Let, $A_0 = initial\ activity\ of$ C-14 $isotope$ (at the time of death)

$A = current\ activity\ of$ C-14 $isotope$ (in remaining fossil part of organisms)

From decay equation,

$$A = A_o\, e^{-\lambda t} \qquad t = age\ of\ the\ fossil.$$

or, $\frac{A_o}{A} = e^{\lambda t}$

or, $ln\left(\frac{A_o}{A}\right) = \lambda t$

or, $\boxed{t = \frac{1}{\lambda}\, ln\left(\frac{A_o}{A}\right)}$

$$\boxed{\lambda = \frac{0.693}{T_{\frac{1}{2}}} \quad ; \quad T_{\frac{1}{2}} = 5730\ years.}$$

Thus, knowing the values in RHS, the age of the sample can be estimated.

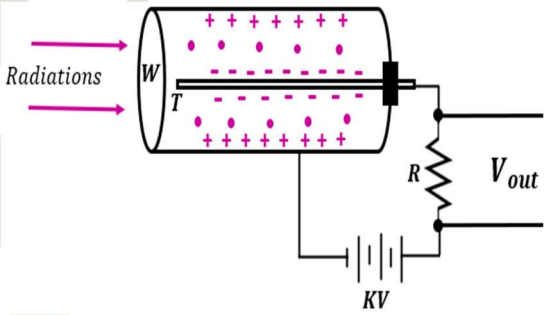
1. The isotope $_{19}K^{40}$ with half-life of $3.7 \times 10^9\ years$, decays to $_{18}Ar^{40}$, which is stable. Moon rock from the sea show that the ratio of these potassium atoms to argon atoms is $1/7$. Estimate the age of the rock. $[\mathbf{4.1 \times 10^9\ years}]$

GM counter (Geiger Muller Counter):

GM tube is an instrument used for detecting and measuring ionizing radiation like alpha particles, beta particles, and gamma rays. A Geiger-Müller counter can count individual particles at rates up to about 10,000 per second and is used widely in medicine and in prospecting for radioactive ores.

Construction

It consists of a hollow metal case enclosed in a thin glass tube. This hollow metal case acts as a cathode. A fine tungsten wire is stretched along the axis of the tube and is insulated by ebonite plugs. This fine tungsten wire acts as anode. At one end of the tube a thin window of mica is arranged to allow the entry of radiation into the tube.



Principle and Working:

When an ionizing particle passes through the gas in an ionizing chamber, it produces a few ions. If the applied potential difference is strong enough, these ions will produce a secondary ion avalanche whose total effect will be proportional to the energy associated with the primary ionizing event.

Thus, one single incoming particle will cause many electrons to arrive at the wire, creating a pulse which can be amplified and counted. This gives us a very sensitive detector.

Uses:

Geiger counters have many applications in radioactivity detection. Here are few of the examples:

1. To detect radioactive rocks and minerals in the course of mineral prospecting.
2. For Fire responders for making an initial determination of radiation risk.
3. To check for environmental levels of radioactivity near a nuclear power facility.
4. To test for radioactive contamination of food.
5. To check for radioactivity in metal objects in your home or office that could be made of recycled radioactive materials.