Name: KEY Official Class: _____ Date: _____

Teacher: _____ Period: _____ Class: _____

Nuclear Fission and Fusion

YOYO: What do you think the difference is between fission and fusion? Write your response below.

Types of Nuclear Reactions

Natural Transmutation	Artificial Transmutation
• Alpha decay • Beta decay • Positron decay • Fusion (energy from the sun)	• Fission (atomic bomb) • Fusion (new technology)

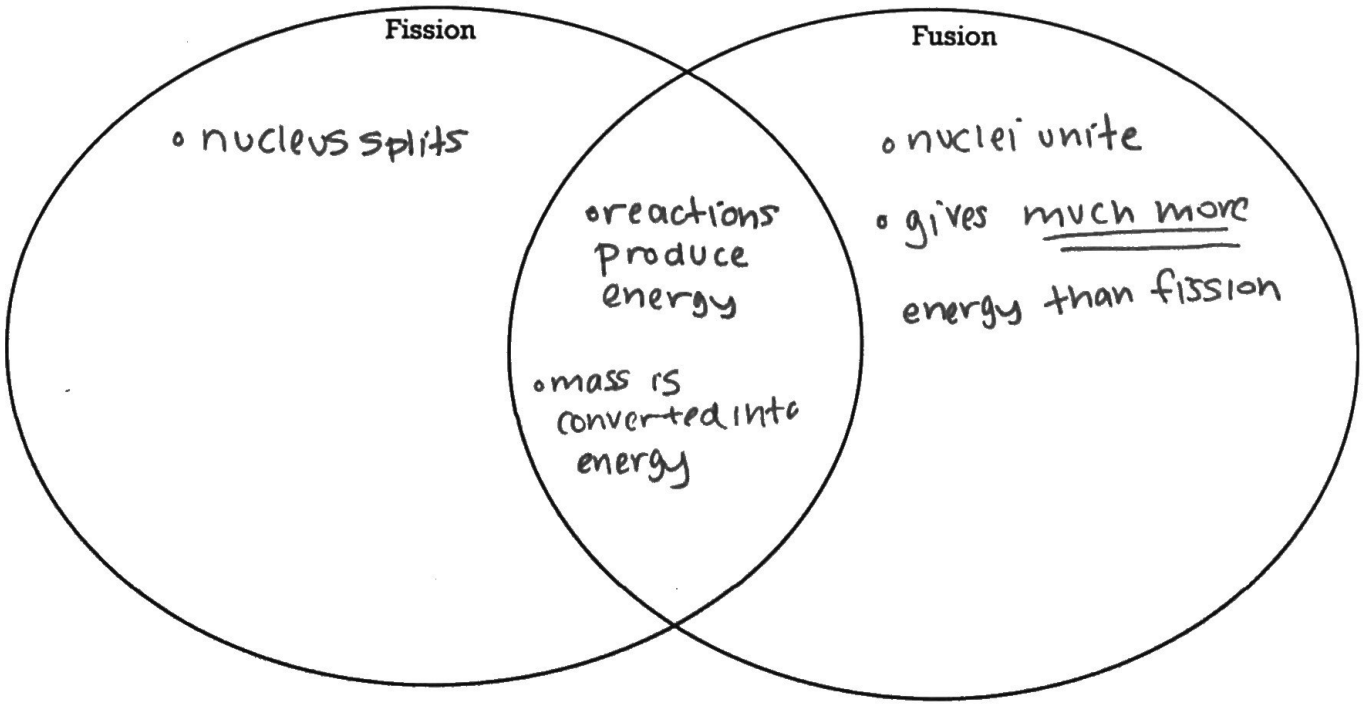
Fission

- Artificial transmutation = man made
- Fission = splitting of heavy element (large nucleus)
- Heavy element + neutron → 2 middle weight nuclei + 1 or more neutrons + energy
- Example:
  - $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{142}_{56}Ba + {}^{91}_{36}Kr + 3\,{}^{1}_{0}n + \text{energy}$

Fusion

- Combines light element to produce a heavier one
- In the sun
- Example:
  - $^{1}_{1}H + {}^{1}_{1}H \rightarrow {}^{2}_{1}H + {}^{0}_{+1}e$
  - $^{1}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}He$

Fission vs. Fusion



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Radioisotopes

Benefits	Risks
• Tracers • Medical: radioactive iodine can be used to diagnose and treat thyroid. • Food can be stored longer. • Nuclear Power • Radioactive dating o U-238 and Pb-206 are used for geological dating. C-14 used for dating living material.	• Biological Damage: damage or destroy cells • Long Term Storage • Accidents: nuclear explosion • Pollution: nuclear waste

Practice Regents Questions

1. In a fusion reaction, reacting nuclei must collide. Collisions between two nuclei are difficult to achieve because the nuclei are
   a. both negatively charged and repel each other
   b. both positively charged and repel each other
   c. oppositely charged and attract each other
   d. oppositely charged and repel each other

2. Given the fusion reaction: ${}^{2}_{1}H + {}^{2}_{1}H \rightarrow X + \text{energy}$
   Which particle is represented by X?
   a. ${}^{1}_{1}H$ b. ${}^{3}_{2}He$ c. ${}^{3}_{1}He$ d. ${}^{4}_{2}He$

3. Which change takes place in a nuclear fusion reaction?
   a. Matter is converted to energy.
   b. Energy is converted to matter.
   c. Ionic bonds are converted to covalent bonds.
   d. Covalent bonds are converted to ionic bonds.

   Fusion: small + small = large
   Fission: large = small + small

4. Nuclear fusion differs from nuclear fission because nuclear fusion reactions
   a. form heavier isotopes from lighter isotopes
   b. form lighter isotopes from heavier isotopes
   c. convert mass to energy
   d. convert energy to mass

5. A nuclear fission reaction and a nuclear fusion reaction are similar because both reactions
   a. form heavy nuclides from light nuclides
   b. form light nuclides from heavy nuclides
   c. release a large amount of energy
   d. absorb a large amount of energy

6. In which reaction is mass converted to energy by the process of fission?
   a. ${}^{14}_{7}N + {}^{1}_{0}n \rightarrow {}^{14}_{6}C + {}^{1}_{1}H$
   b. ${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{87}_{35}Br + {}^{146}_{57}La + 3{}^{1}_{0}n$
   c. ${}^{226}_{88}Ra \rightarrow {}^{226}_{88}Ra + {}^{4}_{2}He$
   d. ${}^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He$

7. Which statement explains why nuclear waste materials may pose a problem?
   a. They frequently have short half-lives and remain radioactive for brief periods of time.
   b. They frequently have short half-lives and remain radioactive for extended periods of time.
   c. They frequently have long half-lives and remain radioactive for brief periods of time.
   d. They frequently have long half-lives and remain radioactive for an extended period of time