What is the principle of 'Radioactive dating'? The isotopes of ^{238}U and ^{235}U occur in nature in the ratio of 140:1. Assuming that at the time of earth formation they were present in equal ratio; make an estimate of the age of the earth. Half life of ^{238}U and ^{235}U are $45x\ 10^9$ years and $7.13x10^8$ years respectively.

Solution: ***'Radioactive dating':*** Radioactive dating (radiometric dating/rock dating) is a technique used to collect archaeological data (mainly age) of the materials like rocks and other century old goods based on comparison between the observed abundance of a naturally occurring radioactive isotope and its decay product, using known decay constant (λ).It is now the principal source of information about the absolute age of rocks and other geological features including the age of earth itself. Among them the best known techniques are (i) Radiocarbon dating (ii) Uranium-Lead dating (iii) Potassium – Argon dating etc.

2^{nd} part:

We know the relation $\mathbf{N=N_0e^{-\lambda t}}$ where all term signify its usual meaning.

Here, for ^{238}U, we can write $N_{238} = N_{0(238)}\, e^{-\lambda_{238} t}$ **.................(I)**

And for ^{235}U we can write $N_{235} = N_{0(235)}\, e^{-\lambda_{235} t}$ ....(II)

Now dividing equation I by equation II, we get

$$\frac{N238}{N235} = \frac{N0(238)\ e^{-\lambda t}}{N0(235)e^{-\lambda t}}$$

As two isotope were presents in equal ration, when the earth was formed, So, $N_{238} = N_{235}$

$$\text{So, } \frac{N238}{N235} = \frac{e^{-\lambda(238)t}}{e^{-\lambda(235)t}} \text{ or, } \frac{N238}{N235} = e^{t(\lambda 235 - \lambda 238)}$$

Or $\ln \frac{N238}{N235} = t(\lambda_{235} - \lambda_{238})$ ....(III)

Here, we can write $\lambda_{238} = 0.693/ t_{1/2\ (U238)}$ and $\lambda_{235} = 0.693/ t_{1/2\ (U235)}$ and $\frac{N238}{N235} = 140/1$ (according to question)

Now according to question, putting all the data in equation (III) and simplifying, we have the age of Earth (t) = 5.17×10^9 Years.