Cheatography

Alvl P2: radioactive decay (ch11) Cheat Sheet

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Decay models of unstable nuclei

Alpha α	Beta minus β-	Beta plus β+	Gamma γ
	N decay to P, emitting e and /Ve	(K capture)	nucleu in excited state emits photon-some after β decay
$^{241}_{95}Am$ -> $^{237}_{93}Np$ + $^{4}_{2}α$	$^{63}_{28}Ni$ -> $^{63}_{29}Cu$ + $_{-1}e$ + /Ve	$^{124}_{53}I$ $_{+1}e$-> $^{124}_{52}Te$ + Ve	$^{99}_{42}Mo$ -> $^{99m}_{43}Tc$ + $_{-1}e$ + /Ve
		m -> metastable state	$^{99m}_{43}Tc$ -> $^{99}_{43}Tc$ + γ
		nucleus in high excited state for extended time	time (grater than a billionth of a second)

Equations

decay rate	ΔN/Δt = -λN
activity	A = λN
half life	T = ln2/λ
activity	ln2N/T
Number of atoms after decay	N = N○e^-λt
activity after decay	A = A○e^-λt
mass	mol x RAM

Definitions

spontaneous	can't be influenced/independent
random	can't predict when it will happen
decay constant	probability of a nucleus decaying per unit time
activity	number of disintegrations (or emissions) per unit time
metastable state	when an atom/nucleus exists for an extended time in a state other than ground state
daughter nucleus	product of the decay of a radioactive ('parent') nucleus
half life	time taken for half of a sample of radioactive nuclei to decay

radioactive decay

--> the significance of the - sign in -λN is that the number of radioactive nuclei in a sample material decreases over time

Example Question:

. Lanthanum-139 is the more abundant isotope and makes up 99.911% of naturally occurring lanthanum. The remaining 0.089% is the radioisotope lanthanum-138

. Lanthanum-138 has a decay constant of 2.0 × 10−19 s−1; and 139g of lanthanum contain 6 × 10^23 atoms.

Calculate the activity of a 40g sample of Lanthanum

The number of atoms in 40g of lanthanum is 6×10^{23} x 40/139 = 1.73 $\times 10^{23}$

However, only 0.089% of these are lanthanum-138.

So the number of lanthanum-138 nuclei is

N = 1.73×10^{23} x 0.089/100 = 1.54×10^{20}

so

A=λN

= 2.0×10^{-19} s^{-1} x 1.54×10^{20}

= 31Bq

Uses of radioisotopes:

Radiotherapy

Gamma rays γ	- rotating source of gamma rays
	- reduces exposure to healthy tissue
	- focuses exposure to tumor
Alpha rays α	- injected directly into the tissue
	- attach to a biological molecule (eg glucose) that needs to divide
	- collects to the caner cells that love to divide

Carbon dating

	- uses ^{14}C (half life of 5700 years)
	- The ratio of Carbon-14 remaining indicates the times since the death of a living substance

Nuclear Instability

- every element has many different isotopes
- however most isotopes are unstable, and decay by emission of radiation to become more stable
- this can be plotted on a no.Neutrons to no.Protons graph

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