

## Nuclear Chemistry

1	<b>Alpha particle</b>	<b>Alpha particles (named after and denoted by the first letter in the Greek alphabet, <math>\alpha</math>) consist of two protons and two neutrons bound together into a particle identical to a helium nucleus; hence, it can be written as <math>\text{He}^{2+}</math> or <math>{}^4_2\text{He}</math>.</b>
2	Antimatter electron	see positron
3	<b>Beta particle</b>	<b>Beta particles are high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei. The beta particles emitted are a form of ionizing radiation also known as beta rays. They are designated by the Greek letter beta (<math>\beta</math>). There are two forms of beta decay, <math>\beta^-</math> and <math>\beta^+</math>, which respectively give rise to the electron and the positron.</b>
4	Cloud chambers	The cloud chamber, also known as the Wilson chamber, is used for detecting particles of ionizing radiation. In its most basic form, a cloud chamber is a sealed environment containing a supercooled, supersaturated water vapor. When an alpha particle or beta particle interacts with the mixture, it ionizes it. The resulting ions act as condensation nuclei, around which a mist will form. The high energies of alpha and beta particles mean that a trail is left, due to many ions being produced along the path of the charged particle.
5	Decay series	The decay chain refers to the radioactive decay of different discrete radioactive decay products as a chained series of transformations. Most radioactive elements do not decay directly to a stable state, but rather undergo a series of decays until eventually a stable isotope is reached.
6	Deuterium	Deuterium, also called heavy hydrogen, is a stable isotope of hydrogen with a natural abundance in the oceans of Earth of approximately one atom in 6500 of hydrogen (~154 PPM). Deuterium thus accounts for approximately 0.015% (on a weight basis 0.030%) of all naturally occurring hydrogen). The nucleus of deuterium, called a deuteron, contains one proton and one neutron, whereas the far more common hydrogen nucleus contains no neutrons. The isotope name is formed from the Greek deuterios meaning "2", to denote the two particles comprising the nucleus.
7	$E=mc^2$	In physics, mass–energy equivalence is the concept that all mass has an energy equivalence, and all energy has a mass equivalence. Special relativity expresses this relationship using the mass–energy equivalence formula $E = mc^2$ where <ul style="list-style-type: none"> <li>· <math>E</math> = the energy equivalent to the mass (in joules),</li> <li>· <math>m</math> = mass (in kilograms), and</li> <li>· <math>c</math> = the speed of light in a vacuum (<i>celeritas</i>) (in meters per second).</li> </ul>
8	<b>Electromagnetic waves</b>	<b>Electromagnetic (EM) radiation is a self-propagating wave in space with electric and magnetic components. These components oscillate at right angles to each other and to the direction of propagation, and are in phase with each other. Electromagnetic radiation is classified into types according to the frequency of the wave: these types include, in order of increasing frequency, radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays.</b>
9	<b>Gamma rays</b>	<b>Gamma rays or gamma-ray (denoted as <math>\gamma</math>) are forms of electromagnetic radiation (EMR) or light emissions of a specific frequency produced from sub-atomic particle interaction, such as electron-positron annihilation and radioactive decay; most are generated from nuclear reactions occurring within the interstellar medium of space. Gamma rays are generally characterized as EMR, having the highest frequency and energy, and also the shortest wavelength, within the electromagnetic radiation spectrum.</b>
10	Geiger-Müller counters	A Geiger counter, also called a Geiger-Müller counter, is a type of particle detector that measures ionizing radiation.
11	<b>Half-life</b>	<b>The half-life of a quantity, subject to exponential decay, is the time required for the quantity to decay to half of its initial value. It can be shown that, for exponential decay, the half-life <math>t_{1/2}</math> obeys this relation:</b> $t_{1/2} = \frac{\ln(2)}{\lambda}$ where $\ln(2)$ is the natural logarithm of 2 (approximately 0.693), and $\lambda$ is the decay constant, a positive constant used to describe the rate of exponential decay.
12	Helium 4 nucleus	alpha particle
13	<b>Isotopes</b>	<b>Isotopes are any of the several different forms of an element each having different atomic mass (mass number). Isotopes of an element have nuclei with the same number of protons (the same atomic number) but different numbers of neutrons. Therefore, isotopes have different mass numbers, which give the total number of nucleons—the number of protons</b>

