difference in cells at X in solution Y compared to the same cells in solution W	difference in solution Y compared to solution W
A	less negative	less negative
B	less negative	more negative
C	more negative	less negative
D	more negative	more negative

9. Cystic fibrosis is a disease where Cl^- ions are unable to be transported into cells.

Which structure in the cell surface membrane is faulty?



10. Red blood cells were placed in a solution of sodium chloride with a less negative water potential than the cell contents. Haemoglobin was released from the cells.

By what process was the haemoglobin released?

A active transport

B exocytosis

C facilitated diffusion

D lysis of cell

11. The table shows three processes that contribute to transport across cell surface membranes.

Which processes are the result of random movement of molecules?

	diffusion	facilitated diffusion	osmosis
A	✓	✓	✗
B	✓	✓	✓
C	✗	✓	✓
D	✗	✗	✗

key
✓ = random
✗ = non-random

12. The cell surface membranes of plants adapted to cold conditions change as the weather gets colder, allowing the plants to carry out exocytosis.

Which change occurs?

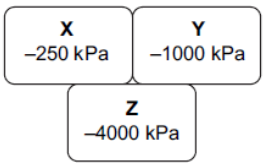
A a decrease in the ratio of proteins to saturated phospholipids

B a decrease in the ratio of unsaturated phospholipids to saturated phospholipids

C an increase in the ratio of proteins to unsaturated phospholipids

D an increase in the ratio of unsaturated phospholipids to saturated phospholipids

13. The water potential of three adjacent plant cells is shown.



In which direction will water move?

A from cell **X** to cell **Y** and then cell **Z** only

B from cell **X** to both cells **Y** and **Z**

C from cell **Z** to cell **Y** and then cell **X** only

D from cell **Z** to both cells **Y** and **X**

14. The table shows three processes that contribute to transport across cell surface membranes.

Which processes are the result of random movement of molecules?

	diffusion	endocytosis	osmosis
A	✗	✗	✗
B	✗	✓	✓
C	✓	✗	✓
D	✓	✓	✗

key
✓ = random
✗ = non random

15. The epithelial cells of people with cystic fibrosis have a defect in the structure of the cell surface membrane. The ability of the cell to transport chloride ions out of the cell is affected.

Which membrane component is involved?

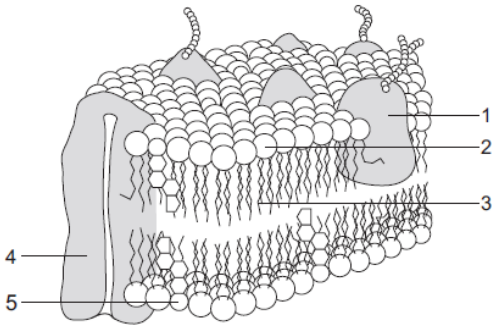
A cholesterol

B glycolipid

C phospholipid

D protein

16. The diagram shows part of the cell surface membrane.

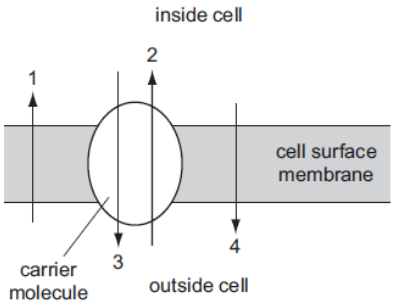


Which components help to maintain the fluidity of the membrane?

A 1 and 3 **B** 1 and 4 **C** 2 and 4 **D** 3 and 5

17. The diagram shows the transport of ions across the cell surface membrane. Inside the cell there is a low concentration of sodium ions (Na^+) and a high concentration of potassium ions (K^+). Outside the cell there is a low concentration of K^+ and a high concentration of Na^+.

The carrier molecule is a pump which exchanges Na^+ for K^+ ions.



