

April 24, 2019

### Aluminum question

- Step 1. How much charge given current + time? :  $5C/s \times 600 \text{ sec} = 3000 C$   
Step 2. How many moles of electrons is this? :  $3000 C \times \frac{1 \text{ mole } e^-}{96,485} = 0.03 \text{ mole } e^-$   
Step 3. How many moles of Al does this correspond to? :  $0.03 \text{ mole } e^- \times \frac{1 \text{ mole Al}}{3 \text{ mole } e^-} = 0.01 \text{ mole Al}$   
Step 4. How many grams of Al is this? :  $0.01 \text{ mole Al} \times \frac{27 \text{ g Al}}{1 \text{ mole Al}} = 0.27 \text{ g Al}$

### 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
- 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  $\rightarrow$  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 into a different element
  - Mass loss - converted into energy (1st law thermodynamics)

mass #  $\rightarrow 12$   
atomic #  $\rightarrow 6$   $\leftarrow$  symbol of element

### Chemical Reactions vs. Nuclear Reactions

#### Chemical

- Bonds breaking
- Atoms unchanged, maybe rearranged
- Involves valence electrons
- Associated w/ small energy changes
- Rxn rate influenced by temp, particle size, concentration, etc.

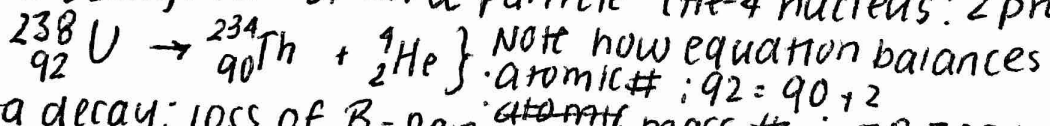
#### Nuclear

- Nuclei emitting particles/rays
- Atoms converted to atoms of another element
- Involves protons, neutrons, and electrons
- Associated w/ large energy change
- Rxn rate  $\neq$  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  $\alpha$  particle (He-4 nucleus: 2 protons, 2 neutrons)



Beta decay: loss of  $\beta$ -particle

- $\beta$ : high-speed electron emitted by the nucleus
  - Net result: loss of a neutron and a gain of a proton
  - $\rightarrow$  atomic # goes up by 1, but the mass number does not change
- $${}_{53}^{131}\text{I} \rightarrow {}_{54}^{131}\text{Xe} + {}_{-1}^0e \quad \text{and} \quad \text{H-3} \rightarrow \text{He-3} + {}_{-1}^0e \quad \text{see slide}$$

Gamma Emission: loss of  $\gamma$  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

