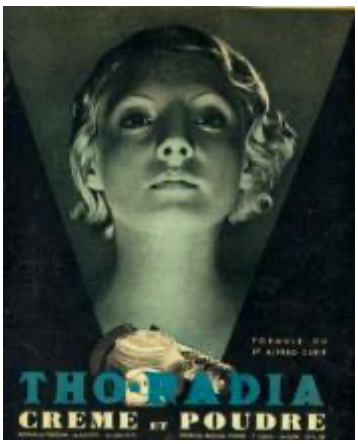
When radioactivity was coooooool



A careful examination of trademark registrations between 1927 and 1934 attests to the "radium craze" that was raging at the time. We have identified around a hundred entries that refer, directly or indirectly, to this radioactive element. Tho-Radia proudly proclaimed its low radium content : "[...] the radioactivity of radium is practically inexhaustible. It has been calculated that it would only decrease by half after sixteen centuries. This is the fundamental difference between a preparation that actually contains radium , such as Tho-Radia cream [...] and products that have only been exposed to radium emanation. The activity of this emanation disappears in a very short time."

"Revue d'histoire de la pharmacie", 3e trimestre 2002

Part one: Activity due to radium 226

Data: *Radioactive constant of radium 226:* $\lambda = 1{,}35.10^{-11}\ s^{-1}$
Avogadro's constant: $N_A = 6{,}02.10^{23}\ mol^{-1}$
Molar mass of radium: M(Ra) $= 226\ g.mol^{-1}$

1. Radium 226.

1.1. State the composition of a radium nucleus, $^{226}_{88}Ra$.

1.2. Radium-226 is alpha-radioactive, and leads to radon, Rn.
Write the equation of the decay reaction of radium 226.

2. When it is produced (t = 0), hundred grams of Tho-Radia cream contain $N_0 = 3.33x10^{14}$ nuclei of radium-226.

2.1. Calculate the corresponding mass of radium-226.

2.2. Activity of the radium contained in the cream.

2.2.1. State the decay law of N, number of radium-226 nuclei, over time.

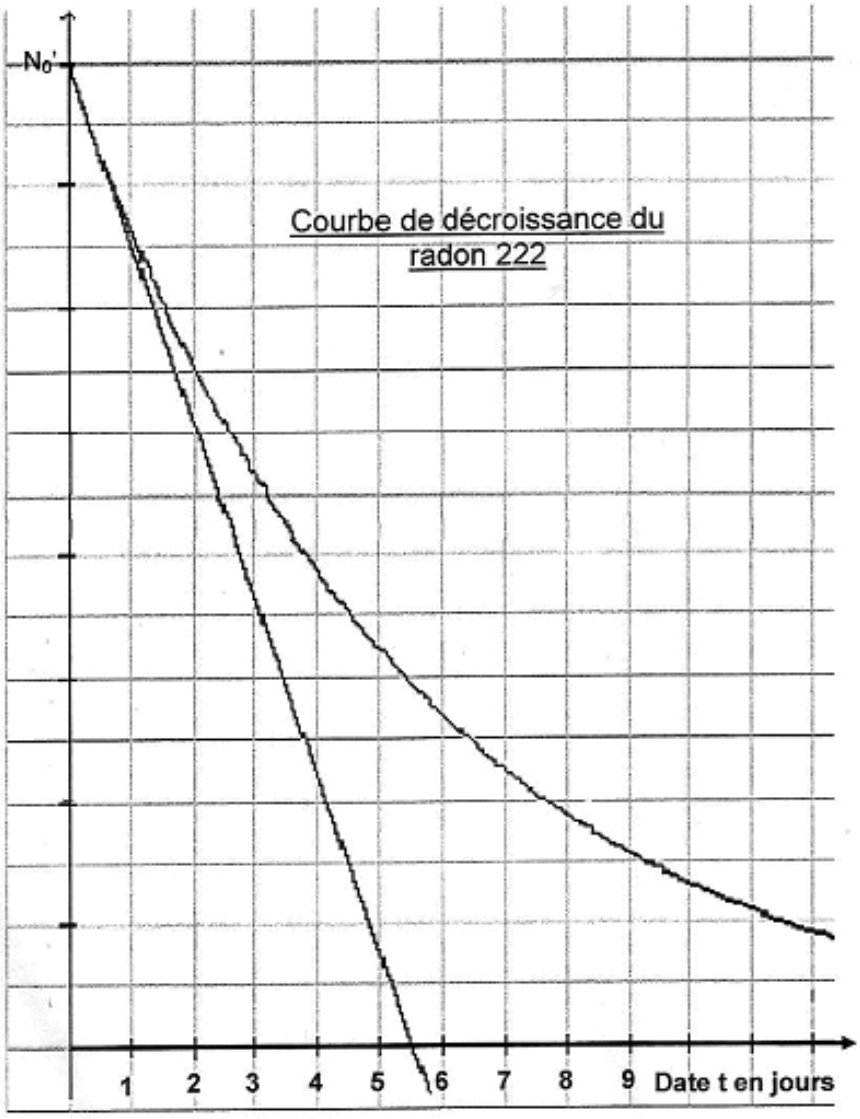
2.2.2. Calculate the percentage of nuclei still present at time t = 10 years.

2.2.3. Explain why we can say that the activity due to radium-226 contained in the cream remains virtually unchanged over a period of ten years.

2.3. Justifiy the following sentence from the introductory text: « *It has been calculated that it would only decrease by half after sixteen centuries.* **»**

Part 2: Activity due to radon-222

Data: *Radon-222 has a half-life of 3.8 days.*
It is produced by the decay of radium-226, and is also radioactive alpha. The decay curve of a sample of radon-222, with an initial number of nuclei N_0, is given below:



1. **Using the graph, determine the half-life of radon-222.**
2. **Deduce the radioactive constant λ.**
3. **On the same graph, using the same scales, construct the curve representing the decay law of radon-222 for an initial number of nuclei that is half as large.**