Which ionic movements are represented by the arrows?

	active transport of K^+	active transport of Na^+	diffusion of Na^+	diffusion of K^+
A	2	3	1	4
B	2	3	4	1
C	3	2	1	4
D	3	2	4	1

18. Plant cells were immersed in solutions of different water potential and left for one hour.

Which row shows the effect of the different solutions on the plant cells?

	water potential of solution compared to plant cells		
	less negative	equal	more negative
A	flaccid	turgid	unchanged
B	flaccid	unchanged	turgid
C	turgid	unchanged	flaccid
D	unchanged	flaccid	turgid

19. Which molecules, found in cell surface membranes, contribute to cell recognition?

1 glycolipids
2 glycoproteins
3 phospholipids

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

20. Molecules 1, 2 and 3 are found in cell surface membranes.

1 glycolipids
2 glycoproteins
3 phospholipids

Which contribute to cell recognition?

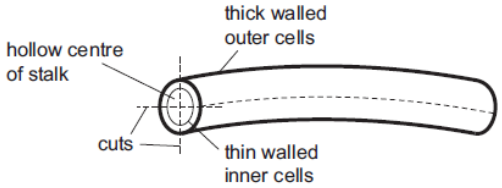
A 2 only
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

21. What are the features of facilitated diffusion?

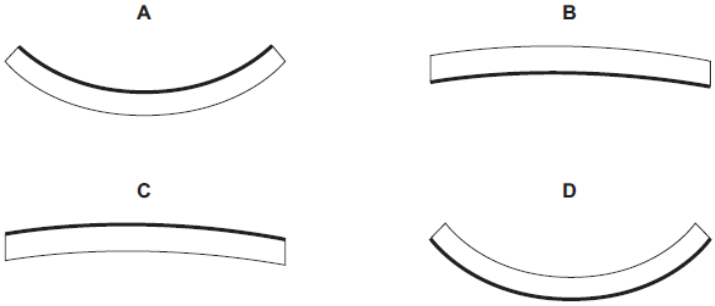
	uses proteins in membrane	uses ATP	molecules move down a concentration gradient
A	✓	✓	✓
B	✗	✓	✓
C	✓	✗	✓
D	✓	✓	✗

key:
✓ correct
✗ incorrect

22. The stalk of a dandelion flower is a hollow tube. Pieces of the stalk are cut as shown and placed in sucrose solutions of different water potentials.



Which diagram shows the piece that is placed in the sucrose solution with the highest water potential?



23. What happens to an animal cell when it is placed in a solution with a more negative water potential?

A It loses solutes to the solution and swells.

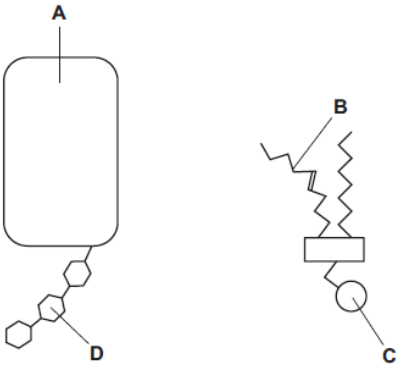
B It loses water by osmosis and shrinks.

C It takes in solutes and swells.

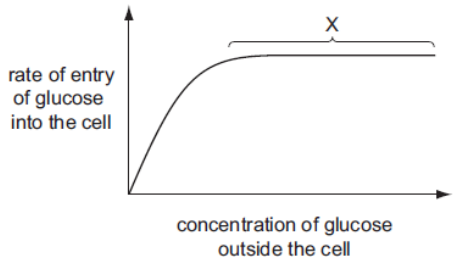
D It takes in water by osmosis and bursts.

24. The diagrams show two molecules found in cell surface membranes.

Which part affects the fluidity of the membrane?



25. The graph shows how the rate of entry of glucose into a cell changes as the concentration of glucose outside the cell changes.



What is the cause of the plateau at X?

