Nuclear Weapons and Warfare

Physics 20061, Fall 2006
Homework 1

1. Do you agree with the opinion expressed by the German scientist Fritz Haber during World War I that it is the duty of the scientist to dedicate his knowledge and his experience to the war or defense efforts of his country? Explain why you agree or disagree with this opinion!

2. Calculate the number of radioactive ^{26}Al atoms ($t_{1/2}$= 716,000 y) in a sample with an activity of 100Ci. What is the decay constant of ^{26}Al? What is the remaining activity of this sample in the year 2506?

3. Imagine the explosion of a 10 000 ton bomb (ton of TNT). Calculate how much mass (in g) of the initial bomb material has been converted into that amount of energy.

4. 1g of Radium (assume pure ^{226}Ra) has an activity of 1Ci which corresponds to $3.7 \cdot 10^{10}$ decays/s. Determine how many atoms of ^{226}Ra are in the 1 g of material. Determine the decay constant and the half-life of ^{226}Ra.

5. Explain the difference between isotopes, isobars, isotones!

6. List the number of protons and neutrons for the following isotopes and compute their total binding energy and binding energy per nucleon by using the masses of the nuclei and their proton, neutron constituents

   a) ^{3}H b) ^{3}He c) ^{56}Fe d) ^{235}U e) ^{238}U

7. Compute the total binding energy and the binding energy per nucleon for the same nuclei using the semi-empirical mass formula.

8. Calculate the total energy contained in 5kg ^{235}U (binding energy) and compare it with the energy released if you split ^{235}U (Z=92) into two medium mass isotopes ^{90}Sr (Z=38) and ^{140}Xe (Z=54) plus five neutrons. Give the results in units “tons of TNT”.