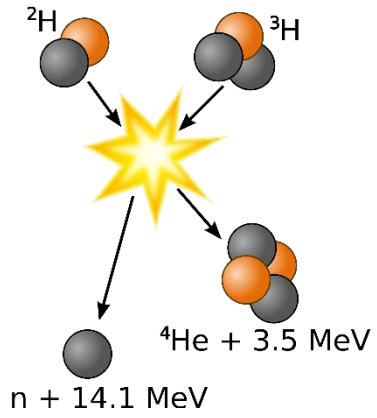
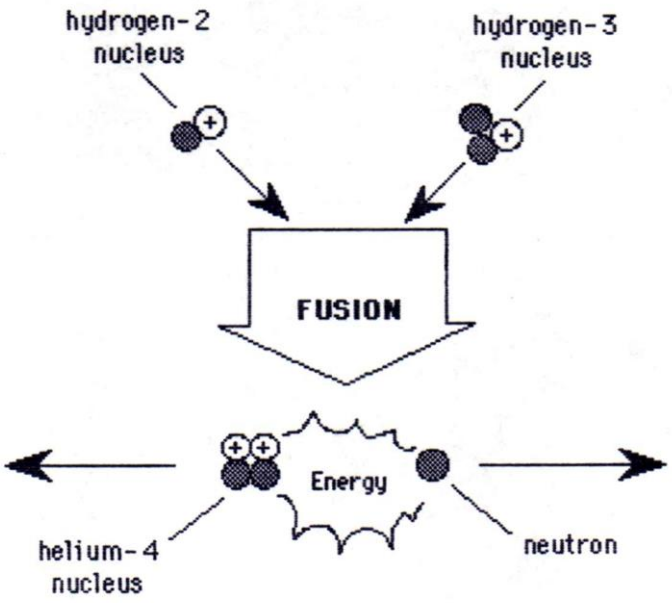
Physics with Synno – Matter – Lesson 9

M.7.6 Nuclear Fusion

Video: Nuclear Physics – Fusion
Nuclear Fusion - Fusion energy explained with Hydrogen atom example

Fusion reactions occur when two light nuclei (usually hydrogen) combine or 'fuse' to form a single, heavier nucleus. Like fission, it results in the release of a large amount of energy without the dangerous radiation products.





The diagrams show the fusion of hydrogen-2 (deuterium) and hydrogen-3 (tritium) to form helium-4 a neutron and energy. The equation for the reaction is

$$^2_1H + {}^3_1H \rightarrow {}^4_2He + {}^1_0n + energy$$

M.7.7 BINDING ENERGY

Video: The Weak and Strong Nuclear Forces (9 of 15)
Strong Nuclear Force
Binding Energy

As technology improved, and more precise measurements could be made. Scientists noticed that the mass of a nucleus was always less than the mass of its constituent parts (the protons and neutrons). For example;

The mass of an alpha particle is 4.00153 u

Whereas the mass of the constituent parts is

Protons	2 × 1.00728 u
Neutrons	2 × 1.00866 u
Total	4.03188 u

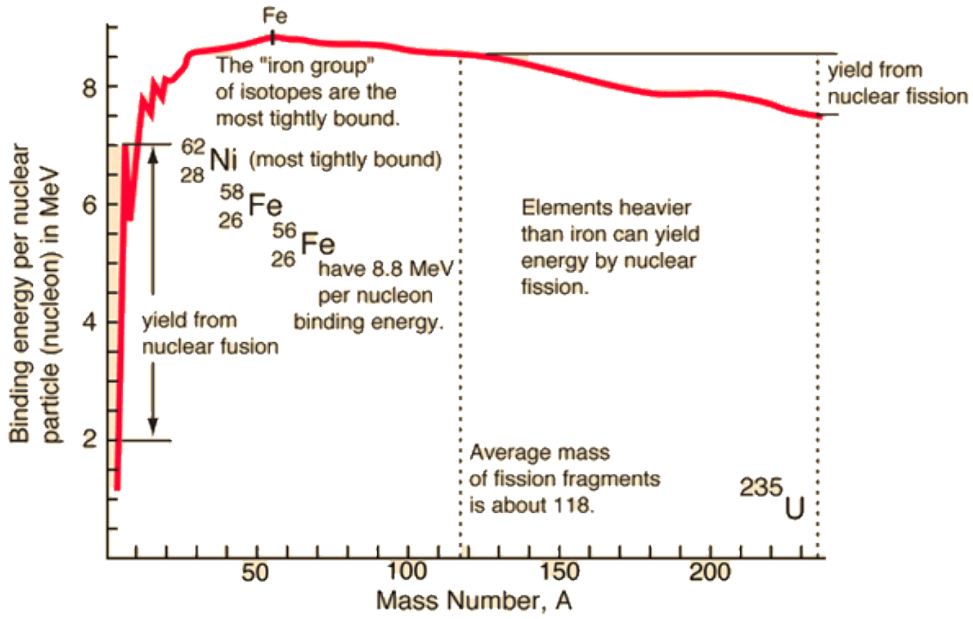
This difference in mass is a measure of the strength of the strong nuclear force that holds the nucleus together, this is known as the nuclear binding energy. The binding energy is different for each element, and each of their isotopes. The graph below shows the binding energy per nucleon for different mass numbers.

The binding energy can be calculated using Einstein's relationship

$$E = m c^2$$

Where E is the nuclear binding energy, m is the mass difference, and c is the speed of light.

Elements or isotopes with a high binding energy are more stable.



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Problem Set #9: Text Page 237 All Questions