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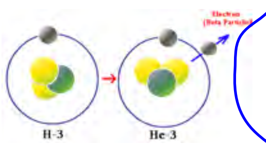

S30 Unit D: Nuclear Energy and Radiation

Name: Key

Date: ______________

Using page 8 of your Data Booklet, calculate the amount of energy, in ~~k~~J, released in each nuclear reaction.

1. Lanthanum-146 fissions to form barium-141, a proton and 5 neutrons.

$^{146}_{57}La \rightarrow ^{141}_{56}Ba + ^{1}_{1}p + 5\,^{1}_{0}n$

145.9258×10^{-3} kg/mol

140.91441×10^{-3} kg/mol

1.00728×10^{-3} kg/mol

$\times 1.00866 \times 10^{-3}$ kg/mol

5.0433×10^{-3} kg/mol

145.9258×10^{-3} kg

146.96499×10^{-3} kg

change in

$\Delta E = \Delta m c^2$

$\Delta E = (146.96499 \times 10^{-3}\text{ kg} - 145.9258 \times 10^{-3}\text{ kg})(3 \times 10^{8}\text{ m/s})^2$

$\Delta E = 9.35271 \times 10^{13}$ J

2. Plutonium-239 fissions to form neon-20, polonium-210 and 9 neutrons.

$^{239}_{94}Pu \rightarrow ^{20}_{10}Ne + ^{210}_{84}Po + 9\,^{1}_{0}n$

239.05216×10^{-3} kg/mol

19.99244×10^{-3} kg/mol

209.98286×10^{-3} kg/mol

1.00866×10^{-3} kg/mol

$\times 9$

9.07794×10^{-3} kg

239.05216×10^{-3} kg

m total = 0.23905324 kg

$\Delta E = \Delta m c^2$

$\Delta E = (0.23905324\text{ kg} - 239.05216 \times 10^{-3}\text{ kg})(3 \times 10^{8}\text{ m/s})^2$

$\Delta E = 9.72 \times 10^{10}$ J

3. Beryllium-7 and a proton fuse to form beryllium-8.

$^{7}_{4}Be + ^{1}_{1}p \rightarrow ^{8}_{4}Be$

7.01693×10^{-3} kg/mol

1.00728×10^{-3} kg/mol

8.00531 kg/mol

mTotal = 0.008024121 kg

8.00531×10^{-3} kg

$\Delta E = (8.00531 \times 10^{-3}\text{ kg} - 0.008024121\text{ kg})(3 \times 10^{8}\text{ m/s})^2$

$\Delta E = 1.701 \times 10^{12}$ J

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Write the decay reaction.

4. Uranium-235 decays alpha.

proton+neutrons

protons neutron

mass number

symbol

$$\boxed{^{235}_{92}}U \rightarrow ^{\boxed{4}}_{\boxed{2}}\alpha + ^{\boxed{231}}_{\boxed{90}}\boxed{Th}$$

protons

protrons

atomic

Write the decay reaction and then determine the amount of energy, in [illegible]J, released.

5. Nitrogen-15 decays beta.

$$^{15}_{7}N \rightarrow ^{0}_{-1}\beta + ^{\boxed{15}}_{\boxed{8}}\boxed{O}$$

$$\underbrace{15.00011\times10^{-3}\,kg/mol}_{15.00011\times10^{-3}\,kg} \qquad \underbrace{0.000549\times10^{-3}\,kg/mol \qquad 15.00307\times10^{-3}\,kg/mol}_{15.003619\times10^{-3}\,kg}$$

$$\Delta E = \Delta m c^2$$

$$= (15.003619\times10^{-3}\,kg - 15.00011\times10^{-3}\,kg)(3\times10^{8}\,m/s)^2$$

$$\Delta E = \underline{\underline{3.1581\times10^{11}\,J}}$$

6. Beryllium-8 decays beta.

$$^{8}_{4}Be \rightarrow ^{0}_{-1}\beta + ^{8}_{5}B$$

$$\underbrace{8.00531\times10^{-3}\,\frac{kg}{mol}}_{m = 8.00531\times10^{-3}\,kg} \qquad \underbrace{0.000549\times10^{-3}\,kg/mol \qquad 8.022161\times10^{-3}\,kg/mol}_{m_{TOT} = 0.008025159\,kg}$$

$$\Delta E = \Delta m c^2$$

$$= (0.008025159\,kg - 8.00531\times10^{-3}\,kg)(3\times10^{8}\,m/s)^2$$

$$= \underline{\underline{1.78641\times10^{12}\,J}}$$