1 All the carrier proteins are saturated with glucose.

2 The cell has used up its supply of ATP.

3 The concentrations of glucose inside and outside the cell are equal.

A 1 only

B 3 only

C 1 and 2 only

D 2 and 3 only

26. The following are all processes by which substances can enter cells.

1 phagocytosis

2 active transport

3 facilitated diffusion

Which processes require ATP?

A 1 only

B 2 only

C 1 and 2 only

D 2 and 3 only

27. In the space below, complete an annotated diagram of a cross-section of a cell membrane. Include a measurement of the membrane's relative thickness.

28. **(a)** Cell surface membranes are involved with the movement of substances into and out of cells.

Calcium pumps in cell surface membranes maintain a concentration of calcium ions inside the cytoplasm that is a thousand times lower than outside the cell.

Fig. 1.1 shows the movement of calcium ions across a cell surface membrane.

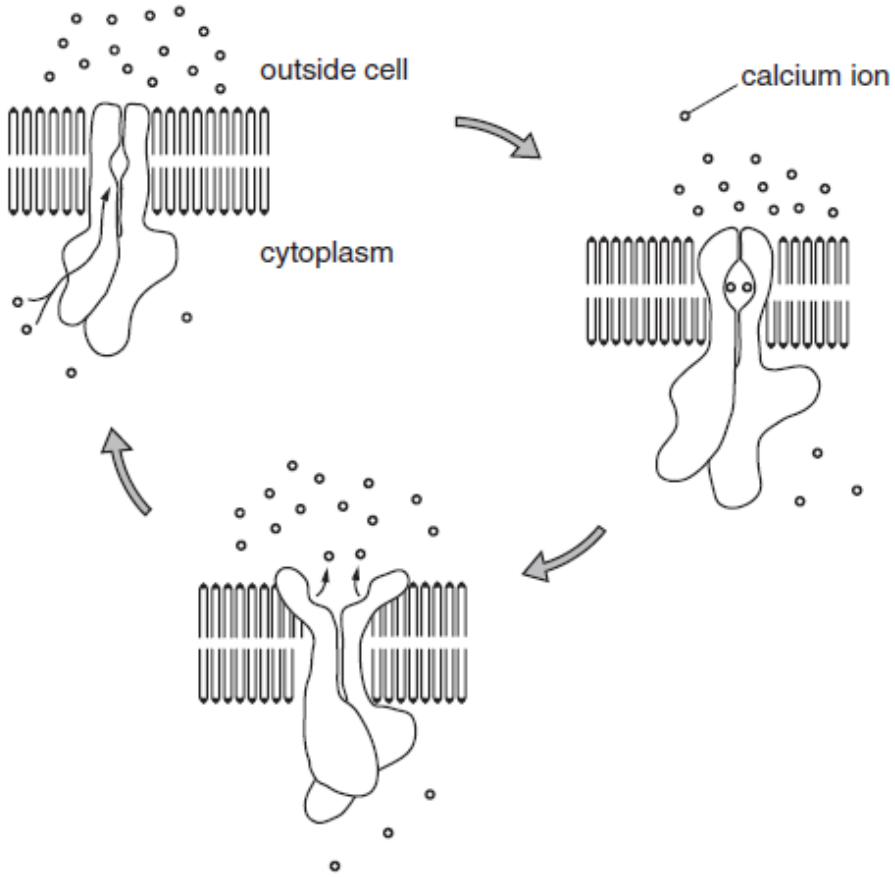


Fig. 1.1

With reference to Fig. 1.1,

(i) explain why calcium ions do not pass through the phospholipid bilayer;

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28. continued…

(ii) name and describe the process by which calcium ions are moved across the membrane.

name .....

description .....

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(b) Phagocytosis is the process by which bacteria are ingested by cells.

Describe the role of the cell surface membrane during phagocytosis.

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(c) Phagocytic cells contain many lysosomes.

Describe the function of lysosomes in destroying ingested bacterial cells.

