

*Show all work for full credit and use complete sentences for short-answer questions.*

1. Consider the following exponential growth functions, representing the populations of Towns A and B. The variable  $t$  represents years from the beginning of 2000.

[15]

$$A = 5000(1.1)^t$$

$$B = 1000(1.15)^t$$

- a. What is the initial population (in 2000) for Town A?
- b. By what percent is Town B growing each year?
- c. Assuming these growth patterns continue indefinitely which town will be larger in the long run? **Explain your answer.**

2. Exponential growth assumes the quantity of interest increases in size indefinitely.

[10]

- a. Describe a specific situation where this assumption may not be very realistic.
- b. Draw the graph of a *logistic model* used to represent a population that begins at 5,000 but has an upper limit of 10,000.

3. Consider the following two cities.

[25]

<u>City</u>	<u>Population in 2000</u>	<u>Growth Pattern</u>
Q	10,000	12 percent growth per year
R	15,000	2000 people added per year

- a. Write an equation representing each city's population as a function of years  $t$  since 1990.

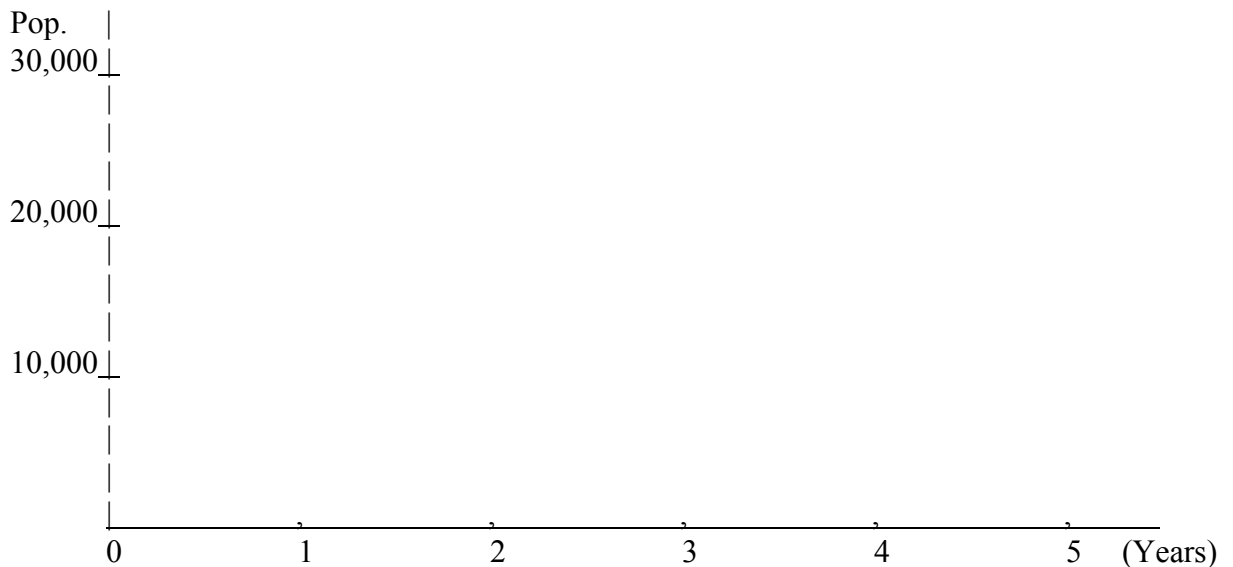
Q =

R =

- b. Compute the populations for Cities Q and R, for each year from 2000 through 2005.

<u>Year</u>	<u>t</u>	<u>Q</u>	<u>R</u>
2000	0	10,000	15,000
2001			
2002			
2003			
2004			
2005			

- c. Use the axes below to draw graphs for these two populations.



- d. Which town will have the larger population eventually? **Explain your answer!**

4. You bought a car at the beginning of 1998 for \$25,000. At the beginning of 2002 it was only worth \$13,000.

[10] a. Assuming that the value of the car decreased *linearly*, write an equation describing the value  $V$  as a function of time  $t$  (in years). **Show all necessary work.**

$V =$

[5] b. If the value continues to decrease according to this pattern, when will the car be worth \$7000? **Show your work.**

[10] c. Draw a graph of your function, going from 1998 to 2005.

5. You place \$10,000 in an account that pays an annual interest rate of 12%, compounded *monthly*.
- a. Assuming you do not withdraw any money from the account, how much money will you have after three years? Use the equation  $A = P_0(1 + r/k)^n$ . **Show all work.**

[15]

- b. Suppose a friend invests their \$10,000 in an account also paying 12% annual interest, but compounded *quarterly*. Explain why you would have more money at the end of the three years than your friend. **(You do not need to actually calculate anything. Just explain why this occurs, using the idea of the “compounding effect.”)**

[5]

6. Consider the following headline: “Teenage crime increasing exponentially — absentee parents to blame.” Critique the way in which the term “exponential” is being used. For example, what is the headline writer trying to suggest to the reader? Is this consistent with the technical definition of “exponential?” **Explain your answer in detail, using a full paragraph!**

[5]

**EXTRA CREDIT: [+5]**

A nation had 75 million people in 1990 with an annual birth rate of 6 per 1,000 people, and an annual death rate of 9 per 1,000 people. Use the *Malthusian population model*,  $P = P_0e^{kt}$ , to estimate the size of the population in 2005.