CLASS: FORM 1

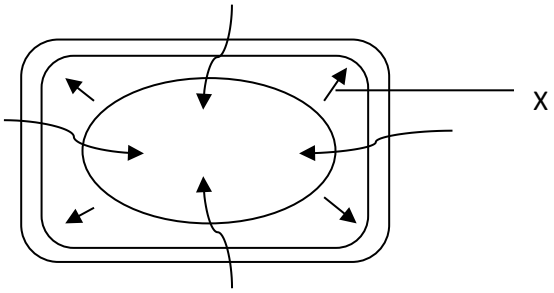
SUBJECT: BIOLOGY.

TOPIC 4: CELL PHYSIOLOGY.

1. Distinguish between diffusion and osmosis.

Diffusion	**Osmosis**
- Involves movement of particles of molecules of liquid or gas **- It may be through a membrane or air.** **- Not affected by PH changes.**	**- Involves movement of solvent molecules** **- It takes place through a semipermeable membrane.** **- Rate affected by pH changes.**

2. The diagram below shows results of what happens to plant cell when placed in a certain solution.



a) What was the nature of the solution in which the cell was placed?
Hypotonic solution;
b) Identify the force represented by the arrow X and explain how it develops.

Turgor pressure; the cell gained water through the process of osmosis and becomes turgid; Rej: Absorbed for gained;

3. Explain how water from the soil is gained by root hair in plants.

The cell sap is hypertonic to soil solution/soil water; water is drawn into the root hair cell across the cell membrane by osmosis;

4. State one similarity between diffusion and osmosis .
Molecules move passively from region of high concentration to region of low concentration;

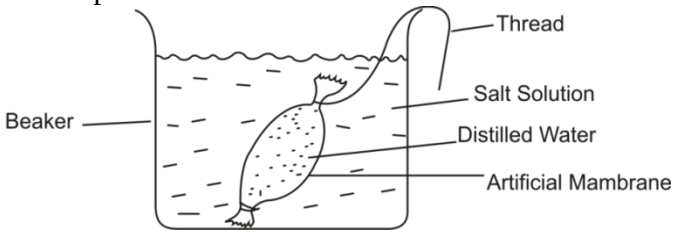
5. State two factors that can reduce the rate of active transport.

-Presence of metabolic poisons;
-Low oxygen concentrations in the cell
-Low glucose concentration in the cell

6. Explain the role of osmosis in organisms.

<u>Absorption of water from the soil;</u>
Root hair cells of plants absorb water from the soil by osmosis; it also helps in water distribution from cell to cell in the body.
Support;
Water taken into the cells increase cell turgor hence cells become firm /rigid/turgid; and therefore turgidity in the cells provide support to plant organs;
<u>Opening and closing of stomata;</u>
Guard cells become turgid; when they take in water by osmosis; Turgid guard cells cause the stomata to open; when the guard cells lose water by osmosis they become flaccid leading to the closure of the stomata;
<u>Feeding of insectivorous plants;</u>
The plants trap insects using special structures that suddenly change there turgor pressures when disturbed; the change in turgor pressure enables the special structures/ leaves to close trapping the insect which are then digested to provide amino acids;
<u>Osmoregulation;</u>
In kidney tubules of animals; water is withdrawn from the tubules through the tubular walls through osmosis; the water then enter the surrounding blood capillaries, this helps the animal to regulate its body osmotic pressure;

7. An experiment was set up as shown below



The set up was left for 30 minutes.
a).What was the aim of the experiment?

Osmosis b).State and explain what would be observed after 30 minutes.

The artificial membrane decreases in size or loss turgidity; salt solution is hypertonic and develops osmotic pressure which draws water osmotically; from inside the membrane across the membrane to the salt solution making the membrane to be less swollen.

8. Distinguish between Plasmolysis and turgidity.

Plasmolysis	**turgidity**
Plant cell loses water by osmosis	**Plant cell gain water by osmosis**

9. Explain how the following factors affect active transport

a).Oxygen concentration

Increase in oxygen concentration increases respiration to produce more energy for higher rate of active transport.

b).Metabolic poisons

Inhibit respiratory enzymes hence reduce energy production thus reduce active transport which require energy.

