

NUCLEAR CHEMISTRY WORKSHEET

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Most nuclear reactions involve changes in the number of protons and/or neutrons in the nucleus of an atom. These changes are called *transmutations* because an atom of one element is changed into an atom of a different element. During these changes, nuclear particles may be absorbed and/or emitted along with a release of energy.

There are four types of nuclear reactions:

- 1) *natural radioactive decay*: transmutations occur by natural radioactivity (the ability of a nucleus to emit a nuclear particle and energy without external stimulation);
- 2) *artificial transmutation*: transmutations occur by nuclear disintegration caused by external stimulation as a scientist bombards a nucleus with a particle (the addition of another nuclear particle makes the nucleus unstable);
- 3) *fission*: certain nuclei having a large mass are bombarded with special particles that cause the nuclei to split into two nuclei each having a smaller mass;
- 4) *fusion*: nuclei of light elements are combined to form heavier nuclei.

Nuclear reactions are written using symbols in the A_ZX notation. The symbols for the major nuclear particles involved in nuclear reactions are given below.

Alpha particle	${}^4_2\text{He}$ (an alpha particle is a helium nucleus)
Proton	${}^1_1\text{H}$ (the most common hydrogen nucleus is a proton)
Neutron	${}^1_0\text{n}$
Electron	${}^0_{-1}\text{e}$ or ${}^0_{-1}\beta$ (also called a beta particle)
Positron	${}^0_1\text{e}$ or ${}^0_1\beta$
Gamma ray	${}^0_0\gamma$

The table below contains information about nuclear reactions involving the emission of radiation.

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Type of Reaction	Radiation (Particle)	Effect on the Atomic Number	Effect on the Atomic Mass
Alpha emission (α)	${}^4_2\text{He}$	decrease by 2	decrease by 4
Beta emission (β)	${}^0_{-1}\text{e}$ or ${}^0_{-1}\beta$	increase by 1	no change
Positron emission (β^+)	${}^0_1\text{e}$ or ${}^0_1\beta$	decrease by 1	no change
Gamma emission	${}^0_0\gamma$	no change	no change
Electron capture (EC)	${}^0_{-1}\text{e}$ or ${}^0_{-1}\beta$	decrease by 1	no change

Gcc Chm130ll Nuclear Chemistry Answers

Victor M. Corman



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