**Nuclear Chemistry Worksheet**
**Half-Life and Nuclear Equations**

**HALF-LIFE PROBLEMS**

1. $^{32}_{15}P$ is used to treat some diseases of the bone. Its half-life is 14 days. What would be the final mass of 650g of $^{32}_{15}P$ to after decaying for 140 days?
   GIVENS: $t_{½}$= 14 days $M_{orig}$= 650g t = 140 days UNKNOWN: $M_{final}$ = ?
   FORMULA: $M_{final} = M_{orig} ( ½ )^n$
   Note: we don't have an "n" value, but we know the ½ life and we know how much time has passed, so we can calculate the number of ½ lives (which is the n value.)
   n = 140 days/14 days per ½ life = 10 half-lives
   n= 10
   SOLUTION: $M_{final} = 650g ( ½ )^{10}$
   $M_{final}$= 650g (0.000976563)
   ANSWER: $M_{final}$=0.63 g

2. A certain isotope has a half-life of 20 days. How long would it take for a sample of this isotope to decay from 10,000g to 4000g?
   GIVENS: $M_{orig}$ = 10,000g $M_{final}$ = 4000g $t_{1/2}$ = 20 days
   UNKNOWN: length of time, t (which is **n x 20 days**, so solve first for n)
   FORMULA: $M_{final} = M_{orig} ( ½ )^n$
   SOLUTION: $4000g = 10{,}000g ( ½ )^n$
   (simplify) $\frac{4000g}{10{,}000g} = \frac{10{,}000g ( ½ )^n}{10{,}000g}$

   $0.4 = ( ½ )^n$

   $\log 0.4 = n(\log 0.5)$

   $\frac{\log 0.4}{\log 0.5} = \frac{n(\log 0.5)}{\log 0.5}$

   $\frac{\log 0.4}{\log 0.5} = n$

   $\frac{-0.39794}{-0.30103} = n$

   1.32 = n (number of half-lives)
   This is not our final answer, b/c we are asked to find how long it would take (time = t.)
   So, if a $t_{1/2}$ = 20 days for this isotope, then in 1.32 half-lives,
   ANSWER: 1.32 half-lives x 20 days per half-life = 26.4 days is how long it would take.

3. Vanadium-49 has a half-life of 330 days. The initial sample of an atom of this isotope is 82g. What would the final mass be after 10 years?