Exercise set 4 (for 4-8 October, week 41)

38) Calculate the nucleon binding energy in ^{24}Mg from the atomic mass excess values. You can use the table found in e.g. http://ie.lbl.gov/toi2003/MassSearch.asp

39) How many times larger is the nucleon binding energy in ^{23}Na than the electron binding energy when the ionization potential of the sodium atom is 5.14 V?

40) Assuming that in the fission of a uranium atom an energy amount of 200 MeV is released, how far would 1 g of ^{235}U drive a car which consumes 1 liter of gasoline (density 0.70 g/cm^3) for each 10 km? The combustion heat of octane is 5500 kj/mole, and the combustion engine has an efficiency of 18%.

41) Estimate if fusion of deutreium into helium releases more or less enrgy per gram of material consumed than the fission of uranium.

42) When a neutron is captured in a nucleus, the mass number of the isotope increases one unit. In the following Table mass excess values are given for three important isotope pairs:

^{235}U	40915 keV	^{236}U	42441 keV
^{238}U	47306 keV	^{239}U	50571 keV
^{239}Pu	48585 keV	^{240}Pu	50122 keV

If the avarage nucleon binding energy in this region is 7.57 MeV one can calculate the difference between this avarage binding energy and the one really observed in the formation of ^{236}U, ^{239}U, and ^{240}Pu. Calculate this difference. Discuss the possible significance of the large differences observed for the $^{238}U/^{239}U$ pair as compared to the other pairs in terms of nuclear power.

43) Set A = constant in the nuclear binding-energy equation for and solve with respect to Z.

44) Write a short explanation for why we never find more than one stable nucleus in isobaric chains with odd mass numbers, but we might find both 1, 2, and 3 stable nuclides in isobaric chains with even mass numbers.

45) Explain shortly why we can find nuclides which disintegrate with both β^+ and β^-, and why they have to be odd-odd nuclei.