April 24, 2019

Aluminum question

Step 1. How much charge given current + time? : $5C/s \times 600\,sec = 3000\,C$

Step 2. How many moles of electrons is this? : $3000C \times \frac{1\,mole^-}{96,485} = 0.03\,mole^-$

Step 3. How many moles of Al does this correspond to? : $.03\,mol\,e^- \times \frac{1\,mol\,Al}{3\,mole^-} = .01\,mol$

Step 4. How many grams of Al is this? : $0.01\,mol\,Al \times \frac{27\,g\,Al}{mol} = 0.3\,g\,Al$

Nuclear Chemistry

- Nucleus: nuclearity dependent on # of protons and neutrons
  - Any element w/ more than 83 protons is radioactive
- Atomic #: # of protons
- Mass number: sum of protons and neutrons

$^{12}_{6}C$ ← mass # → 12, atomic # → 6, ← symbol of element

Isotopes Review:

- Mass # not constant for a given element - differing neutrons
- Each of these nuclides is an isotope of carbon: C-12, C-13, C-14
  - Vast majority of nuclides are unstable → fall apart to release radiation
- Radioactive decay: nuclear particles (nuclides)
  - Radionuclide: unstable nuclide that undergoes radioactive decay
  - Release of energy and/or particles can result in transmutation of a ~~nuclide~~ radionuclide into a different element
- Mass loss - converted into energy (1st law thermodynamics)

Chemical Reactions vs. Nuclear Reactions

Chemical	Nuclear
- Bonds breaking	- Nuclei emitting particles/rays
- Atoms unchanged, maybe rearranged	- Atoms converted to atoms of another element
- Involves valence electrons	- Involves protons, neutrons, and electrons
- Associated w/ small energy changes	- Associated w/ large energy change
- Rxn rate influenced by temp, particle size, concentration, etc.	- Rxn rate ≠ influenced by temp, etc.

Balancing Equations

- Chemical equations: atoms + charges need to balance
- Nuclear equations: atomic # + mass # need to balance

Alpha Decay: loss of an α particle (He-4 nucleus: 2 protons, 2 neutrons)

$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$ } Note how equation balances

- atomic #: $92 = 90 + 2$
- mass #: $238 = 234 + 4$

Beta decay: loss of β-particle

- β: high-speed electron emitted by the nucleus
- Net result: loss of a neutron and a gain of a proton
  - → atomic # goes up by 1, but the mass number does not change

$^{131}_{53}I \rightarrow {}^{131}_{54}Xe + {}^{0}_{-1}e$ and H-3 → He-3 + $^{0}_{-1}e$ - see slide

Gamma Emission: loss of γ ray, high energy radiation that almost always accompanies the loss of a nuclear particle

- Relative penetration:

Positron Emission: nuclei decay by emitting a positron (anti-electron)

- positron: anti-electron - same mass, but positively charged
- Net result: loss of a proton and gain of a neutron

$^{11}_{6}C \rightarrow {}^{11}_{5}B + {}^{0}_{1}e$ } balancing of equation

atomic #: $6 = 5 + 1$

mass #: $11 = 11 + 0$