Problem Sheet 5

3C24

March 21, 2000

1. i) Draw a diagram to show the stages of fission and accompany it with a graph of the energy necessary for each step. [2]
   ii) Two possibilities exist for enabling this to happen: what are they? [2]
   iii) Sketch a graph of the relative sizes of the terms in the SEMF as a function of A [4]
   iv) Using only an order of magnitude calculation, compare the relative energy release in a chemical and a nuclear reaction [4]

2. i) Why is it necessary for ^{235}U to absorb a neutron before decaying? [2]
   ii) Sketch the dependence of the neutron capture cross-section on the neutron energy for ^{235}U and ^{238}U [4]
   iii) Why is ^{238}U stable? [4]
   iv) Why is plutonium a more efficient fission fuel than Uranium?[1]

3. i) Explain what is meant by critical mass [2]
   ii) List the effects which affect the size of the critical mass.[6]
   iii) In an explosive device, why must the fission proceed rapidly? [2]

4. i) Draw a schematic diagram of a nuclear power reactor.[4]
   ii) Explain the considerations which apply when designing a power reactor.[4]
   iii) Describe the mode of operation of a fast breeder reactor and compare this with that of a thermal reactor. [4]
   iv) What is the important by-product of a fast-breeder reactor and how is it produced?[2]
   v) Do you think that nuclear power is a good thing for mankind?[4]

   i) Describe the fusion reaction which takes place in the sun and the energy release of each step.[4]
   ii) There are two effects in this reaction which cause the sun to burn very slowly. What are they and why are they of importance to us?[4]
   iii) What are the major difficulties associated with reproducing fusion in a controlled environment?[4]