10. Define the term diffusion.

Process by which particles move from a region of high concentration to a region of low concentration;

11. Define osmosis.

-Movement of water molecules from a region of high (water) concentration to a region of low (water) concentration through a semi-permeable membranes.

12. Explain why osmosis is a special type of diffusion.

Involve movement of water molecules from a region where they are highly, concentrated (Hypotonic) to a region where they are lowly concentrated (hypertonic);

13. What is the importance of carriers in active transport?

Movement of substances from one part of cell membrane to another;

14. Name a compound that stores energy in a cell.

Adenosine triphosphate.

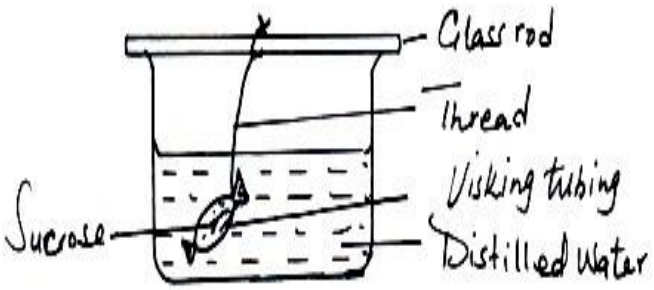
15. Explain why cell membrane is semi-permeable.

Allows the passage of certain substances but prevents passage of others;

16. Why is oxygen important in the process of active transport?

Oxygen is required for respiration that produces energy for active transport;

17. An experiment was set up as shown below.

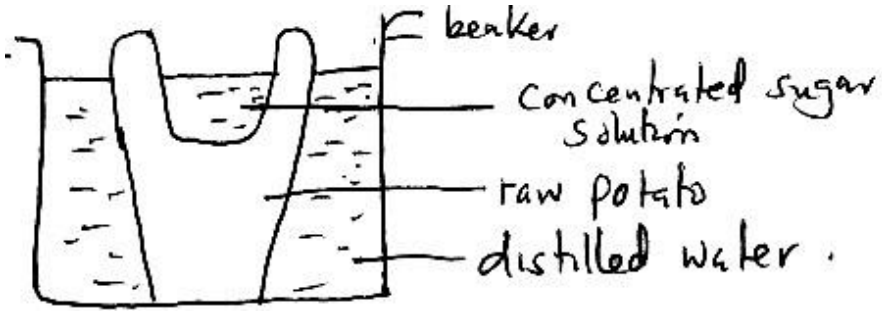


The set up was left for 30 minutes.
a).State the expected results. -
The visking tubing enlarges;
- **Level of sucrose solution in visking tubing increases;**
- **Level of water in beaker decreases;**

(b) Explain the observation above.

- **Water move from the beaker into visking tubing by osmosis; through the semi-permeable visking tubing, with hypertonic solutions;**

18. The diagram below represents a set-up to investigate a certain physiological process.



After some time the level of sugar solution was observed to have risen. a).What physiological process was being investigated?

Osmosis;

b) Account for the rise in the level of sugar solution.

Sugar solution is hypertonic to the cell sap; Potato cell (in contact with sugar solution) loses water by

Osmosis; making cells to draw water from other neighboring cells (by osmosis); the process continue until potato cells draws water from the beaker;

c) Suggest the result that would be observed if the experiment was repeated using a piece of boiled potato.

No change in the level of sugar solution;

19. Define the following terms

i) Crenation

Process by which red blood cell/animal cells lose water by osmosis when placed in hypertonic medium/solution; ii) Turgidity

Process by which plant cell gain water by osmosis when placed in a hypotonic solution/medium until it becomes firm and rigid;

20. State **three** roles of active transport in the human body.

-Reabsorption of glucose and some salts in the kidney / kidney tubules; -Absorption of digested food / mineral salts /vitamins from the alimentary canal.

