

Nuclear Reactions

I. Nuclear Fusion

1. Define the term nuclear fusion.

Nuclear Fusion - process in which lightweight atomic nuclei combine to form a heavier nucleus and release tremendous amounts of energy

2. What does each part of Einstein's Theory of Energy ($E = mc^2$) represent?

$E =$ Energy $m =$ Mass $c =$ Constant
(Hydrogen or Helium) (Speed of light)

3. List three conditions necessary for nuclear fusion reactions to occur.

1. Atomic nuclei need to be heated to high temps (180,000,000°F)
2. Nuclei need to be maintained at very high concentrations
3. Must be properly confined.

II. Nuclear Fission

1. Define the term nuclear fission.

Nuclear Fission - process in which the nucleus of an atom splits into two or more smaller nuclei (tremendous amounts of energy released)

2. Describe how nuclear fission occurs.

- Nuclei of uranium atoms are bombarded by neutrons
 - ↳ Collisions cause nuclei to split
 - ↳ Tremendous amounts of neutrons + energy released
 - ↳ More collisions occur (escalates quickly)

3. List how a nuclear power plant operates.

1. Energy from nuclear reaction heats water
2. Superheated water produces high-pressure steam
3. Steam turns turbine to generate electricity
4. Steam is cooled + released as waste heat through cooling tower

4. What is the difference between a fuel rod and control rod?

Fuel Rod - contain solid uranium pellets (bombarded with neutrons)
(cadmium, thorium)

Control Rod - contain boron or cadmium to slow fission reactions
(absorb neutrons as lowered between fuel rods)

3. An example of an uncontrolled fission reaction is a(n) atomic bomb.

Powers the stars!

Sustained long-term.

1979 - Three Mile Island
1986 - Chernobyl
2011 - Fukushima

Phosphorescence - glowing effect after exposure to X-Rays

III. Nuclear Decay

1. In 1896, radioactivity was discovered by Henri Becquerel and Marie Curie.

2. The early work of "radioactivity" led to the discovery of:

- Polonium
- Radium

(Through the use of uranium salts.)

↳ "invisible" radiation

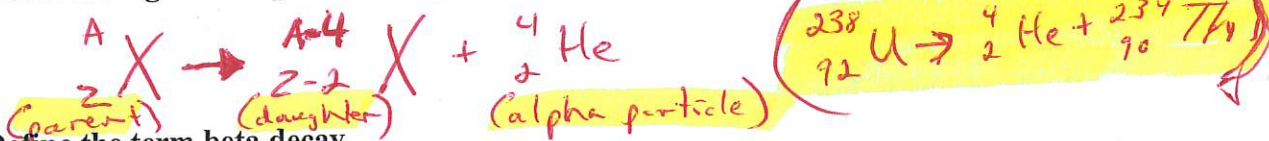
Nuclear Transmutation

- Conversion of one element into another element
of protons or neutrons changed

3. Define the term alpha decay.

Alpha Decay - radioactive decay in which the nucleus emits an alpha particle (similar to He atom) (M.N. - reduced by 4) (A.N. - reduced by 2)

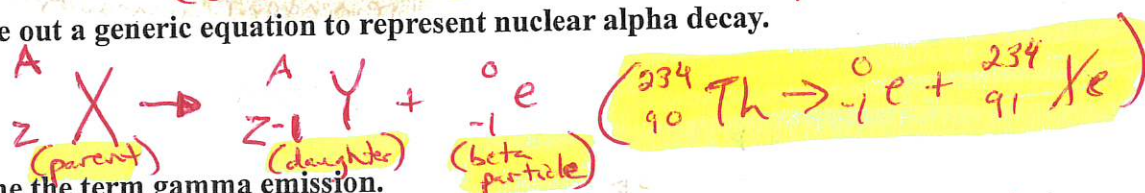
4. Write out a generic equation to represent nuclear alpha decay.



5. Define the term beta decay.

Beta Decay - radioactive decay in which the nucleus emits an electron (beta particle) (converts a neutron to a proton)

6. Write out a generic equation to represent nuclear alpha decay.

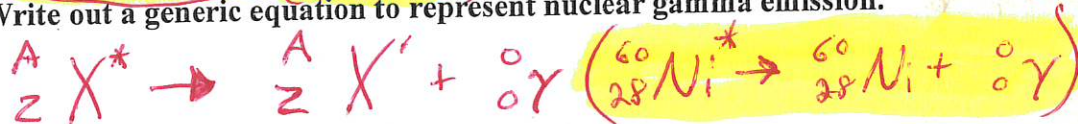


7. Define the term gamma emission.

Gamma Wave
- No mass

Gamma Emission - radioactive decay in which a high-frequency photon is emitted as an excited electron state is converted into a ground state (unstable) (stable)

8. Write out a generic equation to represent nuclear gamma emission.



IV. Use Of Nuclear Reactions

1. List four uses of nuclear reactions.

- Cancer Treatment
 - Nuclear Power Plants
 - Atomic Bombs
 - Space Exploration
- Food decontamination / Desalination