On fission and fusion

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Warm-up problems

1. What is the difference between nuclear *fission* and *fusion*?
2. (a) What two possible isotopes are usually used in a nuclear power station?
   (b) Nuclear fusion powers the Sun. What elements in the Sun are fused together in the Sun?

Regular problems

3. Uranium-235 is a fissionable isotope of uranium, meaning that is is possible to get it to undergo fission.
   (a) How is a uranium-235 nucleus made to undergo fission?
   (b) Describe what happens to the nucleus in the fission process?
   (c) Draw a diagram to show what is meant by a *chain reaction*, and how one might occur in uranium-235.
4. A nuclear power station allows energy released by a nuclear chain reaction to be harnessed to produce electricity.
   (a) What kind of nuclear reactions take place in the nuclear reactor in today's nuclear power stations?
   (b) Explain how the rate of the chain reaction is controlled in the reactor.
   (c) How is the electricity generated from the heat energy released in the reactor?
5. JET is an experimental fusion reactor near Oxford. It has not been able to produce large amounts of nuclear fusion.
   (a) Why is it so difficult to get fusion reactions to work?
   (b) How is the Sun able to get nuclear fusion to occur?
   (c) The main fusion reaction that could be used here on Earth is
   $$^{2}_{1}\mathrm{H} + ^{3}_{1}\mathrm{H} \longrightarrow ^{4}_{2}\mathrm{He} + ^{1}_{0}\mathrm{n}.$$
   Draw a diagram to show what is happening in this reaction.
   (d) What would be the source of the fuel required by a such fusion reactor?

Extension problem

6. Complete the following reaction:
   $$^{239}_{94}\mathrm{Pu} + ^{1}_{0}\mathrm{n} \longrightarrow ^{134}_{52}\mathrm{Te} + \ldots + ^{1}_{0}\mathrm{n} + ^{1}_{0}\mathrm{n}.$$