Examrace

Environmental Science: Numerical Questions – Energy (Nuclear Fission)

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Nuclear Fission

Q 1) A typical fission reaction involving an atom of $_{92}U^{235}$ leads to a mass defect =0. 37×10−27 kg. How much energy is going to be released by 1.0 g of $_{92}U^{235}$?

(1) 3.33×10^{-11} MJ

(2) 2.23×10^{12} MJ

(3) 2.56×10^{4} MJ

(4) 8.53×10^{4} MJ

Answer: Option (4) 8.53×10^{4} MJ

Mass Defect = 0. 37×10−27 kg

Amount of $_{92}U^{235}$ = 1 gm

$E = mc^2$

$E = 0.37 * \mathbf{10^{-27}} * (\mathbf{3 * 10^{8}})^2$

$E = 0.37 * \mathbf{10^{-27}} * \mathbf{9} * \mathbf{10^{16}} = 3.33 * 10^{-11}$

Number of Atoms in 5 gm of $_{92}U^{235}$ = nA

$= 1/235 * 6.023 * 10^{23}$

$= 0.0042 * 6.023 * 10^{23}$

$= 0.026 * 10^{23}$

Total Energy = Energy of 1 atom * Number of Atoms

$= 3.33 * 10^{-11} * 0.026 * 10^{23}$

$= 0.0865 * 10^{12} = 8.65 * 10^{4}$ MJ

Q 2) In a nuclear fission reaction involving $^{235}U_{92}$ and a slow neutron, the mass defect is found to be 0.223 U. How much energy will be released from 5.0 gram of $^{235}U_{92}$? (1U = 1.66×10^{-27} kg)

(1) 426.7 GJ

(2) 85.3 GJ

(3) 170.6 GJ

(4) 42.6 GJ

Answer: Option (1) 426.7 GJ

Mass Defect = 0.223 u

Amount of $_{92}U^{235}$ = 5 gm

1u = 1.66 x 10^{-27} kg

Mass Defect = 0.223 * 1.66 x 10^{-27} (As, 1u is equal to 1.66 x 10^{-27} kg)

= 0.3791 x 10^{-27} kg

$E = mc^2$

Total Energy Released from 5 gm of ^{92}U = nA * mc^2

n = number of moles

A = Avogadro's number (6.023 * 10^{23})

$$= \frac{5*6.023*10^{23}0.3791*10^{-27}*9*10^{16}}{235}$$

$$= \frac{102.74*10^{39}*10^{-27}}{235}$$

$$= 437.19\ GJ$$

-Mayank

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