Problem 1 (10 points)
This problem concerns a comparison between a chemical and a nuclear reaction.
a) The formation of 1 mole of water from H$_2$ and O$_2$ releases 285.8 kJ. How much energy is released in the formation of 1 kg of water? Note that you need to determine the mass of one mole of water as one of the ingredients to answer this question.
b) In the nuclear fusion reaction

$$^{2}\text{H} + ^{3}\text{H} \Rightarrow ^{4}\text{He} + \text{n}$$

17.6 MeV energy is released. The names for the heavy hydrogen nuclei are deuteron ($^2\text{H}$) and triton ($^3\text{H}$), respectively. Show that the same number of protons and neutrons are present in the initial and final state of this reaction. How much energy can be obtained from 0.5 kg of $^2\text{H}$ and an unlimited supply of $^3\text{H}$? Show that your result in b) should be substantially bigger than the result you get in a).

Problem 2 (10 points)
The total binding energy of the nuclei $^{12}\text{C}$, $^{16}\text{O}$ and $^{28}\text{Si}$ are 92.16 MeV, 127.62 MeV, and 296.54 MeV, respectively. For completeness: $^{12}\text{C}$ has 6 protons, $^{16}\text{O}$ has 8, and $^{28}\text{Si}$ has 14. How much energy becomes available from the fusion reaction

$$^{12}\text{C} + ^{16}\text{O} \Rightarrow ^{28}\text{Si} + \text{energy}.$$ 

This reaction is important in the burning of nuclear fuel in the sun.

Problem 3 (10 points)
In the following reaction for the spontaneous fission of $^{238}\text{U}$

$$^{238}\text{U} \rightarrow ^{140}\text{Cs} + ^{92}\text{Rb} + ? \text{n}$$

determine the number of neutrons emitted. Look up the atomic numbers of Cesium (Cs) and Rubidium (Rb) (and Uranium if necessary). Use the figure of the binding energy per particle to determine approximately how much energy is released.