Recap

We learnt about water and its importance as a solvent for metabolic reactions. You now understand its many properties i.e. how it provides a cooling effect through evaporation in organisms, and cohesion between other water molecules in plant for water flow and transport. mitosis is used.

1.8 Inorganic Ions

Ions

- **An ion is a particle with an electric charge**. A particle can be an atom or a group of atoms.

- **Ions can be positive or negative**.
  - A **cation** is a positively charged ion.
  - An **anion** is a negatively charged ion.

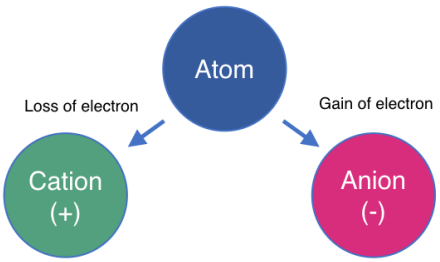


Fig 1. How an Anion and a Cation Can Be Formed From an Atom. An atom that loses one or more electron becomes a cation. An atom that gains one or more electron becomes an anion.

Key Aims

1. *Ionic Formation and Classification.*
2. *Inorganic Ions in the Body.*
3. *Biologically Relevant Inorganic Ions.*

- **Ions can be organic or inorganic**.
  - An **organic** ion contains carbon.
  - An **inorganic** ion doesn't contain carbon.

AQA Specification

Inorganic ions occur in solution in the cytoplasm and body fluids of organisms, some in high concentrations and others in very low concentrations.

- **Ions are formed when an atom transfers its electrons to another atom**. The atom which loses electrons becomes a cation. The atom which gains the electrons is called an anion.

Inorganic Ions in the Body

- **Inorganic have key biological functions**. Many different organic ions can be found in organisms and play an important role in organisms. Inorganic ions can be found in the cytoplasm and body fluids of organisms.

AQA Specification

Each type of ion has a specific role, depending on its properties. Students should be able to recognise the role of ions in the following topics:

- *Hydrogen ions and pH*
- *Iron ions as a component of haemoglobin*
- *Sodium ions in the co-transport of glucose and amino acids; and phosphate ions as components of DNA and of ATP.*

- **Ion concentrations vary**. Some ions are found in high concentrations, and others in low concentrations. The body carefully regulates ion levels through organs such as the kidney.

Examples of Biologically Relevant Inorganic Ions

Iron Ions

- **Iron ions are key for oxygen transport in haemoglobin**. Iron ions are primarily found in red blood cells in the protein called haemoglobin. The iron ions, Fe2+, are actually the ones that bind to the oxygen atoms, which makes this ion crucial for the survival of most organisms.

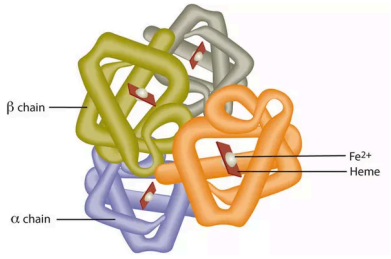


Fig 2. Haemoglobin. Iron ions are key for oxygen transport in haemoglobin.They (Fe2+) bind to the oxygen atoms. This ion is crucial for the survival of most organisms.

Knowledge Recall

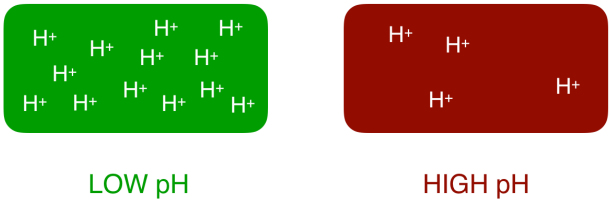
1. *What is a cation?*
2. *What is an anion?*
3. *What is the difference between an inorganic ion and an organic ion?*
4. *What charge do iron ions in haemoglobin molecules (with oxygen not bounded) contain?*

Hydrogen Ions

- **Hydrogen ions are important for regulating pH in organisms**.
  - The greater the concentration of hydrogen ions, the lower the pH.
  - The lower the concentration of hydrogen ions, the higher the pH.

- **pH control is important for many metabolic reactions**. Enzyme controlled reactions are sensitive to pH, which makes hydrogen ions very important.

- **Hydrogen ions help control pH in digestion**. Hydrogen ions are also important for maintaining the low pH of the gastric juices within the stomach which is important for digestion.



.**Fig 3. Hydrogen ions in pH regulation.** The greater the concentration of hydrogen ions, the lower the pH.

- **Hydrogen ions also help in respiration**. Hydrogen ions play a very important role in ATP synthesis in the mitochondria during cellular respiration.

Sodium Ions

- **Sodium ions are key for co-transport**. Sodium helps molecules such as glucose and amino acids cross the cell membrane in order to enter a cell through a process known as co-transport.

- **Sodium and potassium are key in the nervous system**. Sodium and potassium ions are very important in the nervous system and communication between neurones.

Knowledge Recall

1. *Which would have a higher pH, a solution with a lower concentration of H+ ions or a solution with a higher concentration of H+ ions?*
2. *Name a biological process that sodium ions are key in?*
3. *Name another biological process that sodium ions are key in?*
4. *Name a biological molecule that phosphate ions are found in?*

Phosphate Ions

- **Phosphate ions are found in phosphate groups**. Phosphate ions, in the form of PO43-, are often found attached to many biological molecules as phosphate groups.

- **Phosphate groups are found in DNA, RNA, and ATP**. In ATP the energy is stored in the phosphoanhydride bonds between the three phosphate groups which make up ATP.

- **Phosphate groups drive phosphorylation**. Phosphate groups can be added to molecules to make them more reactive through phosphorylation.

- **Phosphate groups are found in phospholipids**. The phospholipids are a key component of cell membranes, forming the phospholipid bilayer.