

Radioisotopes

The elements having the same atomic number but a different mass number are known as isotopes.

The isotopes which emit various radioactive radiations, are known as radioisotopes.

Every chemical element has one or more radioactive isotopes. For example, hydrogen has three isotopes: ${}_1\text{H}^1$, ${}_1\text{H}^2$, and ${}_1\text{H}^3$.

Only ${}_1\text{H}^3$ (tritium) is a radioactive isotope (the other two being stable).

Some other examples of radioisotopes are: **Iodine (I^{131})**, **Phosphorous (P^{30})**, **carbon (C^{14})**, etc.

Properties:

The main properties of radioisotopes are

- Their half-life period is relatively small.
- They undergo spontaneous disintegration emitting γ -rays or positron.
- Their presence in any substances can be detected by using a counter like G. M. counter
- Radiation from radioisotopes can damage a living organism.

Uses:

(a) **Medicine:** Radioisotopes are used in three regions of medicine.

(i) **For medical diagnosis:**

- Radioisotopes are used in radiotherapy. Cancer cells are treated by exposing gamma radiation. They are also used to treat brain tumors.
- Radioactive iodine ($I - 131$) is used to diagnosis the condition of the human thyroid gland.
- Radioactive mercury ($Hg - 203$) is used to study the disorders of the kidney and liver. It also helps in the diagnosis of brain tumors.
- Radioactive chromium ($Cr - 51$) is used to locate the exact position where the hemorrhage might have taken place inside the body.
- Radioactive sodium ($Na - 24$) is used to study the restricted circulation of blood in the body.
- Radioactive iron ($Fe - 59$) is used to distinguish many diseases caused by a deficiency of red blood cells in the human body.

(ii) **For medical therapy:**

- Radioactive cobalt-60 (Co^{60}) is used to destroy the cancerous tumors in the body.
- Radioactive bismuth is used in the treatment of Syphilis.
- Radioactive iodine ($I - 131$) is used to treat an overactive thyroid gland.
- Radioactive gold is also used for the treatment of leukemia.
- Radioactive phosphorous ($P - 32$) can be used for treating skin diseases.

(iii) **For sterilization and preservation:**

- Medical instruments and bandages are sterilized after packing by short exposure to gamma radiation.
- Foodstuff like meat may be kept fresh for many days by exposing them to γ -rays for some time.

(b) **Industry:** Radiations from radioisotopes are used:

- To check the thickness of paper, rubber, or metal sheets.
- The thickness of the materials can be checked and measured by measuring the amount of radiation absorbed by the sheets of the materials.
- To check leakage in buried pipes carrying petrol.
- leakage in pipes can be detected by adding a little suitable radioactive solution to the liquid to be pumped through the pipes and count the rate of radioactive radiation at different places above the pipeline.
- To find the level of liquid in a closed reservoir.
- In the steel smelting process and grading, the steel is produced in steel industries.

(c) **Agriculture:** In Agriculture, the radioisotopes help to raise crop yields. A suitable choice of fertilizers could be made for a plant if the preferential assimilation of materials for growth can be discovered. Radio phosphorous ($P - 32$) is largely employed for this purpose.