

Nuclear Fission and Fusion Assignment

NAME _____

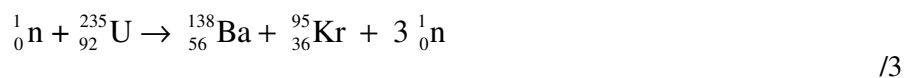
1. Given the following masses:

$${}_{92}^{235}\text{U} = 3.9017 \times 10^{-25} \text{ kg}$$

$${}_{56}^{138}\text{Ba} = 2.28922 \times 10^{-25} \text{ kg}$$

$${}_{36}^{95}\text{Kr} = 1.57534 \times 10^{-25} \text{ kg}$$

Calculate the energy (in J and MeV) released per the following fission reaction:



2. Compare the approximate amounts of energy released in chemical, fission and fusion reactions. /1

3. Explain fission in terms of short-range nuclear-attractive forces and long-range coulomb-repulsive forces. /2

4.

(a) State why neutrons have to be slowed down in order to produce fission in ${}^{235}\text{U}$ /1

(b) Explain why the most effective moderators have atoms of low mass and low absorption of neutrons /2

(c) State why the nuclei produced by fission reactions are likely to have an excess of neutrons /1

(d) State why fission products are hazardous and difficult to process /1

(e) State why it is generally not possible to attain a continuous chain reaction using naturally occurring uranium unless it is enriched with ${}^{235}\text{U}$ /1

5.

(a) Draw and label a basic diagram showing the following components of a water-moderated reactor: core, fuel rods, moderator, control rods, heat exchanger, and shielding. /4

(b) Describe the function of each of the following components of a water-moderated fission power reactor: fuel rods, moderator, control rods, heat exchanger, safety rods, and shielding. /6

(c) Explain starting, normal operation and stopping of a nuclear reactor in terms of chain reactions. /3

(d) Explain briefly why the delayed emission of neutrons allows the chain reaction in a nuclear power reactor to be controlled. /1

(e) Discuss the advantages and disadvantages of nuclear fission over fossil fuel power stations. /3

6. Given that deuterium has a mass of $3.344 \times 10^{-27} \text{ kg}$ and helium-3 has a mass of 5.008×10^{-27} , calculate the energy (in J and MeV) released in the fusion reaction ${}_1^2\text{H} + {}_1^2\text{H} \rightarrow {}_2^3\text{He} + {}_0^1\text{n}$. /3

7. State the main energy conversion process in suns and stars and describe the conditions that favour this kind of reaction. /2

8. Discuss the advantages and disadvantages of nuclear fusion over nuclear fission as a source of power. /3

TOTAL /37