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[Total: 12]

29. Fig. 1.1 is a diagram of a cell surface membrane.

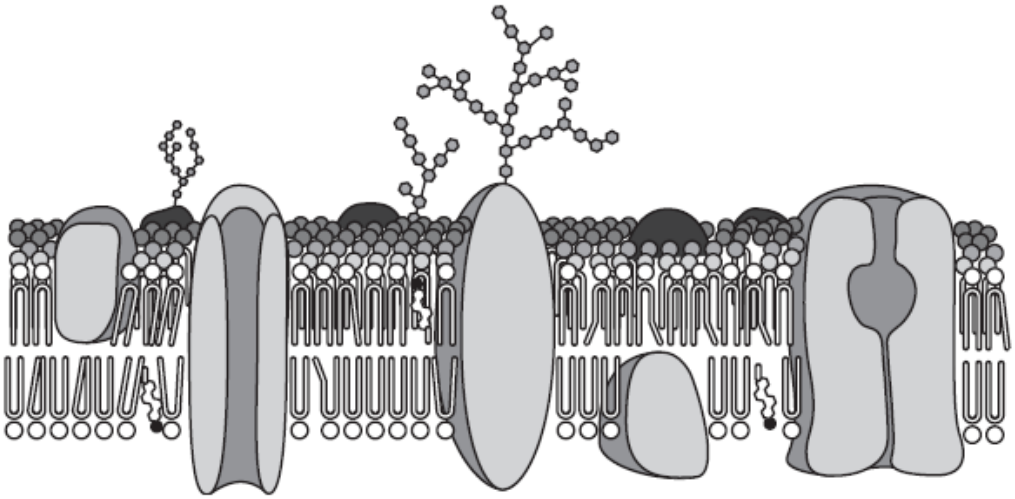

Fig. 1.1

(a) Use a label line and the appropriate letter to label each of the following on Fig. 1.1.

P protein for active uptake of potassium ions

Q protein for facilitated diffusion of polar molecules

R receptor site for a hormone

S hydrophilic heads of phospholipids on the internal surface of the membrane

T molecule that modifies the fluidity of the membrane [5]

(b) Some cells take in bacteria by endocytosis.

Explain how endocytosis occurs at a cell surface membrane.

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[Total: 8]

30. Red blood cells are suspended in plasma which has a concentration equivalent to that of 0.9% sodium chloride (NaC*l*) solution.

A student investigated what happens to red blood cells when placed into sodium chloride solutions of different concentration.

A small drop of blood was added to 10 cm^3 of each sodium chloride solution. Samples were taken from each mixture and observed under the microscope. The number of red blood cells remaining in each sample was calculated as a percentage of the number in the 0.9% solution. The results are shown in Fig. 3.1.

