**Advanced Placement Calculus** Name _____

Copy original problem. Per _____ Date _____

Convince *me* that **you** understand the concept***!***

# Chapter 11 Exam

**I** After an organism dies, the amount of carbon-14 in the remains of the organism decreases exponentially with a half-life of 5730 years. (25 pts total)

a) Determine an expression for the constant $e^k$. Do not use a calculator.

b) Determine an expression for the constant $k$. Do not use a calculator.

c) A sample of an organism's remains contains one-sixth the amount of carbon-14 it contained when the organism died. When did it die? Write an expression for the number of years ago and then evaluate your expression on your calculator.

**II** Let $y$ represent an index number that measures the smog level in a certain city. Environmentalists believe that $y$ is a function of the city's population. In fact, they project that

$$y = \frac{7x + 8}{x + 4}$$

where $x$ is the number of people, in millions, that will reside in the city $t$ years from now. (25 pts tot)

a) How fast will the smog level be changing when the population is 6,000,000 if, *at that time* the population increases at the rate of 0.75 of a million per year?

b) How fast will the smog level be changing five years from now, if the population at any time $t$ is given in millions as $x = 0.08t^2 + 2$ ?

**III** Without studying, Jake always makes a 45 on Mr. Mumaugh's tests. Whenever he studies 5 hours, he manages to make an 85. Suppose his grade on any of Mr. Mumaugh's tests is given by a function of the type $G(t) = b - ce^{-kt}$ where $t$ represents the number of hours he studies. Also, suppose his grade approaches 95 as he increases his studying time. What will his grade be on a test for which he studies 10 hours? (25 points)

**IV** Describe the similarities and differences between the Cartesian and the polar graphing planes. Include in your discussion directions for converting from one form to the other and back again. List, identify and label with the cartesian as well as the polar equations: one for a straight line through the pole with positive slope, one for a straight line through the pole with negative slope, one for a straight line with positive slope NOT through the pole; one for a straight line with negative slope NOT through the pole; one for a circle with center at the pole; one for a circle with center NOT at the pole; one for a circle with center located in what would be called the "second quadrant" if we were using cartesian rather than polar labeling. Briefly describe eccentricity including examples of the equations in polar form of an ellipse, a circle, a hyperbola, and a parabola.. (tot 25 pts)

**Extra Credit ---------- 5 pts ----------**

Jake walks at the rate of four feet per second toward a street light whose lamp is twenty feet above the street. Jake is four feet tall. How fast is the length of this shadow changing at the moment he is

a) 12 feet from the base of the lamp post?

b) 4 feet from the base of the lamp post?