This homework is due on Wednesday, April 2, 2008, at classtime. Late homework is not accepted.

1. (2 points) The half-life of $^{135}\text{Pr}$ is 24 minutes. If the initial activity of a $^{135}\text{Pr}$ sample is 5000 cpm (counts per minute), what would its activity be after 96 minutes?

**SHOW YOUR WORK.** (Section 10.3)

96 minutes = 4 half-lives (96/24 = 4), so the activity after four half-lives is:

$$\text{Activity after four half lives} = 5000 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 312 \text{ cpm}$$

2. (2 points) A particular radioactive sample decays from an activity of 10000 cpm to 625 cpm in 400 minutes. What is the half-life of the radioactive sample? **SHOW YOUR WORK** (Section 10.3)

First, how many half-lives did the sample go through?

$$10000 \text{ cpm} \times \frac{1}{2} = 5000 \text{ cpm} \times \frac{1}{2} = 2500 \text{ cpm} \times \frac{1}{2} = 1250 \text{ cpm} \times \frac{1}{2} = 625 \text{ cpm}$$

so it went through 4 half-lives. Since it took 400 minutes, each half-life must be 400 minutes/4 half-lives = 100 minutes for each half-life.

3. (10 points) Complete each of the following equations. (Section 10.3)

$$^{4}_1\text{n} + ^{28}_{14}\text{Si} \rightarrow ^{28}_{13}\text{Al} + ^{1}_1\text{H}$$

$$^{252}_{98}\text{Cf} \rightarrow ^{106}_{43}\text{Tc} + ^{142}_{55}\text{Cs} + 4^{1}_0\text{n}$$

$$^{226}_{88}\text{Ra} \rightarrow ^{226}_{89}\text{Ac} + ^{0}_{1}\text{e}$$

$$^{209}_{84}\text{Po} \rightarrow ^{205}_{82}\text{Pb} + 4^{2}_2\text{He}$$

$$4^{2}_2\text{He} + ^{14}_7\text{N} \rightarrow ^{17}_8\text{O} + ^{1}_1\text{H}$$
4. (2 points) Calculate the mass defect (in u) and the energy produced (in MeV) in the deuterium reaction shown. **SHOW YOUR WORK.** (Section 10.6)

\[
\begin{align*}
\frac{2}{1}H + \frac{2}{1}H & \rightarrow \frac{3}{1}H + \frac{1}{1}H \\
(2.0140 \text{ u}) + (2.0140 \text{ u}) & \rightarrow (3.0161 \text{ u}) + (1.0078 \text{ u})
\end{align*}
\]

Mass defect = 2.0140 u + 2.0140 u - 3.0161 u - 1.0078 u = 0.0041 u

energy = 0.0041 u \times 931 \text{ MeV/u} = 3.82 \text{ MeV}

5. (10 points) (Section 11.4)
   a. Give the chemical symbols of five elements that are metals.  
      ️*Take your pick to the left of the zig – zag line*
   
   b. Give the chemical symbols of five elements that are nonmetals.  
      ️*Take your pick to the right of the zig – zag line*
   
   c. Name the element that is the most abundant in the Earth’s crust.  
      *Oxygen – notice silicon is second and, together, they are the major components of sand.*
   
   d. Name two elements that occur naturally as liquids.  
      *Mercury, Bromine*
   
   e. Give the chemical symbol for the following elements.
      - copper \( Cu \)
      - iron \( Fe \)
      - sodium \( Na \)
      - carbon \( C \)
      - silver \( Ag \)
      - gold \( Au \)

6. (8 points) For each of the following, state whether it is a pure substance or a mixture. Further, if it is a pure substance identify it as an element or a compound. If it is a mixture, classify it as a homogeneous or heterogeneous mixture. (Section 11.1)

   Water with salt dissolved in it **mixture – homogeneous**
   
   Water with so much salt in it that some solid salt is sitting on the bottom **mixture – heterogeneous**
   
   A sample of pure silver **pure substance - element**
   
   Pure water **pure substance - compound**