

Announcements

To join clicker to class today
(Clickers with LCD display
join automatically):

- Turn on the Clicker (the red LED comes on).
- Push “Join” button followed by “20” followed by the “Send” button (switches to flashing green LED if successful).
- First quiz in discussion Wednesday, covers material through Friday's lecture.

- Get your clickers registered. About 85% of you have so far.
- Get signed up for the e-mail discussion list. About 80% of you have so far.

Review

- Doppler effect
 - Red Shift => expansion
- Expansion of universe/Big Bang
 - energy->quarks->n -> p + e -> nucleons -> atoms -> stars/galaxies
- radioactive decay
- Isotopes (average atomic mass)
 - Example H + D: $1.007825(0.99985)$
 $+2.014108(0.00015) = 1.0080 \text{ amu} = m_{\text{H}}f_{\text{H}}$
 $+ m_{\text{D}}f_{\text{D}} = m_{\text{avg}}$

Temperature Scales

Chang Fig. 1.8

- $^{\circ}\text{C} = (^{\circ}\text{F} - 32) * 5/9$

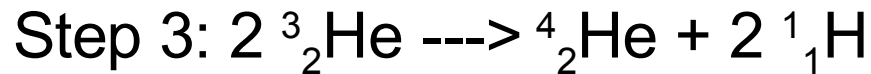
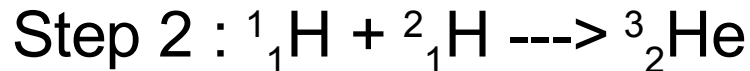
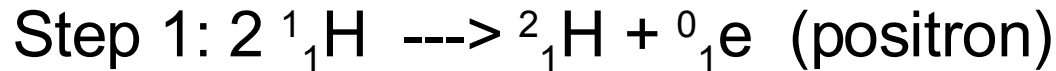
- $\text{K} = ^{\circ}\text{C} + 273.15$

Chapter 2: Nuclear Chemistry

- A. Fusion
- B. Nuclear binding energy/Mass defect/binding energy per nucleon
- C. Neutron & electron capture
- D. Radioactive decay (β , positron emission, α)-Belt of stability.
- E. Nuclear fission (chain reaction, critical mass)
- F. Artificial isotopes/elements (accelerators)
- G. Measurement of radioactivity
- H. Biological effects of radioactivity (medical uses and radon)
- I. Radiochemical dating
- J. Review of composition of Universe.

Fusion of Hydrogen

- This is a multistep process



- Note need 2 of steps 1 and 2 to generate enough He for the last step.
- positrons eventually collide with $\text{}^0_{-1}\text{e}$ (electrons) destroying each other to produce energy in the form of gamma (γ) rays.

Fusion of Heavier Elements in Larger Stars

- ${}^2_1\text{d} + {}^4_2\alpha \rightarrow {}^6_3\text{Li}$ (stable isotope)
- $2 {}^4_2\alpha \rightarrow {}^8_4\text{Be}$ (but rapidly decays...)
- Still may see ${}^8_4\text{Be} + {}^4_2\alpha \rightarrow {}^{12}_6\text{C}$ (stable)
- More collisions \rightarrow heavier nuclei.
- Dense Centers of large stars ($\sim 10^9$ K) kinetic energy can overcome electrostatic repulsion to fuse nuclei up to ${}^{56}_{26}\text{Fe}$.
- Cannot go any farther with fusion.

Binding Energy per Nucleon

- Deuterium (${}^2_1\text{d}$) = n + p
 - total mass = $M_d = 3.34370 \times 10^{-24}\text{g}$
 - $M_n = 1.67493 \times 10^{-24} \text{ g}$
 - $M_p = 1.67262 \times 10^{-24} \text{ g}$
- Mass lost = $M_n + M_p - M_d = 0.00385 \times 10^{-24} \text{ g}$
- Total binding energy = $E = mc^2 =$
 $0.00385 \times 10^{-24} \text{ g}(1 \text{ kg}/1000 \text{ g})(2.998 \times 10^8 \text{ ms}^{-1})^2 = 3.46 \times 10^{-13} \text{ J}.$
- Have 2 nucleons, so per nucleon we have : $3.46 \times 10^{-13} \text{ J}/2 = 1.73 \times 10^{-13} \text{ J/nucleon}$

Chang Fig. 21.2