

KEY QUESTIONS

1. How many electrons does Mg^{2+} have?

Typically it has 12 electrons, but in this inquiry, the ($^{2+}$) means it has lost two electrons. Thus resulting in a total number of 10 electrons.

2. Given that the half-life of the radioisotope Carbon-14 is 5730 years, how useful do you think this isotope would be for dating bones that are over one million years old?

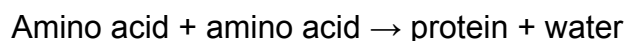
Carbon-14 is primarily used to date organic materials that are less than 50,000 years old (decaying at a constant rate), and not useful when using this dating style on petrified fossils. The half-life of said radioisotope does not meet the measuring criteria for bones that old; after 40,000 years, less than 1% of Carbon-14 remains. Potassium-argon dating, for example, would be an effective radiometric alternative (which is commonly used in archeology).

3. Summarize the four major types of biochemical reactions studied in this lesson. For each type give its name, a word summary of what happens during the reaction, and a specific biological example (word or chemical equation) where the reaction might be biologically important.

i) *Hydrolysis*: water is crucial to breakdown and conjoin various molecules together. When consuming food for sustenance, a combination of water and enzymes are necessary for converting those units into smaller units (i.e. macronutrients to micronutrients) in order to be properly assimilated. Please see the hydrolysis example listed below:



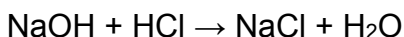
ii) *Condensation*: this reaction occurs when two molecules combine to form one molecule (which is the opposite of hydrolysis). An alternate name for said reaction is 'dehydration synthesis' - where water is removed from the molecule. When building muscle tissue, the body undergoes this biochemical reaction. In this case, water is the product, and not the reactant. A chemical reaction example of this is listed below:



iii) *Oxidation-Reduction (Redox)*: in some instances, many chemical reactions utilize the transfer of one or more electrons from one reactant to another, rather than the transfer of atoms or molecules. When losing electrons, the appropriate term would be oxidation. When gaining electrons, it's known as reduction. Cellular respiration would be a critical instance of this biochemical process; the transfer of electrons from glucose helps the cell make high-energy molecules (ATP - adenosine triphosphate). The redox reaction below exemplifies this aforementioned explanation:



iv) *Neutralization*: in this biochemical reaction, the use of an acid and a base (reactants) then produce water and a salt. Acids are substances that, when dissolved in water, increase the concentration of the hydrogen ions. Bases are substances that, when dissolved in water, increase the concentration of hydroxide ions. Neutralization reactions occur continually inside the cells, including the stomach and intestines. Said type of reaction is crucial for optimal body functioning; keeping the environment pH balanced. This further influences the speed and direction of essential biological reactions, i.e. DNA synthesis. Listed below is an example of a neutralization reaction of sodium hydroxide and hydrochloric acid to produce salt and water:



4. For the following chemical reaction: $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{energy}$
a) the substance(s) being oxidized.

The substance being oxidized is glucose ($\text{C}_6\text{H}_{12}\text{O}_6$).

b) the substance that is reduced.

The substance that is being reduced is oxygen (O_2).

5. a. CARBOHYDRATES

- i) **Monomer(s):** monosaccharides - ketoses and aldoses
- ii) **Functional Groups:** hydroxyl and carbonyl
- iii) **Linkage Type:** glycosidic bonds
- iv) **Primary Function:** critical for providing energy to the cell and additionally used to join other molecules

b. PROTEIN

- i) **Monomer(s):** amino acids
- ii) **Functional Groups:** amino group, carboxylic group, and a radical group
- iii) **Linkage Type:** peptide bonds (and polypeptide chains)
- iv) **Primary Function:** build structures, communicate between cells, control chemical reactions via enzymatic activity, and provide cellular energy

c. LIPIDS

- i) **Monomer(s):** glycerol and a maximum of three fatty acid chains
- ii) **Functional Groups:** ester group
- iii) **Linkage Type:** ester linkages
- iv) **Primary Function:** physical and thermal insulators for the body, key components in cell membranes, raw materials for hormone synthesis

d. NUCLEIC ACIDS

- i) **Monomer(s):** nucleotides
- ii) **Functional Groups:** multifunctional groups, principally phosphate groups
- iii) **Linkage Type:** phosphodiester linkages
- iv) **Primary Function:** typically found in the form of DNA and RNA carrying genetic expression (hereditary molecules)

