Homework 10 PHGN 300

1) What are the number of neutrons and protons for the following nuclei: $^6$Li, $^{15}$C, $^{40}$K, and $^{64}$Cu?

2) Consider two protons in the $^{27}$Al nucleus located 2.0 fm apart. How strong does the nuclear force need to be to overcome the Coulomb force?

3) What is the energy released when three alpha particles combine to form $^{12}$C?

4) Show that the mean (or average) lifetime of a radioactive sample is $\tau = 1/\lambda = t_{1/2}/\ln(2)$.

5) Tritium (half-life=12.33 y) is mostly produced for military purposes. If we (the US) had stopped producing tritium in 1960 with a 2000-kg stockpile, how much would be left in the year 2010?

6) Show directly using masses that protons do not undergo any of the beta decays.

7) Calculate the energy released in kilowatt hours from the fission of 1kg of $^{235}$U. Compare this with the energy released from the combustion of 1kg of coal. The heat of combustion of coal is about 29,000 BTU/kg.


Extra Credit

Radon gas in the form of $^{222}$Rn is a health hazard because it is a gas that occurs as a result of one of the naturally occurring radioactive decay chains. It tends to collect in basements and can be inhaled by humans.

a) Which decay chain produces this isotope of radon?

b) Show that $^{222}$Rn produces five more disintegrations before a stable isotope is reached.

c) Choose one of the paths of the decay chain from the $^{222}$Rn to the stable isotope and sum the half-lives. Approximate the number of days it would take for more than half these decays to occur for a given amount of radon.