

## HW 12E Auxiliary Worksheet

Start each problem by writing a function  $P(t) = P_0 \cdot e^{rt}$  to model the situation.

$t$  represents how much time has passed;  $r$  is a constant representing rate of growth or decay;  $P(t)$  is how much remains at time  $t$ ; and  $P_0$  is the starting amount (at time 0).

- 1) Polonium-218 has a half-life of about 3 minutes.
  - a) If you have 100 g of A and wait 30 minutes, how much will remain?
  - b) If you have 100 g of A and wait 100 minutes, how much will remain?
  - c) If you have 100 g of A and wait 100 years, *approximately* how much will remain?
  
- 2) Plutonium-238 has a half-life of 88 years. If you start with 1 kg of Plutonium-238, how long must you wait before only 1 mg of Plutonium-238 remains? (There are 1,000,000 mg in a kg.)
  
- 3) A piece of bone is found to contain 16% of its original Carbon-14 content. How old is the bone? (The half-life of Carbon-14 is 5730 years.)
  
- 4) A 50 g sample of an unknown element is found to have decayed to 10 g after 3 hours.
  - a) Write a function for its decay and solve for any unknown constants.
  - b) Find the half-life of this unknown element. (Hint: use "100%" as  $P_0$ .)
  
- 5) A population of bacteria begins with 100 individuals and doubles once every 4 hours.
  - a) How many bacteria will there be after 12 hours?
  - b) ...after 15 hours?
  - c) When will the population reach 10,000 bacteria?
  
- 6) The worldwide human population reached 5 billion people in 1987 and 7 billion people in 2011.
  - a) Write a function for population growth and solve for any unknown constants.
  - b) According to your function, what will the population be in 2020?
  - c) According to your function, when did the population reach 6 billion? (Actual answer: 1999.)
  - d) According to your function, when will the population reach 100 billion?