Osmosis Coursework

Definition
Osmosis is the passage of water from a region of high water concentration through a semi-permeable membrane to a region of low water concentration.
The definition contains three important statements:

1. Osmosis is **the passage of water** from a region of high water concentration **through a semi-permeable membrane** to a region of low water concentration.
2. Osmosis is **the passage of water from a region of high water concentration** through a semi-permeable membrane to a region of low water concentration.
3. Osmosis is **the passage of water** from a region of high water concentration through a semi-permeable membrane **to a region of low water concentration**.

It does not matter too much which order you put these statements in. Nor does it matter if you write the definition as one sentence or three sentences. All that matters in your exam is that you make all three points when you explain what osmosis is.

Explanation
First the definition of osmosis:

1. *Semi-permeable membranes* are very thin layers of material (cell membranes are semi-permeable) which allow some things to pass through them but prevent other things from passing through.

   Cell membranes will allow small molecules like Oxygen, water, Carbon Dioxide, Ammonia, Glucose, amino-acids, etc. to pass through. Cell membranes will not allow larger molecules like Sucrose, Starch, protein, etc. to pass through.
2. *A region of high concentration of water* is either a very dilute solution of something like sucrose or pure water. In each case there is a lot of water: there is a high concentration of water.

   Some teachers use the definition which starts "Osmosis is the passage of water from a dilute solution to a....." this means exactly the same as the definition I have given.
3. *A region of low concentration of water* is a concentrated solution of something like sucrose. In this case there is much less water.

   So you could use the definition "Osmosis is the passage of water *from a dilute solution* through a semi-permeable membrane *to a more concentrated solution*.

Now to explain osmosis:
When you put an animal or plant cell into a liquid containing water one of three things will happen.

1. If the medium surrounding the cell has a higher water concentration than the cell (a very dilute solution) the cell will gain water by osmosis.

   Water molecules are free to pass across the cell membrane in both directions, but more water will come into the cell than will leave. The net (overall) result is that water enters the cell. The cell is likely to swell up.
2. If the medium is exactly the same water concentration as the cell there will be no net movement of water across the cell membrane.

   Water crosses the cell membrane in both directions, but the amount going in is the same as the amount going out, so there is no overall movement of water. The cell will stay the same size.
3. If the medium has a lower concentration of water than the cell (a very concentrated solution) the cell will lose water by osmosis.

   Again, water crosses the cell membrane in both directions, but this time more water leaves the cell than enters it. Therefore the cell will shrink.

The Consequences of Osmosis
Firstly what happens to plant cells:
Plant cells always have a strong cell wall surrounding them. When the take up water by osmosis they start to swell, but the cell wall prevents them from bursting. Plant cells become "turgid" when they are put in dilute solutions. Turgid means swollen and hard. The pressure inside the cell rises, eventually the internal pressure of the cell is so

high that no more water can enter the cell. This liquid or hydrostatic pressure works against osmosis. Turgidity is very important to plants because this is what make the green parts of the plant "stand up" into the sunlight.
When plant cells are placed in concentrated sugar solutions they lose water by osmosis and they become "flaccid"; this is the exact opposite of "turgid". If you put plant cells into concentrated sugar solutions and look at them under a microscope you would see that the contents of the cells have shrunk and pulled away from the cell wall: they are said to be plasmolysed.
When plant cells are placed in a solution which has exactly the same osmotic strength as the cells they are in a state between turgidity and flaccidity. We call this incipient plasmolysis. "Incipient" means "about to be". When I forget to water the potted plants in my study you will see their leaves droop. Although their cells are not plasmolsysed, they are not turgid and so they do not hold the leaves up into the sunlight.

And now for the animal cells:
When animal cells are placed in sugar solutions things may be rather different because animal cells do not have cell walls. In very dilute solutions, animal cells swell up and burst: they do not become turgid because there is no cell wall to support the cell membrane. In concentrated solutions, water is sucked out of the cell by osmosis and the cell shrinks. In either case there is a problem. So animal cells must always be bathed in a solution having the same osmotic strength as their cytoplasm. This is one of the reasons why we have kidneys. The exact amount of water and salt removed from our blood by our kidneys is under the control of a part of the brain called the hypothalamus. The process of regulating the amounts of water and mineral salts in the blood is called **osmoregulation.** My insulin page will tell you more about other homeostatic mechanisms.
Animals which live on dry land must conserve water; so must animals which live in the sea (the sea is very salty!), but animals which live in freshwater have the opposite problem; they must get rid of excess water as fast as it gets into their bodies by osmosis.