

Topic 7

Nuclear chemistry

1

- Radioactive decay:
 - radioactive decay involves changes in the nuclei of atoms;
 - unstable nuclei (radioisotopes) can become more stable nuclei by giving out alpha, beta or gamma radiation.

2

- Alpha decay:
 - alpha particles (α) consist of two protons and two neutrons, and carry a double positive charge;
 - alpha particles have a range of only a few centimetres in air and are stopped by a piece of paper;
 - alpha particles will be attracted towards a negatively charged plate.

4

- Beta decay:
 - beta particles (β) are electrons ejected from the nucleus of an atom;
 - beta particles are able to travel over a metre in air but can be stopped by a thin sheet of aluminium;
 - beta particles will be attracted towards a positively charged plate.

5

- Gamma decay:
 - gamma rays (γ) are electromagnetic waves emitted from within the nucleus of an atom;
 - gamma rays are able to travel great distances in air;
 - gamma rays can be stopped by barriers made of materials such as lead or concrete;
 - gamma rays are not deflected by an electric field.

6

- Nuclear equations:
 - balanced nuclear equations can be written using nuclide notation;
 - in nuclear equations:
 - an alpha particle can be represented as ${}^4_2\text{He}$
 - a beta particle can be represented as ${}^0_{-1}e$
 - a proton can be represented as 1_1p
 - a neutron can be represented as 1_0n

7

- In the course of any nuclear reaction:
 - the sum of the atomic numbers on the left of the reaction arrow is equal to the sum of the atomic numbers on the right of the reaction number;
 - the sum of the mass numbers on the left of the reaction arrow is equal to the sum of the mass numbers on the right of the reaction number.

8

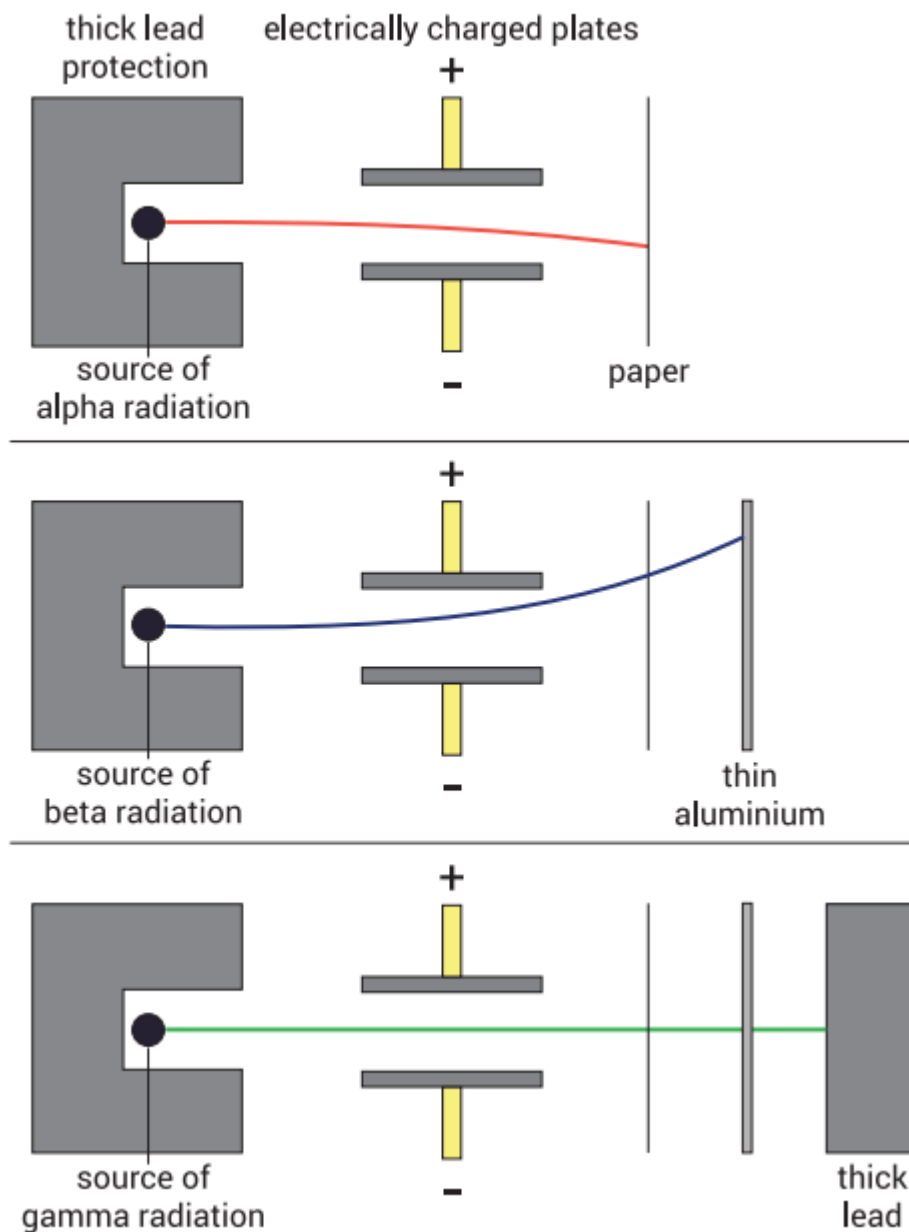
- Half-life:

- half-life is the time taken for half of the nuclei of a particular isotope to decay;
- the half-life of an isotope is a constant, unaffected by chemical or physical conditions;
- the half-life of an isotope can be determined from a graph showing a decay curve;
- calculations can be performed using the link between the number of half-lives, time and the proportion of a radioisotope remaining.

9

- Use of radioactive isotopes:

- radioisotopes have a range of uses in medicine and in industry;
- radioactive isotopes can be used to date materials;
- given information on the type of radiation emitted and/or half-lives, the suitability of an isotope for a particular application can be evaluated;
- you do not need to be able to name the isotope used in a particular application.



Examples of uses of Radioactive isotopes

Gamma rays from cobalt-60 to kill the cancerous cells.

Gamma rays from cobalt-60 are used to show up leaks in pipelines.

Alpha radiation from Americium-241 is used in smoke detection devices