

Nuclear Reactions

May 19, 2017 8:43 AM

Units & Constants

$$m_p = 1.007825 \text{ amu}$$

$$m_n = 1.008665 \text{ amu}$$

$$931.49 \text{ MeV} = 1 \text{ amu}$$

$$1 \text{ MeV} = 1.6 \times 10^{-13} \text{ J}$$

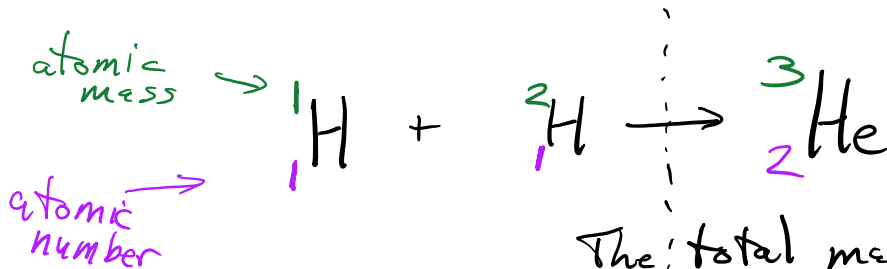
$$1 \text{ amu} = 1.6 \times 10^{-27} \text{ kg}$$

Avogadro's Number

$$6.022 \times 10^{23} \text{ atom/mol}$$

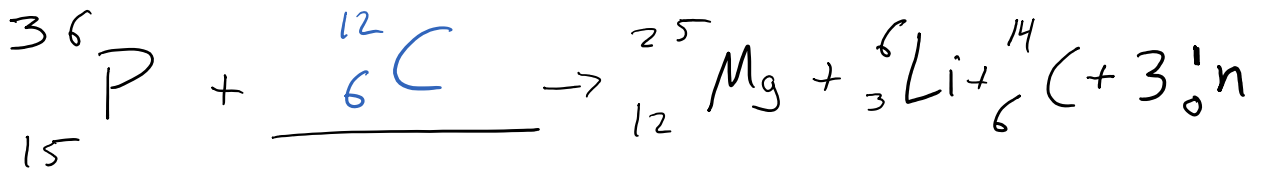
Nuclear Equation

Hydrogen and deuterium (H-2) fuse in stars.



The total mass number and atomic numbers must be equal on both sides.

Ex.



Exo/Endo-Thermic Reactions

Exothermic - A reaction where energy is a product.

Reactants will have a higher mass
- can be spontaneous (decays)

Endothermic - A reaction where energy is a reactant
Products will have more mass

- Only known to happen in supernova sized events

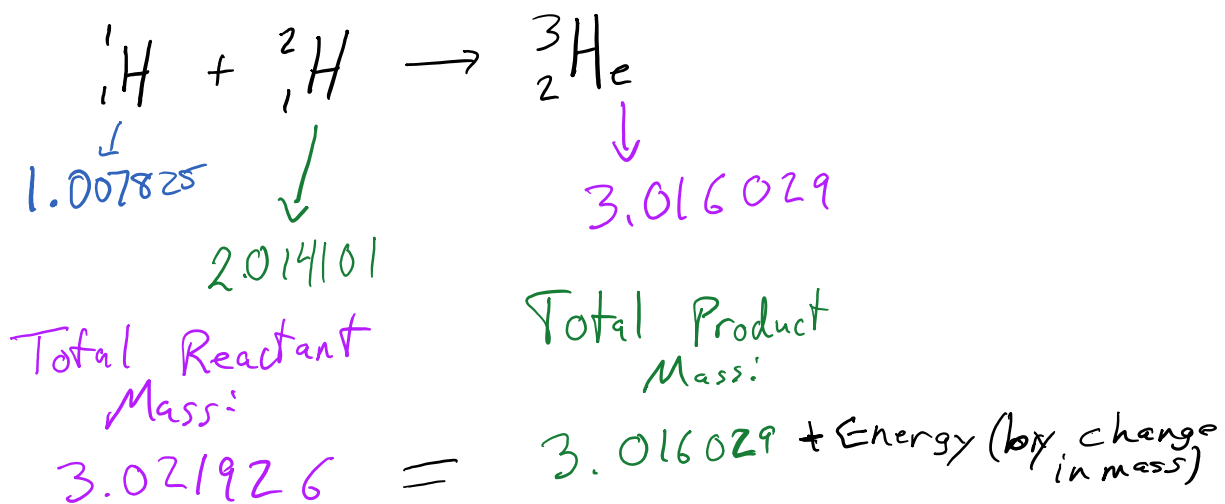
Decays

${}^4_2\alpha \Rightarrow {}^4_2\text{He}$ is shot from the nucleus of a heavy radioisotope.

${}^0_{-1}\beta \rightarrow$ A neutron (udd) Flips one of its quarks to become a proton (uud)

${}^0_0\gamma \rightarrow$ High energy light

Example: ${}^1_1\text{H}$ and ${}^2_1\text{H}$ reaction



$$\Delta m = 0.005897 \text{ amu}$$

How much energy is this?

$$0.005897 \text{ amu} \times \frac{931.49 \text{ MeV}}{\text{amu}} = 5.4930 \text{ MeV}$$

$$5.4930 \text{ MeV} \times \frac{1.6 \times 10^{-13} \text{ J}}{\text{MeV}} = 8.7888 \times 10^{-13} \text{ J}$$

If we had 1 mol of each reactant

(~ 1 g of ${}^1_1\text{H}$) and (~ 2 g of ${}^2_1\text{H}$)

$$8.7888 \times 10^{-13} \times 6.022 \times 10^{23} = 5.292 \times 10^{11} \text{ J}$$

~ 3 g of Reactant gives 529 GJ

529,000,000,000 J