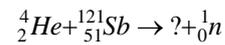
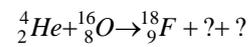
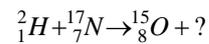
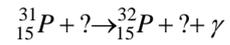


TAP 527-1: Isotope production

The production of radio-nuclides by nuclear transmutation is now big business. They are for use in medicine (diagnostic and therapy) and industry (imaging, tracers, process monitoring etc) and are made by neutron bombardment in nuclear reactors and by proton, deuteron (2_1H) or α particle bombardment by accelerators.

Complete these equations that represent examples of these processes.



Find out the half-lives of the isotopes produced in these processes

Find out a typical use of these products.

Practical advice

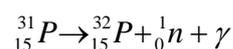
These questions are to help your students write decay equations and carry out research.

Half lives can be found at

http://www.kayelaby.npl.co.uk/atomic_and_nuclear_physics/4_6/4_6_1.html

Answers

Isotope	Half Life	Emitted particle(s)	Energy / Mev
${}_{15}^{32}\text{P}$	14.3 days	beta	1.178
${}_{8}^{15}\text{O}$	126 seconds	positron	1.7
${}_{9}^{18}\text{F}$	112 minutes	positron	0.6
${}_{53}^{123}\text{I}$	13.2 hours	gamma	0.159

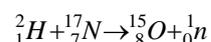


Phosphorus-32 is commonly the highest energy radionuclide encountered in a research setting, and thus requires special caution. Exposure should be avoided and handling should be limited as much as possible.

<http://www.unh.edu/ehs/P-32.htm>

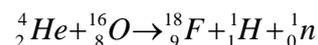
A solution of phosphate, containing radioactive phosphorus-32, is injected into the root system of a plant. Since phosphorus-32 behaves identically to that of phosphorus-31, the more common and non-radioactive form of the element, it is used by the plant in the same way. A Geiger counter is then used to detect the movement of the radioactive phosphorus-32 throughout the plant. This information helps scientists understand the detailed mechanism of how plants utilized phosphorus to grow and reproduce.

http://www.chem.duke.edu/~jds/cruise_chem/nuclear/agriculture.html



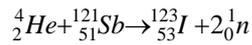
Air tagged with O^{15} has been applied to the study in dogs for (a) the kinetics of the transfer of oxygen from pulmonary gases to blood, (b) the rate of incorporation of oxygen into water during metabolism, c) the rate of exchange of plasma water with tissue water

<http://ajplegacy.physiology.org/cgi/content/abstract/201/3/582>



F-18 is for many reasons a useful radioisotope for bio-medical studies. Physically, the longer half-life (112 min) allows more time for relatively complex synthetic manipulations and for biological studies. In addition, the lowest positron energy, and thus its shortest positron range, allows for the sharpest imaging with a high-resolution PET.

http://www.csulb.edu/~cwallis/482/petscan/pet_lab.html



The usefulness of iodine-123 whole-body scans in evaluating thyroid cancer

<http://tech.snmjournals.org/cgi/content/short/27/4/279>

Clinical Pharmacology: Sodium Iodide is readily absorbed from the upper gastrointestinal tract. Following absorption, the iodide is distributed primarily within the extracellular fluid of the body. It is concentrated and organically bound by the thyroid and concentrated by the stomach, choroid plexus, and salivary glands. It is also promptly excreted by the kidneys. The normal range of urinary excretion in 24 hours is reported to be 37-75% of the administered dose varying with thyroid and renal function. The iodide-concentrating mechanism of the thyroid, variously termed the iodide "trap" or "pump" accounts for an iodide concentration some 25 times that of the plasma level, but may increase to as much as 500 times under certain conditions.

<http://www.nuclearonline.org/PI/Nycomed%20I-123%20Na%20I%20capsules.pdf>