Half-Life Worksheet **Name: _____**

Half-life is defined to be the time required for something to fall to half its initial value (in particular, the time for half the atoms in a radioactive substance to disintegrate).

1. Let Q represent a mass of radioactive Radium, in grams, whose half-life is 1620 years. The quantity of radium present after t years is given by $Q(t) = 25\left(\frac{1}{2}\right)^{t/1620}$.

   a. Determine the initial quantity of Radium.

   b. Determine the quantity present after 1000 years. After 1620 years. After 3240 years.

   c. Use a graphing calculator to graph the function on the interval $0 \le t \le 5000$. Sketch below.

d. When will the quantity of Radium be approximately 20 grams? How did you determine this?

e. When will the quantity of Radium be 0 grams? Explain.

2. Let Q represent a mass of Carbon-14, in grams, whose half-life is 5730 years. The quantity present after t years is given by $Q(t) = 10\left(\frac{1}{2}\right)^{t/5730}$.

   a. Determine the initial quantity of Carbon-14.

   b. Determine the quantity present after 2000 years. After 5730 years.

c. Sketch the graph of the function over the interval $0 \le t \le 10,000$.

3. In both of the problems, the equation for the quantity present after *t* years followed the form $Q(t) = a \cdot \left(\frac{1}{2}\right)^{t/c}$.

   a. Why is ½ the "natural" choice for the base of the half-life exponential function?

   b. Look at the multiplier out front, *a*. In the problems above, what did *a* represent in the problem? Why?

c. In the exponent in both problems, t was divided by a number c (or multiplied by a number $1/c$). In each problem, what did c represent? What kind of function transformation is this?

d. What you should notice is that if you know the initial quantity and the half-life, you can write a function describing the quantity left after a certain time. Use this fact to write a function describing the quantity of Ununquadium-289 left after t seconds if the initial quantity was 7 grams. Ununquadium-289 has a half-life of 30 seconds.

e. Look back at your equation from the Candyons experiment. Given that the half-life of an M&M was one trial, use the form above to write an equation for the quantity left after a certain number of trials. How close is it to the equation you made in class? Write both below, graph both on a calculator, and discuss.