-Excretion of waste products from body cells

-Reabsorption of useful materials in the blood stream;

-Sodium pump mechanism in the cell;

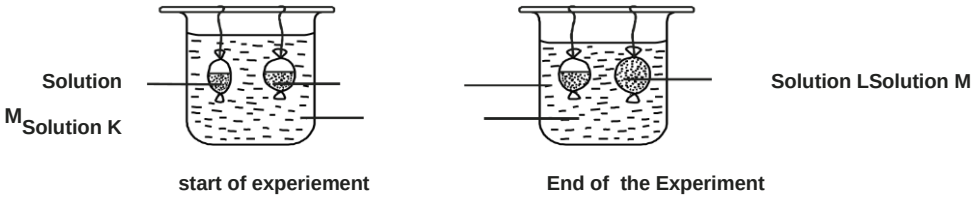
21. If a solution of 0.9% salt solution is isotonic to a certain type of animal cell, explain what happens when the animal cell is placed in a solution of 1.2% salt solution.

The cell cytoplasm is hypotonic to the salt solution; the cell loses water by osmosis into the salt solution through the cell membrane; it then shrinks and the cell (membrane) becomes crenated.

22. State **three** differences between osmosis and active transport.

Osmosis	**Active transport**
- Does not require energy	**- Require / use energy**
- No carrier molecules are involved.	**- Carrier molecules**
- Involves movement of solvent molecules	**- Involves movement of solule particles**
- Solvent molecules move along concentration gradient	**- Solute molecules move against concentration gradient.**

23. In an experiment, two equal volumes of solutions L and M were placed into visking tubings. The two viskig tubings were suspended as shown below.

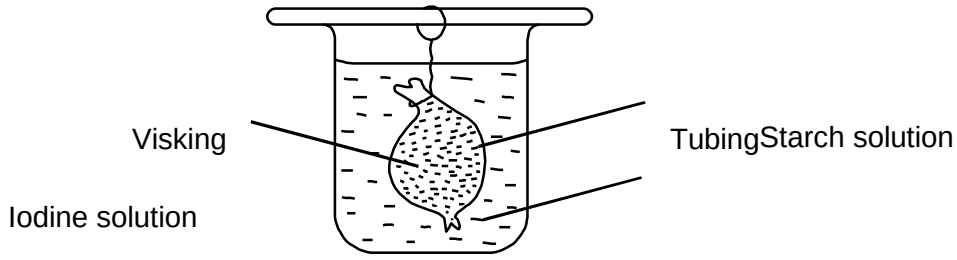


Explain the results that were obtained in the visking tubings at the end of the experiment.

Solution M - increased in volume because solution M is hypertonic to solution K; therefore solution K moved into visking tubing by osmosis;

Solution L - remained the same volume because it was isotonic to solution K, osmosis did not occur;

24. An experiment was set up as shown in the diagram below.



The set up was left was 30 minutes.

(a).State the expected results from the starch solution.

The starch solution turned blue black;

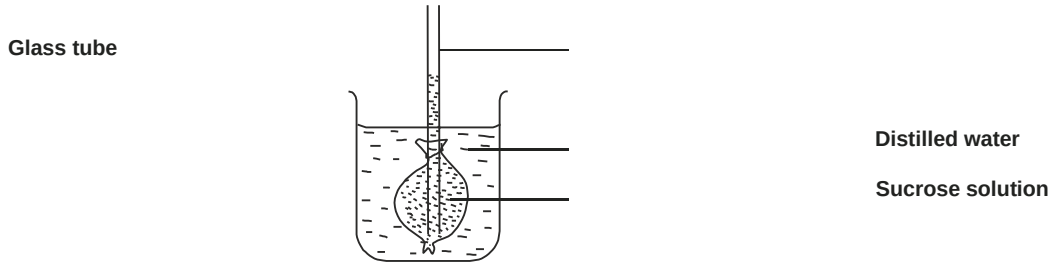
(b) Explain your answer in (a) above

Iodine molecules diffused; across the microscopic pores; (in the visking tubing) into the starch solution; (resulting to be blue black colouration)

25. Explain why the number of red blood cells decreases when placed in a hypotonic solution.

Red blood cells draw water by osmosis; and burst/ haemolyse;

26. An experiment was set up as shown below.



a).Suggest the observations made after 20 minutes.

