Name:_____

Sheet #558: Exponential Models 3

Possibly helpful formulas: $y = A(1+r/n)^{nt}$ $y = Ae^{kt}$ $y = A(2)^{t/T}$ $y = A(0.5)^{t/T}$

1. Solve for the unknowns to 3 significant figures. Use algebra. You may check with the calculator.

   (a) $30 = 60e^{-0.05t}$

   (b) $120 = Ae^{0.7}$

2. The number of bacteria in a culture, y, is modeled by $y = 400e^{kt}$, where t is the time in hours.

   (a) Find k if $(t, y) = (3, 600)$ is on the graph of y. Write k to six decimals.

   (b) Using part (a), find the number of bacteria y after $t = 4$ hours. Round down.

   (c) Find the doubling time, T, to 4 decimals.

   (d) Find the value of t for which $y = 1000$ bacteria.

3. The radioactive isotope Rubikskubium-299, ^{299}Rk, could have a half life of 3 attoseconds. If there were 40 femtograms of the isotope at zero attoseconds, how much of the isotope is there after the following time intervals?

   (a) 12 attoseconds (answer exactly).

   (b) 14 attoseconds (answer to two decimals).

4. A beetle population is growing exponentially. If the continuous exponential growth ***rate constant*** is 20% per day and there are 1,000 beetles now, how many beetles will there be after 14 days? Round down to the nearest beetle.

5. A student began taking the ACT at 8am ($t = 0$ hours). The student had 100% brain energy (y in percent) at that time. By 12:30pm ($t = 4.5$ hours), the student had 30% brain energy left. Use a continuous exponential decay model to find the following.

   (a) Find the half life (T in hours) of brain energy. Answer to the nearest 10th of an hour.

   (b) Predict the brain energy that was left at 10am. Answer to the nearest percent.

Answers. 1a: 13.9. 1b: 59.6; 2a: 0.135155/h. 2b: 686. 2c: 5.1285h. 2d: 6.7796h; 3a: 2.5fg 3b: 1.57fg; 4: 16,444; 5a: 2.6h. 5b: 59%.