5.3 Nuclear Reactions

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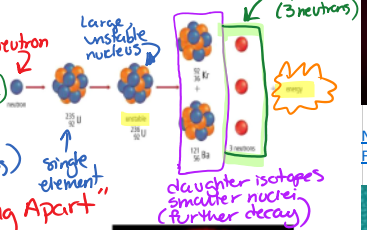
5.3 : NUCLEAR REACTIONS

Fission:

- The decay of a large unstable nucleus into smaller nuclei, subatomic particles, and ENERGY is called FISSION
- The two daughter isotopes of fission reactions are usually large, radioactive isotopes, leading to other decay reactions (usually also radioactive)
- Fission equations have a single element and a neutron which triggers the decay in the reactants, and two elements (daughter isotopes) + neutrons in the products



⇒ FISSION = "Breaking Apart"

Fusion

- The joining together of lighter nuclei making a more MASSIVE nucleus and energy is called FUSION
- The single daughter isotope of fusion reactions is usually a stable isotope
- Fusion equations have two elements in the reactants, and a single element plus neutrons in the products (+energy)
- Fusion reactions occur naturally in the enormous heat and pressure inside of stars, beginning with the fusion of hydrogen atoms together to make helium

SUN

⇒ FUSION = Joining together

Completing Fission/Fusion Reactions

1. Total up the mass numbers and atomic numbers on BOTH sides of the equation
2. The difference in the atomic numbers identifies the unknown product, look it up on the periodic table and write it in SAN (standard atomic notation) *use P.T.
3. The difference in the mass numbers gives you the mass of the unknown product
4. Rewrite finished equation and BALANCE the number of particles emitted if necessary

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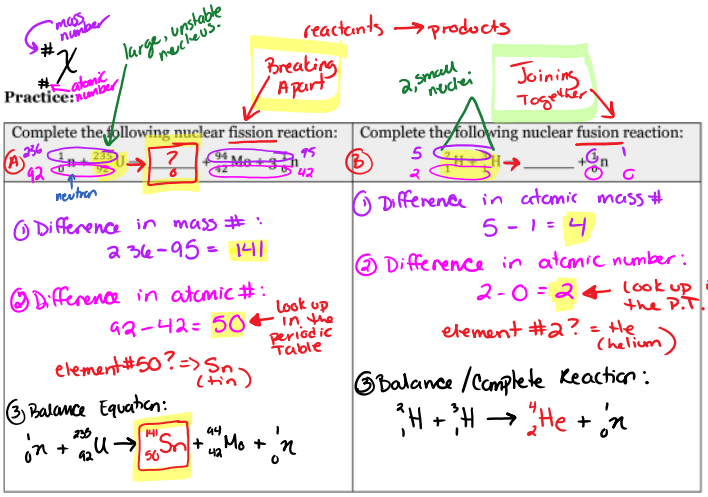
Fission vs. Fusion - Instant Egghead #5

Nuclear Chemistry Part 2: Fusion and Fission - Crash Course Chemistry #39

How does an atom-smashing particle accelerator work? - Don Lincoln

What is Nuclear Fission? | Physics | The Fuse School

New GCSE BBC Bitesize - Nuclear Energy



The Benefits of Using Nuclear Reactions

- Fission reactions are used around the world inside of nuclear power plants generating Electricity without combustion or CO_2, and radioactive 'waste' that is useful in medicine for creating images of internal organs
- Fusion power plants exist but they currently require MORE energy to run than they produce (developing technology ... not quite where yet)

The Costs of Using Nuclear Reactions

- Normal operation of fission power plants does not release radioactivity, but when they fail HUGE amounts can be released into the environment (of radioactivity)
- **Fission** plants create 'waste' daughter isotopes that are also radioactive and must be safely stored to avoid contamination the environment
- Half-lives of these radioactive waste isotopes are thousands - millions of years, meaning that we will be dealing with them for many generations.
- Fusion reactions result in stable daughter isotopes (we would combine hydrogen to make helium) which have NO environmental effects; fusion technology would greatly reduce the impact of generating electricity

non-radioactive waste

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The Chernobyl Disaster

- A catastrophic nuclear accident occurred in 1986 in the chernobyl power plant
- A sudden surge of power caused a nuclear power plant to explode and burst into flames
- massive amounts of radiation were released
- This caused many devastating short and long-term effects, including cancer risk and mutations
- Currently, Chernobyl is uninhabitable, and is not expected to be habitable for 20,000 years.

Chernobyl power plant after the meltdown

huge amounts of radioactive material were released

Summary

Fission	Fusion
Heavy, unstable nuclei break apart	Light nuclei, join together
some of the mass is converted into energy	← (same)
Radioactive daughter isotopes (products)	stable (non-radioactive) products.
used currently around the world to generate electricity	not currently used to generate electricity. (research phase)
unstable element → 2 smaller elements + n° + energy	2 smaller elements → 1 element + n° + energy

MORE

LESS