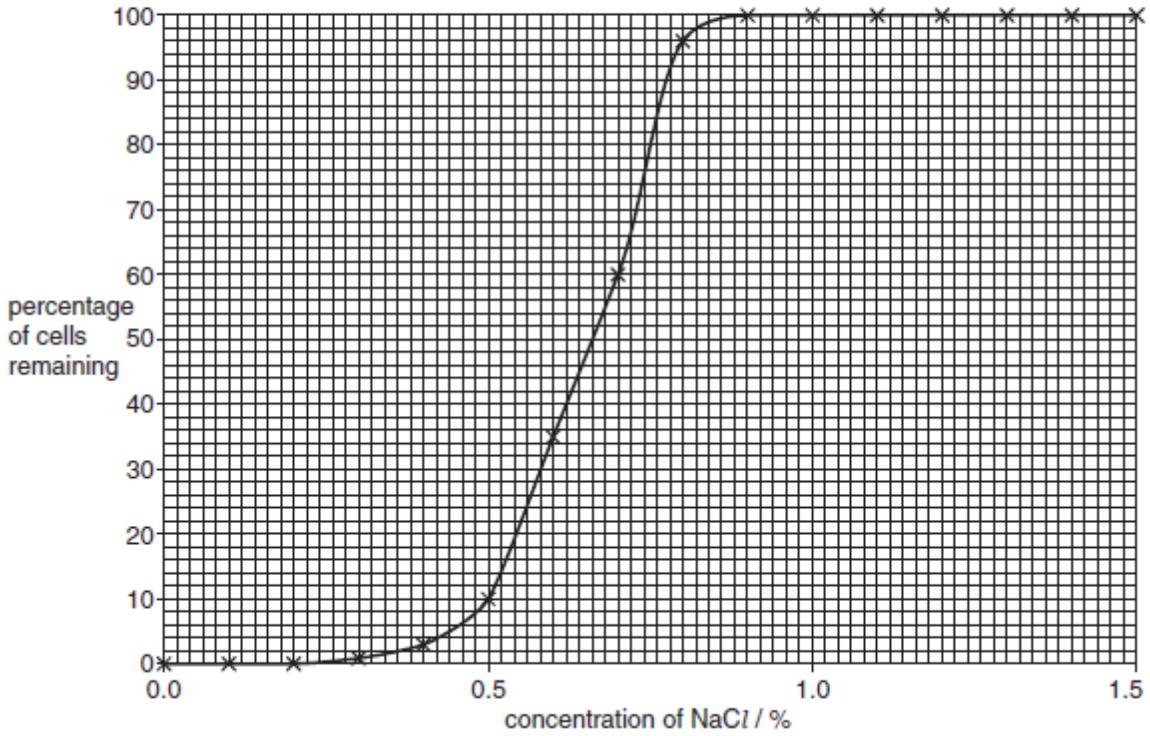

Fig. 3.1

(a) With reference to Fig. 3.1, describe the student's results.

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30. continued…

The student also measured the cell volumes of the red blood cells in three of the sodium chloride solutions. The results are shown in Table 3.1.

Table 3.1

concentration of sodium chloride /%	mean red cell volume /μm^3
0.7	120
0.9	90
1.5	65

Fig. 3.2 shows the appearance of some red blood cells removed from the 1.5% sodium chloride solution.

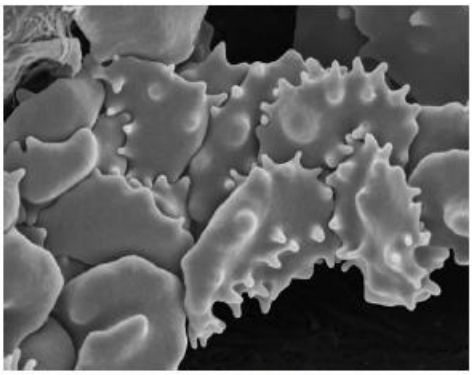

Fig. 3.2

(b) Explain the results shown in Fig. 3.1, Table 3.1 and Fig. 3.2, in terms of **water potential**.

0% NaCl solution .....

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0.7% NaCl solution .....

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1.5% NaCl solution .....

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31. **(a)** Enzymes are globular proteins that catalyse metabolic reactions.

Describe the features of globular proteins.

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(b) Enzymes can be used to remove cell walls from plant and fungal cells. The cells are incubated in a solution that contains a mixture of enzymes.

(i) Suggest an explanation for the fact that a different mixture of enzymes is required to remove the walls of plant cells compared to the walls of fungal cells.

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(ii) Explain why, when plant cells are incubated with enzymes to remove their cell walls, it is important to maintain an optimum pH.

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31. continued…

(c) A student carried out an investigation into osmosis using red blood cells.

Red blood cells were placed in sodium chloride (salt) solutions at five different concentrations. For each concentration, a sample was added immediately to a microscope slide and the cells were viewed using a light microscope for a period of time. The observations recorded are shown in Table 3.1.

