

(1) In Medicinal Diagnosis

- (1) By adding traces of a suitable radioisotope to a particular food, it is possible to find out to which parts of the body the food is reaching.
- (2) Metastable technetium ($^{99}_{43}\text{Tc}$) is used in the diagnosis and treatment of brain tumors.
- (3) $^{32}_{15}\text{P}$ in the form of phosphate is used in diagnosis and treatment of blood disorders, bone cancer and to distinguish between cancer cells and their healthy neighbours.
- (4) $^{24}_{11}\text{Na}$ is used to check the circulation of blood and in diagnosis of problems occur in blood clotting.
- (5) Radioisotopes of iodine (^{123}I , ^{125}I , ^{131}I) are used in the diagnosis and treatment of diseases of thyroid glands.
- (6) $^{60}_{27}\text{Co}$ is used in the diagnosis and treatment of cancer.
- (7) ^{201}Tl is used in diagnosis and treatment of heart diseases.
- (8) ^{59}Fe is used in the diagnosis of anaemia.
- (9) $^{51}_{24}\text{Cr}$ is used in tagging leucocytes and labelling of blood platelets.
- (10) $^{90}_{38}\text{Sr}$ is used in the treatment of eye cancer of animals.
- (11) $^{198}_{79}\text{Au}$ is used in the treatment of prostate and cervix uterine carcinoma and bladder tumors.



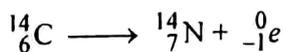
(2) Radio Carbon Dating

In radio carbon dating i.e. in predicting the age of a fallen tree or dead animal. The radio active isotope $^{14}_6\text{C}$ is produced in the atmosphere by the action of cosmic ray neutrons (present in the upper atmosphere) on $^{14}_7\text{N}$.



The $^{14}_6\text{C}$ is oxidized to CO_2 and this radioactive CO_2 mixes with the non-radioactive CO_2 . The radioactive carbon disappears through radioactive decay but it is also being formed constantly. Thus in the atmosphere, the ratio of the radioactive carbon to non-radioactive carbon remains almost constant.

The CO_2 of the atmosphere is absorbed by the plants through the process of photosynthesis and the ratio of radioactive carbon ($^{14}_6\text{C}$) to ordinary carbon ($^{12}_6\text{C}$) in plants that are alive and growing is the same as that in the atmosphere. As the plants are eaten by the animals, the ratio of $^{14}_6\text{C}$ to $^{12}_6\text{C}$ is same in animals as well. When a plant or animal dies, the amount of $^{14}_6\text{C}$ diminishes through radioactive decay and the loss is not made up by the assimilation of the atmospheric CO_2 . The ratio of $^{14}_6\text{C}$ to $^{12}_6\text{C}$ therefore decrease.



Knowing that the half-life period of $^{14}_6\text{C}$ is 5770 years, the age of the animal or the plant (i.e., the time since its death) can be calculated. For example if in an object the ratio of $^{14}_6\text{C}$ to $^{12}_6\text{C}$ diminishes to half that of the atmosphere, the object is one half life i.e., 5770 years old.

The age of plant or animal (the time since its death) can be calculated from the following formula:

$$t = \frac{2.303}{k} \log \frac{N_0}{N_t}$$

where $k = \frac{0.693}{t_{1/2}}$

where k = disintegration constant of ^{14}C

$t_{1/2}$ = Half life of ^{14}C

t = age of animal or plant

N_0 = amount or activity of ^{14}C in the living animal or plants

N_t = amount or activity of ^{14}C in old wood or animal fossil

Example. An old piece of wood has 25.6% as much C^{14} as ordinary wood today has. Find the age of the wood. Half life period of C^{14} is 5760 years.

Solution:

Suppose the amount of C^{14} present in the wood originally (i.e., the same which the wood today has) = N_0

Then the amount of C^{14} present now in the old wood (N_t) = $\frac{25.6}{100} N_0 = 0.256 N_0$

The time t in which C^{14} hanged from N_0 to $0.256 N_0$ will then be given by

$$t = \frac{2.303}{k} \log \frac{N_0}{0.256 N_0}$$

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{5760}$$

$$= 1.203 \times 10^{-4} \text{ year}^{-1}$$

$$t = \frac{2.303}{1.203 \times 10^{-4}} \log \frac{1}{0.256}$$

$$= 11329 \text{ years}$$



Problem: A sample of carbon derived from one of the dead sea scrolls is found to be decaying at the rate of 11.5 disintegration per min. per gram of carbon. Estimate the age of dead sea scrolls. $t_{1/2}$ for ^{14}C = 5568 yrs. Carbon from living plants disintegrates at the rate of 15.3 disintegration per minute per gram.

Solution:

$$k = \frac{0.693}{5568} = 1.244 \times 10^{-4} \text{ yr}^{-1}$$

$$t = \frac{2.303}{1.244 \times 10^{-4}} \log \frac{15.3}{11.5}$$

$$= 2.3 \times 10^3 \text{ yrs.}$$