(4.4) Estimate if fusion of deuterium into helium releases more or less energy per gram of material consumed than the fission of uranium.

First we define the Avogadro number, N_A, and the electron volt, *eV*.

$N_A := 6.0221367 \cdot 10^{23} \cdot mole^{-1}$ $\quad eV := 1.60217733 \cdot 10^{-19} \cdot joule$ $\quad MeV := 10^{6} \cdot eV$

The fission energy of a ^{235}U atom, Q_U, is given by eqn. (19.1):

$Q_U := 200 \cdot MeV$

The atomic weight of ^{235}U, Mw_U, and of ^{4}He, Mw_{He}, can be approximated as follows:

$Mw_U := 235 \cdot gm \cdot mole^{-1}$ $\quad Mw_{He} := 4 \cdot gm \cdot mole^{-1}$

$$Q_{fiss} := \frac{Q_U N_A}{Mw_U} \qquad Q_{fiss} = 5.125 \cdot 10^{23} \cdot MeV \cdot gm^{-1}$$

$EB_{He} := 28.30 \cdot MeV$ $\quad EB_D := 2.22 \cdot MeV$

$Q_{He} := EB_{He} - 2 \cdot EB_D$ $\quad Q_{He} = 23.86 \cdot MeV$

Neglect the very small mass difference between fuel as 2 D and helium in the calculation of the energy content:

$$Q_{fus} := \frac{Q_{He} \cdot N_A}{Mw_{He}} \qquad Q_{fus} = 3.592 \cdot 10^{24} \cdot MeV \cdot gm^{-1}$$

$$\frac{Q_{fus}}{Q_{fiss}} = 7.009$$

Thus fusion gives about 7 times more energy per g of fuel