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BIOLOGY

BIOLOGICAL MOLECULES

LEVEL & BOARD:	AQA (A - LEVEL)
TOPIC:	Water
PAPER TYPE:	Solution 1
TOTAL QUESTIONS:	06
TOTAL MARKS:	43

Water

1.

(a)

- It is a metabolite in condensation.
- It is a solvent so metabolic reactions can occur.
- It has high specific heat capacity so buffers changes in temperature.
- Large latent heat of vaporisation so provides a cooling effect through evaporation.
- Cohesion between water molecules so supports columns of water in plants.
- Cohesion between water molecules so produces surface tension supporting small organisms.

2.

(a) Property : water has high heat capacity

Explanation: so, lots of energy required to increase the temperature

3.

(a)

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4.

(a) High specific heat capacity: Water has a high specific heat capacity, which means that it can absorb or release large amounts of heat energy without changing temperature significantly. This makes water an excellent temperature buffer, helping to regulate temperature in living organisms and environments.

5.

(a) The polarity and the ability to form hydrogen bonds are two important properties of water in the cytoplasm of the cells.

- The polarity makes water an excellent solvent facilitating metabolic reactions.
- The capacity to form hydrogen bonds allows ions and polar molecules to dissolve.

6.

Water

Drinking water does more than just quench your thirst. It's essential to keeping your body functioning properly and feeling healthy.

Nearly all of your body's major systems depend on water to function and survive. With water making up about 60% of your body weight, it's no surprise what staying hydrated can do for you.

Examples:

- Regulates body temperature
- Moistens tissues in the eyes, nose and mouth
- Protects body organs and tissues
- Carries nutrients and oxygen to cells
- Lubricates joints
- Lessens burden on the kidneys and liver by flushing out waste products

- Dissolves minerals and nutrients to make them accessible to your body

Osmosis

Osmosis is a process by which the molecules of a solvent pass from a solution of low concentration to a solution of high concentration through a semi-permeable membrane.

Osmotic Solutions

There are three different types of solutions:

- Isotonic Solution
- Hypertonic Solution
- Hypotonic Solution

An **isotonic solution** is one that has the same concentration of solutes both inside and outside the cell.

A **hypertonic solution** is one that has a higher solute concentration outside the cell than inside.

A **hypotonic solution** is one that has a higher solute concentration inside the cell than outside.

Types of Osmosis

Osmosis is of two types:

- **Endosmosis**– When a substance is placed in a hypotonic solution, the solvent molecules move inside the cell and the cell becomes turgid or undergoes deplasmolysis. This is known as endosmosis.
- **Exosmosis**– When a substance is placed in a hypertonic solution, the solvent molecules move outside the cell and the cell becomes flaccid or undergoes plasmolysis. This is known as exosmosis

Effect of Osmosis on Cells

Osmosis affects the cells differently. An animal cell will lyse when placed in a hypotonic solution compared to a plant cell. The plant cell has thick walls and requires more water. The cells will not burst when placed in a hypotonic solution. In fact, a hypotonic solution is ideal for a plant cell.

An animal cell survives only in an isotonic solution. In an isotonic solution, the plant cells are no longer turgid and the leaves of the plant droop.

The osmotic flow can be stopped or reversed, also called reverse osmosis, by exerting an external pressure to the sides of the solute. The minimum pressure required to stop the solvent transfer is called the osmotic pressure.

Osmotic pressure is the pressure required to stop water from diffusing through a membrane by osmosis. It is determined by the concentration of the solute. Water diffuses into the area of higher concentration from the area of lower concentration. When the concentration of the substances in the two areas in contact is different, the substances will diffuse until the concentration is uniform throughout.

Osmotic pressure can be calculated using the equation:

$\Pi = MRT$

Gas Exchange in Plants

Gas exchange in the leaves occurs through the stomata on the lower epidermis. Most plants, including dicotyledonous plants, use the stoma for gas exchange.

Stoma (singular) are openings which allow for the exchange of carbon dioxide and oxygen. They are opened by ions (mainly K^+) which move in via active transport, which allows water loss, something that needs to stay balanced.

Stomata open in response to guard cells bending due to becoming turgid (and uneven thickness in the walls). Water moves in via osmosis due to the water potential being decreased.

Unlike other organisms, plants are reliant on both oxygen and carbon dioxide for processes such as photosynthesis and respiration:

- During photosynthesis, which occurs in most plants during the day (favourable conditions), plants take in carbon dioxide through the open stoma and release oxygen into the environment.
- During respiration, which occurs in most plants at night, plants take in oxygen through the closed stoma and release carbon dioxide into the environment.
- Both carbon dioxide and oxygen enter and exit through the stoma by simple diffusion down their concentration gradients.

Transport in Plant

Translocation

Translocation is the movement of dissolved substances, such as sucrose and amino acids, from parts of the plant where the substances are made to other parts of the plant where they're needed. Translocation takes place in the phloem - transport vessels made up of two types of cells, sieve tube elements and companion cells. The parts of the plant which make these substances are referred to as sources (e.g., the leaves) and the parts of the plant which store or use the substances are called sinks (examples include bulbs and roots). When sucrose reaches a sink, it is converted into starch for carbohydrate storage. This maintains a concentration gradient between the source and the sink, so that more sucrose moves into the source. Translocation is an active process, so if respiration is reduced or inhibited (e.g., using a respiratory toxin), translocation will be impaired.

The Mass Flow Hypothesis

The mass flow hypothesis is a theory which attempts to explain how solutes are transported from source cells into sinks through the phloem. It isn't concrete, but it is the best-accepted theory we currently have based on the available evidence. It states that mass flow of solutes takes place in the phloem in the following stages:

- Sucrose moves from companion cells into sieve tube elements by active transport.
- This reduces the water potential of the sieve tube element.

- Water moves into the phloem by osmosis, which increases the hydrostatic pressure.
- There is a pressure gradient with high hydrostatic pressure near the source cell and lower hydrostatic pressure near the sink cells.
- Solutes move down the pressure gradient towards the sink end of the phloem.
- Solutes move into sink cells and are converted into other molecules (e.g. starch).
- The removal of solutes increases the water potential at the sink end, causing water to move out of the phloem by osmosis. This maintains the hydrostatic pressure gradient between the source and the sink.

Active Loading

Sucrose is actively transported into the sieve tube elements in the first place. This process involves the companion cells which are associated with each sieve tube element:

- The companion cell actively transports hydrogen ions into the surrounding cells.
- This creates a hydrogen ion gradient between the surrounding cells and the companion cell.
- Hydrogen ions move back into the companion cell down their concentration gradient through a co-transporter protein.
- Whenever a hydrogen ion moves through the co-transporter, a sucrose molecule is also transported into the companion cell, against its concentration gradient.
- The same process occurs to transport sucrose from the companion cell into the sieve tube element.

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I am Sorry !!!!!