Level of sucrose solution rose;

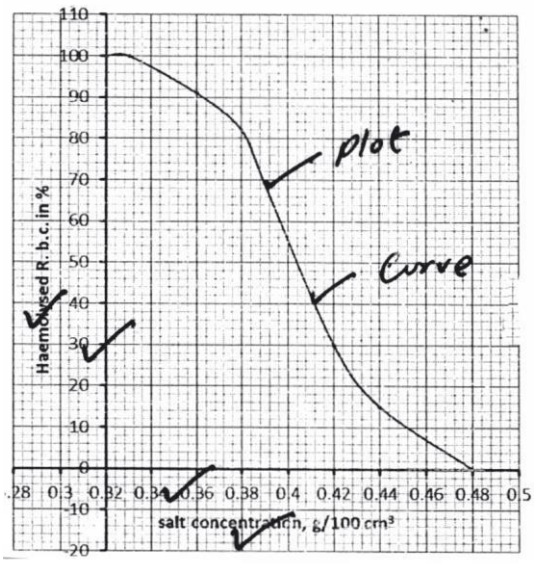
b) Explain the observations.

Visking tubing is semi permeable; sucrose solution in hypertonic to distilled water; water enters into the sucrose solution by osmosis;

27. An experiment was carried out to investigate haemolysis of human red blood cells. The red blood cells were placed in different concentration of sodium chloride solution. The percentage of haemolysed cells was determined. The results were as shown in the table below.

Salt concentration ($g/100cm^3$) (%)	0.33	0.36	0.38	0.39	0.42	0.44	0.48
Red blood cells (haemolysed) (%)	100	91	82	69	30	15	0

a) i) On the grid provided, plot a graph of haemolysed red blood cells against salt concentration.



ii) At what concentration of salt solution was the proportion of haemolysed cell equal to nonhaemolysed cells?

0.403 ±0.002 iii) State the percentage of cells haemolysed at salt concentration of 0.45%.

10±1%;

b) Account for the results obtained at:

i) 0.33 percent salt concentration.

0.33 percent salt concentration - Less concentration/dilute/hypotonic than blood cells cytoplasm; water is drawn in by osmosis; the cell swell and eventually burst (a process called haemolysis); ii) 0.48 per cent salt concentration.

0.48 percent salt concentration - concentration of red blood cells cytoplasm is same as concentration of salt solution (isotonic) therefore no net movement of water by osmosis; hence cells remained normal and none were haemolysed.

c).What would happen to the red blood cells if they were placed in 0.50 percent salt solution?

0.50% salt concentration is highly concentrated solution/hypertonic than blood cells cytoplasm; red blood cells would lose water by osmosis; shrink and become creanated.

28. Explain what would happen to onion epidermal cells if they were placed in distilled water.

The cell sap is more concentrated than surrounding; water enters into the cell by osmosis; the cell swells/become turgid; but does not burst due to the rigid cellulose cell wall;

29. In an investigation, a student extracted three pieces of pawpaw cylinders using a cork borer. The cylinders were cut back to 50mm length and placed in a beaker containing a solution. The results after 40 minutes were shown in the table below.

Feature	Results
Average length of cylinders mm	56mm
Stiffness of cylinders	Stiff

a).Account for the results in the table above.

- **The solution was hypotonic/less concentrated compared to the cell sap of pawpaw cylinders cell;**

-The tissue cells gain water by osmosis becoming turgid/stiff

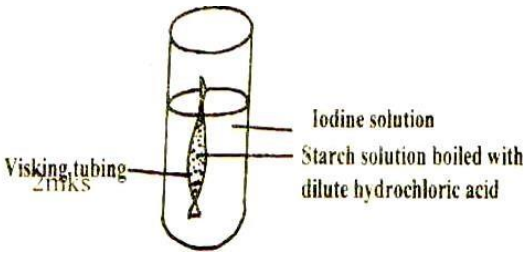
b) What would be a suitable control set-up for the investigation?

