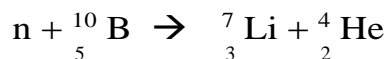


Questions

1. Boron undergoes fission via thermal neutron capture to produce lithium-7, an alpha particle and energy in the following reaction:



Using the data below, calculate the energy released (in MeV) for this reaction.

mass of a neutral boron atom	10.013 u
mass of a neutral lithium-7 atom	7.016 u
mass of a neutral helium-4 atom	4.003 u
mass of a neutron	1.01 u

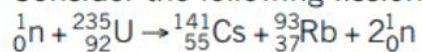
2. Thorium-228 undergoes fission according to the equation:



Use the data below to calculate the energy released for this reaction.

mass of a neutral thorium-228 atom	228.029u
mass of a neutral radium-224 atom	224.020u
mass of a neutral helium-4 atom	4.003u

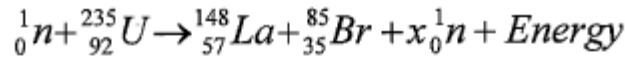
3. Consider the following fission reaction of uranium-235:



During this reaction there is a mass defect of 4.99×10^{-28} kg. How much energy in joules is produced per reaction?

4.

Uranium – 235 can fission according to the following equation:



a) Balance the equation and determine a value for x [1 mark]

x = _____

The masses of the various nuclei are:

Neutron = 1.00867 u; Uranium-235 = 235.03854 u;
Lanthanum-148 = 147.95736 u; Bromine-85 = 84.93617 u

b) Explain the term **mass defect** related to this fission reaction [1 mark]

c) What causes a mass defect in a nuclear reaction? [1 mark]

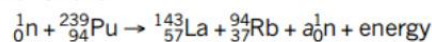
d) Calculate the energy that would be released from the reaction given above. [2 marks]

e) 1 kg of uranium-235 contains about 2.55×10^{24} atoms. Calculate the energy (in MeV) that the total fission of 1 kg of uranium-235 could produce. [2 marks]

5.

Plutonium-239 is a fissile material. When a plutonium-239 nucleus is struck by and absorbs a neutron, it can split in many different ways. Consider the example of a nucleus that splits into lanthanum-143 and rubidium-94 and releases some neutrons.

The nuclear equation for this is:



a How many neutrons are released during this fission process, i.e. what is the value of *a*?

b During this single fission reaction, there is a loss of mass (a mass defect) of 4.58×10^{-28} kg. Calculate the amount of energy that is released during fission of a single plutonium-239 nucleus. Give your answer in both MeV and joules to two significant figures.

c The combined mass of the plutonium nucleus and bombarding neutron is 2.86×10^{-25} kg. What percentage of this initial mass is converted into the energy produced during the fission process?