14	Nuclear binding energy	Nuclear binding energy is derived from the strong nuclear force and is the energy required to disassemble a nucleus into free unbound neutrons and protons, strictly so that the relative distances of the particles from each other are infinite (essentially far enough so that the strong nuclear force can no longer cause the particles to interact). At the atomic level, the binding energy of the atom is derived from electromagnetic interaction and is the energy required to disassemble an atom into free electrons and a nucleus.
15	Nuclear fission	<b>Nuclear fission—also known as atomic fission—is the splitting of the nucleus of an atom into parts (lighter nuclei) often producing photons (in the form of gamma rays), free neutrons and other subatomic particles as by-products. Fission of heavy elements is an exothermic reaction which can release large amounts of energy both as electromagnetic radiation and as kinetic energy of the fragments (heating the bulk material where fission takes place). Fission is a form of elemental transmutation because the resulting fragments are not the same element as the original atom.</b>
16	Nuclear fusion	<b>Nuclear fusion reactions are a kind of reaction, two light atomic nuclei fuse together to form a heavier nucleus and release energy. In a more general sense, the term can also refer to the production of net usable power from a fusion source, similar to the usage of the term "steam power." Most design studies for fusion power plants involve using the fusion reactions to create heat, which is then used to operate a steam turbine, similar to most coal-fired power stations as well as fission-driven nuclear power stations.</b>
17	Nuclear reaction	A nuclear reaction is a process in which two nuclei or nuclear particles collide to produce products different from the initial particles. While the transformation is spontaneous in the case of radioactive decay, it is initiated by a particle in the case of a nuclear reaction. If the particles collide and separate without changing, the process is called an elastic collision rather than a reaction.
18	Nucleons	In physics a nucleon is a collective name for two baryons: the neutron and the proton. They are constituents of the atomic nucleus and until the 1960s were thought to be elementary particles. In those days their interactions (now called internucleon interactions) defined strong interactions. Now they are known to be composite particles, made of quarks and gluons.
19	Nuclide	A nuclide is a nuclear species which is characterized by the number of protons and neutrons that every atomic nucleus of this species contains. For a short-hand designation of the nuclide, one writes the mass number (number of nucleons) in the upper left corner and the atomic number (number of protons) in the lower left corner of the chemical symbol.
20	Positron	<b>A positron is an anti-matter electron. It is identical to the electron in mass, but has an opposite charge of +1 (the electron is defined to have a charge of -1)</b>
21	Quarks	A quark is one of the two basic constituents of matter (the other are the leptons). Quarks are the only fundamental particles that interact through all four of the fundamental forces. Quarks come in six flavors; their names (up, down, strange, charm, bottom, and top) were chosen arbitrarily based on the need to name them <i>something</i> that could be easily remembered and used.
22	Radioactive decay	Radioactive decay is the process in which an unstable <i>atomic nucleus</i> loses energy by emitting radiation in the form of particles or electromagnetic waves. This decay, or loss of energy, results in an atom of one type, called the <i>parent nuclide</i> transforming to an atom of a different type, called the <i>daughter nuclide</i> . The SI unit is the becquerel (Bq). One Bq is defined as one transformation (or decay) per second. Another unit of decay is the curie, which was originally defined as the radioactivity of one gram of pure radium, and is equal to $3.7 \times 10^{10}$ Bq.
23	Radioactive	<b>Spontaneous emission of particles or high-energy electromagnetic radiation from the nuclei of unstable atoms. "Radiation" refers to the emissions, and "radioactive source" refers to the source of the radiation</b>
24	Radon detection	Radon is a chemical element in the periodic table that has the symbol Rn and atomic number 86. A radioactive noble gas that is formed by the decay of radium, radon is one of the heaviest gases and is considered to be a health hazard. The most stable isotope is <sup>222</sup> Rn which has a half-life of 3.8 days and is used in radiotherapy. Radon is a significant contaminant that affects indoor air quality worldwide.