Homework to be handed in by 1700 hours on Tuesday 22 April 2014

[1] Assume 200 MeV of energy is released per fission of uranium in a nuclear reactor
(a) Calculate the number of fissions per second to provide 1 GW.
(b) Calculate the mass burnt per day to produce a steady 1 GW.

[2] The counting rate from a radioactive source is 10,000 counts/s at time t=0, while 10 mins later the rate is 1000 counts/s.
(a) What is the half-life?
(b) What is the decay constant?
(c) What is the counting rate after 30 minutes?

[3] Assume that your body contains 50 kg of carbon. For living tissue the ratio of $^{14}C$ to total carbon is $1.3 \times 10^{-12}$. Estimate the number of $^{14}C$ decays per minute in your body.

[4] In 1989, two electrochemists, Pons and Fleischmann claimed to have discovered cold fusion of deuterium in an electrochemical cell. The fusion reactions lead to two possible final states that occur with equal probability:

\[
\begin{align*}
^2H + ^2H &= ^3He + n + 3.27\,\text{MeV} \\
^2H + ^2H &= ^3H + ^1H + 4.03\,\text{MeV}
\end{align*}
\]
(a) How many neutrons will be emitted in the generation of 4 W?
(b) If 15% of these neutrons are absorbed by a 60 kg Fleischmann, and if each neutron carries an average energy of 0.5 MeV with an RBE of 4, what radiation dose rate in rems/hour will Fleischmann receive?
(c) How long would it take for Fleischmann to receive a lethal 500 rem dose?