- **Boiled pawpaw cylinders of the same size/lengths placed in a similar solution; /Isotonic solution.**

30. Explain what happens when a wilting young plant is well watered.

Root hairs/ roots absorb water by osmosis; cells of the plant become turgid, leaves become firm and spread out/ plants become firm/ upright.

31. A group of students set up an experiment to demonstrate a certain process as shown below.



After 10 minutes the students carried out iodine test inside and outside the visking tubing

a) state two roles of the process being investigated in animals **-Facilitates absorption of products of digestion.**
-Gaseous exchange
-Excretion of nitrogenous wastes

b) account for the results expected in the experiment above
-No observable change in color, boiling starch with hydrochloric acid hydrolyses starch into sugars/ maltose/ glucose which facilitates active transfer of materials across the cell membrane has phosphate groups which is be used in synthesis of AIP to release energy for active transport .

32. What is the importance of plasma membrane in active transport?
Cell membrane – contains carriers

33. Give one similarity between osmosis and active transport

-They are both involved in the movement of molecules across a semi permeable membrane.

34. State the role of active transport in animal nutrition.

Helps in absorption of some products of digestion from alimentary canal into blood stream.

35. Give two factors which affect active transport.

- Oxygen concentration / amount t of oxygen

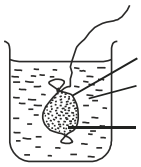
Change of temperature

substrate / glucose concentration -Enzyme inhibitors / metabolic poisons.

36. In an experiment, raw banana was peeled, mashed into a paste and was treated as shown in the set-up below.

visking tubing iodine solution

suspesion of banana paste



a) Name the physiological process being investigated.

Diffusion

b) State the expected colour of the solutions inside the visking tubing after 30 minutes.

Inside - colour turns blue-black

c). Explain the observation made in (b) above.

Inside - Iodine molecules diffused across the visking tubing (outside - banana molecules are large hence couldn't pass through visking tubing).

37. The table below shows differences in the relative concentrations of various ions in the cell sap of a sea weed (valonia) and in the sea water in which it is growing.

Ions	Relative concentrations in%	
	Valonia cell sap	Sea water
Chloride	21.2	19.6
Sulphates	0.005	3.33
Sodium	2.1	10.9

Magnesium	0.001	1.31

a) Name the process by which the following ion will enter the cell sap of the valonia cells.

i).Sulphates.

Diffusion

ii).Chlorides.

Active transport

d).Give a reason for each of your answers in (a) (i) and (a) (ii) above.

The valonia cell sap has a larger concentration of sulphate ions than the sea water.

The valonia cell sap has a higher concentration of the chloride ions than the sea water.

38. Eight potato cylinders of the same size were used to investigate a certain physiological process. Four of the potato cylinders were placed in solution S. The other four potato cylinders were placed in solution T. After 2 hours, the potato cylinders from solution S were found to longer and stiff, while those from solution T were found to be shorter and flexible. Explain the results in solution S and T.

Solution S is hypotonic to cell sap of potato cylinder cells; the cells drew in water by osmosis increased in size and became turgid hence increase in length and stiffness in cylinder. Solution T was hypertonic to cells of potato cylinder; the cells lost water by osmosis to solution T and became flaccid leading to decrease in length and becoming flexible.

39. In an experiment, the concentration of ions in the cell sap of reeds growing in a swampy area and the water in the swamp were determined. The data below was obtained. Study it and answer the questions that follow:

Sample	Na^+	Mg^{2+}	Cl^-	SO_4^{2-}
Cell sap	50	11	101	13
Swamp water	1.2	30	10.2	0.67

a) Name the process by which uptake of the following ions by the reeds occurs.

