Today: Start chapter 19
tomorrow: Expt 11
Friday: finish chapter 19

Ch 18 day 3 #4

cathode: $2(2H_2O + 2e^- \rightarrow H_2 + 2OH^-)$ $E^\circ_{red} = -0.83V$ LCM = 4
anode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ $E^\circ_{ox} = -1.23V$ n = 4

$6H_2O \rightarrow 2H_2 + \overbrace{4OH^- + 4H^+}^{4H_2O} + O_2$ $E^\circ_{rxn} = -2.06V$

$2H_2O \rightarrow 2H_2 + O_2$ $E^\circ_{rxn} = -2.06V$

charge = current x time
charge = 2A x 3600s
charge = $\frac{7200\,C \mid 1\,mol\,e^-}{\mid 96500\,C}$ = 0.0746 mol e^-

$\frac{0.0746\,mol\,e^- \mid 2\,mol\,H_2}{\mid 4\,mol\,e^-}$ = **0.0373 mol H_2**

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mass number → $^{12}_{6}C$ $^{13}_{6}C$ $^{14}_{6}C$
atomic # (# protons) → 6

	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
	6P, 6N	6P, 7N	6P, 8N
abundance:	99%	<1%	radioactive (has a lifetime), unstable
	C-12	C-13	

$^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$ ← ${}^{0}_{-1}\beta$ (beta particle)

$\Delta E \approx 500{,}000 \times \Delta H_{typical\ reaction}$ (200-1000 kJ/mol)

$t_{1/2}$ = 5730 years (half life = in 5730 years half the $^{14}_{6}C$ will be $^{14}_{7}N$)

alpha particle (high energy He nucleus)

$^{238}_{92}U \longrightarrow {}^{4}_{2}\alpha + {}^{234}_{90}Th$ (unstable) $\quad t_{1/2} = 4.51 \times 10^{9}$ yr

$^{234}_{90}Th \longrightarrow {}^{0}_{-1}\beta + {}^{234}_{91}Pa$ (unstable) $\quad t_{1/2} = 24$ days

$^{234}_{91}Pa \longrightarrow {}^{0}_{-1}\beta + {}^{234}_{92}U$ (unstable) $\quad t_{1/2} = 6.8$ hours

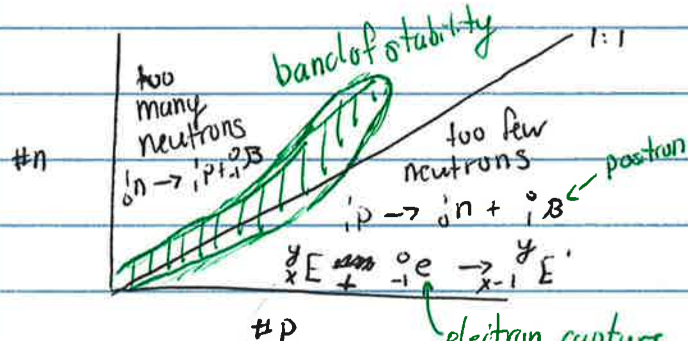
$^{234}_{92}U \longrightarrow {}^{4}_{2}\alpha + {}^{230}_{90}Th \quad t_{1/2} = 247{,}000$ years

etc.

overall: $^{238}_{92}U \longrightarrow 8\,{}^{4}_{2}\alpha + 6\,{}^{0}_{-1}\beta + {}^{206}_{82}Pb$ (stable)

$t_{1/2} = 4.51 \times 10^{9}$ years

- balance top number first (α first)
- then use β particles to finish



* anything in the band of stability are stable enough to be detected (but could still be radioactive).

γ = gamma ray (wave)

$\lambda \approx 10^{-3} \times \lambda_{xray}$

- produced by positrons

$^{190}_{79}Au$ — too many neutrons ∴ beta emission

$^{206}_{79}Au$ — too few neutrons ∴ positron emission or electron capture

What will they do?

· Follow first order kinetics ↙ can be moles, grams, percent, decay counts [ ]

~~time-amount eq~~ time-amount equation $\ln\left(\frac{N_0}{N_t}\right) = kT$

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

given $t_{1/2}$ → k → use time-amt eqn

$^{99}_{43}Tc \longrightarrow ^{0}_{-1}\beta + ^{99}_{44}Ru \quad t_{1/2} = 6.00 \text{ hours}$

What percent Tc remains after 2 days?

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{6.0 \text{ hrs}} = 0.1155 \text{ per hours}$$

$$\ln\left(\frac{N_0}{N_t}\right) = kT$$

$$\ln\left(\frac{100}{N_t}\right) = (0.1155\,hr^{-1})(48hr)$$

$$\ln\left(\frac{100}{N_t}\right) = 5.54$$

$$\frac{100}{N_t} = 256$$

$$N_t = 0.39\%$$