Table 3.1

concentration of salt solution/%	observation of red blood cells
0.0	swell and burst, numbers decrease
0.4	increase in size
0.9	remain the same size
1.5	decrease in size
3.0	smaller and shrivelled

Explain, in terms of **water potential** and osmosis, the results that the student obtained.

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31. continued…

(d) The student also carried out a similar investigation using plant cells with cell walls removed. These cells were suspended in a 12% mannitol solution so that the water potential inside and outside of the cells was equal.

Fig. 3.1 is a photomicrograph of these cells.

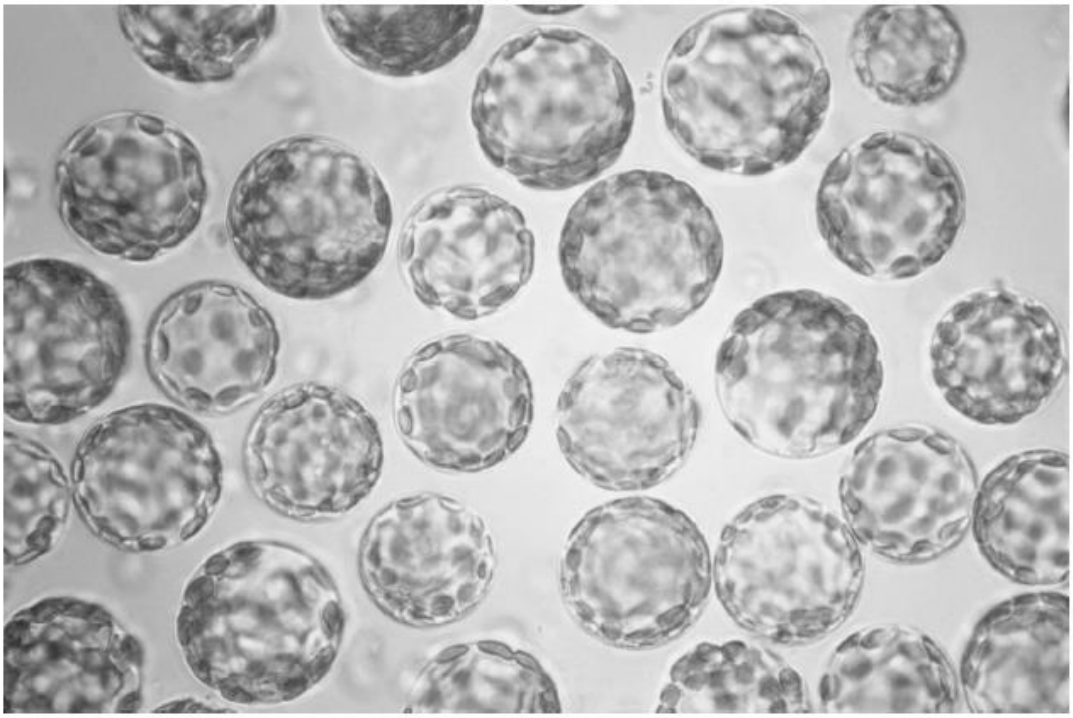

Fig. 3.1

The student removed a sample of these cells. The sample was placed into distilled water and was viewed using a light microscope.

Describe what you would expect the student to observe and explain why this would not occur with normal plant cells.

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[Total: 14]

32. The fluid mosaic model of membrane structure was first proposed in 1972 by Singer and Nicolson. The model describes in detail how the components of a membrane are organised.

(a) Some of the components of the cell surface membrane are:

- phospholipid molecules
- protein molecules
- cholesterol molecules.

(i) In the box below, draw a labelled diagram of a section through a cell surface membrane to show how the above components are organised within the membrane.

The diagram should include other named components of the membrane.

Label the inner and outer surfaces of the membrane.

[5]

(ii) Suggest why 'fluid mosaic' is an appropriate term to use to describe membrane structure.

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[Total: 8]