Na^+ ions

Active transport

Mg^{2+} ions

Diffusion

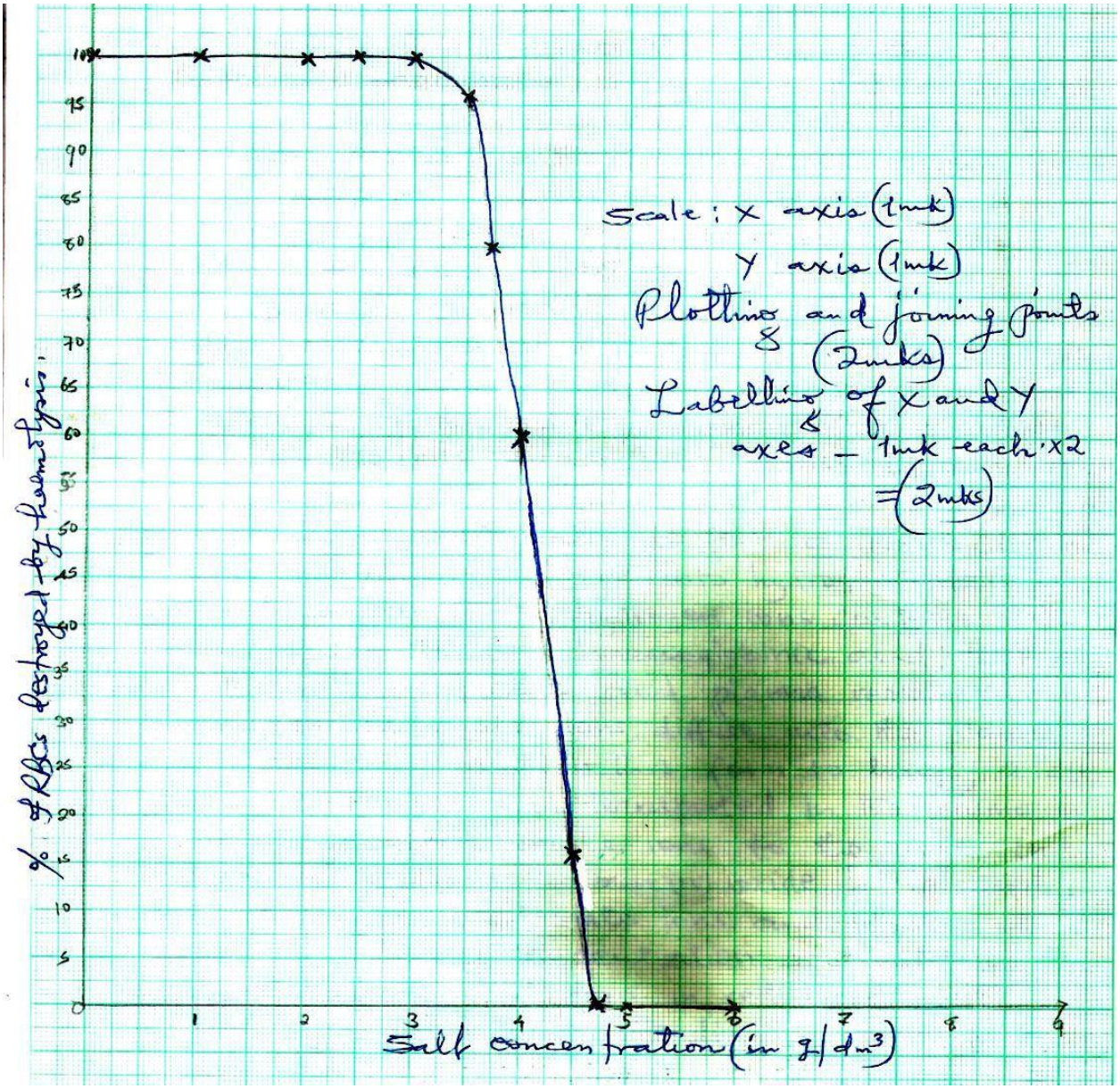
b) What effect would reduce oxygen supply have on the uptake of sulphate ions? Explain your answer.

Reduces the rate of active transport due to increased rate of respiration/oxidation of glucose, hence less energy;

40. An experiment was carried out in which red blood cells were put in salt solutions of different concentrations. The table below shows the percentage of cells which were destroyed by haemolysis in different salt concentration.

