AL-Mustaqbal University College
Department of Medical Physics
The first Stage
General chemistry

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Electrical nature of matter

1. Atoms always contain electric charges, but we don’t notice them until we make them move from their normal positions.
2. Atoms have equal numbers of protons and electrons.
3. Protons cannot move; electrons move.
4. Protons and electrons have the same amount of charge, but their charges are opposite.
5. When atoms become charged, **only the electrons move from atom to atom.**
6. In each atom the number of electrons surrounding the nucleus equals the number of protons and so a single atom is electrically neutral.
7. In some elements (e.g. copper - Cu) the nucleus has a weaker attraction to its electrons and the electrons are able to move freely from atom to atom.
8. In elements such as sulfur (S) the electrons are strongly bonded to the atom and do not move freely.
9. If an atom **gains an extra electron**, the overall (net) charge on the atom is
10. **negative** and the atom is called a **negative ion**.
11. If the atom **loses an electron**, the overall charge is **positive** and the atom is called a **positive ion**.
12. **Like charges repel. Unlike charges attract**.

The study of charge separation (“static electricity”) is called electrostatics.

There are 3 ways to make an object have an electrical charge:

1. by friction
2. by contact and
3. by induction

Radioactivity

radioactivity is the act of emitting radiation spontaneously. This is done by an atomic nucleus that, for some reason, is unstable; it "wants" to give up some energy in order to shift to a more stable configuration.

Radioactive rays were observed to be of three types:

1. Alpha rays, which could barely penetrate a piece of paper

2. Beta rays, which could penetrate 3 mm of aluminum

3. Gamma rays, which could penetrate several centimeters of lead.

We now know that alpha rays are helium nuclei, beta rays are electrons, and gamma rays are electromagnetic radiation.

Alpha Decay

In alpha decay, an energetic helium ion (alpha particle) is ejected, leaving a daughter nucleus of atomic number two less than the parent and of atomic mass number four less than the parent. An example is the decay (symbolized by an arrow) of the abundant isotope of uranium, ^{238}U, to a thorium daughter plus an alpha particle:

$$^{238}_{92}\mathrm{U} \longrightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He} \qquad Q_\alpha = 4.268 \text{ MeV} \qquad t_{1/2} = 4.51 \times 10^9 \text{ years}$$

Radium-226 will alpha decay to radon-222: