Physics 222 CID ____________

Homework 25

Score ________ / 30

1. (4 pts) Is $^{40}_{19}$K stable against β^- decay (the one in which an electron is emitted)?

2. (4 pts) How much energy is released when a $^{54}_{25}$Mn nucleus undergoes β^+ decay?

3. (4 pts) How much energy is released when a ^{180}Ta nucleus decays via electron capture?

4. (4 pts) A $^{174}_{72}$Hf nucleus undergoes alpha decay. (a) How much energy is released (in MeV)? (b) Use equation 12.11 in the text to estimate the kinetic energy of the alpha particle (in MeV)? Assume that the decay takes the daughter nucleus directly to the ground state.

5. (4 pts) Explain why figure 12.9 in the text is evidence that alpha decay occurs via tunneling?

6. (4 pts) A 1 cm $\times$ 1 cm $\times$ 100 μm foil of pure uranium-235 is irradiated by a beam neutrons with a flux of 1.04×10^{12} neutrons per cm^2 per second. How many ^{235}U(n, 2n)^{234}U reactions occur in the sample each second? The cross section s for this reaction is 542.9 mbarn, and the density of pure ^{235}U is 18.9 g/cm^3.

7. (6 pts) What is x in the following reactions? (a) ^{14}N(n, p)x, (b) ^{12}C(x, α)^{9}Be, and (c) ^{24}Na(x, n)^{23}Na?

Extra problems I recommend you work (not to be turned in)

- A ^{77}As atom undergoes β^- decay to become ^{77}Se. How much energy is released?
- If only the nuclei along the stability line are stable, why do we observe the existence of neutron stars (essentially planet sized aggregates of neutrons)?
- From the problems worked in this assignment, we see that typical nuclear reactions release energies on the order of an MeV. How many nuclear reactions per second would you need to generate one Watt of power?