Salt concentration (g/dm^3)	% of RBC destroyed By haemolysis
0	100
1	100
2	100
2.5	100
3.0	100
3.5	96
3.7	80
4.0	60
4.5	16
4.7	0
5.0	0
6.0	0

a).Draw a graph of percentage of red blood cells haemolysed against salt concentration.



b).Explain haemolysis of red blood cells.

Haemolysis of red blood cells occurs when they are placed in a hypotonic solution; they gain a lot of water; swell an then burst; (c) From the graph, state:

(i) The salt concentration at which 50% red blood cells were haemolysed.

4.1 g/dm^3; + 0.1;

(ii) The highest salt concentration when the largest number of red blood cells were haemolysed.

3.0 g/dm^3; + 1;

(d) (i) Suggest the normal salt concentration in the blood of the mammal from which the red blood cells were obtained.

4.7 g / dm^3 + 0.1;

(ii) Give a reason for your answer in (d) (i) above.

At 4.7 g / dm^3 salt concentration; as there is no haemolysis / haemolysis was zero;

41. What term is used to describe the solution with equal solute concentration as that of the cells?

Isotonic solution;

42. Name the process in the human body that ensures that haemolysis of red blood cells is prevented.

Osmoregulation;

43. Discuss FIVE factors affecting the rate of Diffusion

a) <u>Diffusion gradient</u>

-A greater diffusion gradient between two points increases the rate of diffusion. Increasing the concentration of diffusing molecules also increases diffusion gradient with corresponding regions hence increases the rate of diffusion.

b) <u>Surface area to volume ratio</u>

-Rate of diffusion directly depends on the surface area to volume ratio. The greater the surface area to volume ratio, the greater the rate of diffusion will be. Conversely, low surface area to volume ratio results in a low diffusion rate.
-This implies that diffusion rate is greater in small organisms than the large organisms. This is because the small organisms have a large surface area to volume ratio. As a result, most of their body parts are closer to the external surrounding leading to faster diffusion. -Small organisms can, therefore, depend on diffusion alone as a means of transporting foods, respiratory gases and waste products.
-To large organisms, diffusion alone is inadequate as a means of transport of foods and excretion. They have an additional transport system.
-Organisms always lose heat to the surrounding through diffusion. This implies that small animals lose a lot of heat to the surrounding compared to the large animals.

c) <u>Thickness of membranes and tissues</u>

-The thicker the membrane or tissue, the lower the rate of diffusion. This is because the distance covered by the diffusing molecules is greater through the thicker membranes. -The rate of diffusion is higher in thinner membranes.

d) <u>Size of molecules</u>

-Small and light molecules diffuse much faster than the heavy and large sized particles. e)

<u>Temperature</u>

-An increase in temperature increases the energy content of the diffusing particles; thereby causing them to move faster, this implies that the rate of diffusion increases with increase in temperature.

44. Distinguish between osmotic pressure and osmotic potential.

Osmotic pressure refers to the force with which a concentrated solution draws water to itself while Osmotic potential is a measure of the pressure a solution would develop to withdraw water molecules from pure water when separated by a semi permeable membrane.

45. Define Crenation.

The process by which animal cells shrink and become smaller when placed in hypertonic solutions.

46. What is wilting?

-Wilting is a phenomenon that occurs when plant cells lose more water than they draw from the soil making the plant cells to lose their turgor pressure and droop.

47. Highlight three factors affecting the Rate of Osmosis.

-Concentration of solutions and concentration gradient. Osmosis is greater when the separated solutions have a greater difference in osmotic pressure. In summary, the greater the concentration gradient, the greater the rate of osmosis and vice versa.

-Temperature-An increase in temperature would increase the rate of osmosis as it increases the energy content of the molecules.

-Thickness of the membranes-The thicker the membrane the lower the rate of osmosis while the rate of osmosis is greater through thinner membranes.

48. Define plasmolysis.

The process through which plant cells lose water, shrink and become flaccid.

49. What is the meaning of the term heamolysis?

-Swelling of red blood cell when placed in a hypotonic solution.

50. Distinguish between hypotonic and hypertonic solutions.

Hypotonic solution is the lowly concentrated solution while the hypertonic solution is the highly concentrated solution when the two are separated by a semi-permeable membrane.