

MATH 103 - Test #1 - 9/24/01

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*Show all work for full credit and give complete answers in full sentences.*  
**Points in [brackets] total 100.**

1. In 1990, Town #1 had 8,000 people and Town #2 had 6,000. Suppose Town #1 has been growing by 100 people per year, while Town #2 has been growing 10% per year.

[15]

- a. For each town, write an equation describing the population  $P$  as function of time  $t$  (years after 1990).

#1)  $P =$

#2)  $P =$

- b. If these growth patterns continue indefinitely, which town will be larger “in the long run.”  
**Explain your answer in detail.**

[5]

2. You place \$10,000 in an account that pays an annual interest rate of 10.4%, compounded *weekly*. Assuming you do not withdraw any money from the account, how much money will you have after two years? Use the equation  $P = P_0(1 + r/k)^n$ . **Show all work.**

[15]

3. Continuing Question #2: Suppose a friend invests their money in an account also paying 10.4% annual interest, but compounded *monthly*. Explain why you would have more money at the end of the two years than they would. (HINT: The answer relates to the “compounding effect.”)

[5]

4. You bought a piece of land at the beginning of 1993 for \$50,000. At the beginning of 2001 it was only worth \$45,000.

[8]

a. Assuming that the value of the property decreased *linearly*, write an equation describing the value  $V$  as a function of time  $t$  (in years). **Show your work.**

$V =$

[7]

b. What was the value of the property at the beginning of 1996? **Show your work.**

[8]

c. If the value continues to decrease according to this pattern, how many years after the beginning of 1993 will it be worth \$41,000? **Show your work.**

[7]

d. Draw a graph of your function, going from 1993 to 2001. Should you represent this as a *continuous* graph or a *discrete* graph? **Justify your answer based on the context of this problem.**

5. Consider the following three exponential functions. Suppose  $x$  represents years after 1995 and  $y$  represents the size of the given animal population in Wabash County.

Foxes

$$y = 1000 (1.10)^x$$

Dear

$$y = 1000 (1.20)^x$$

Otters

$$y = 1000 (.75)^x$$

- a. What was true about all three populations in 1995?  
[5]

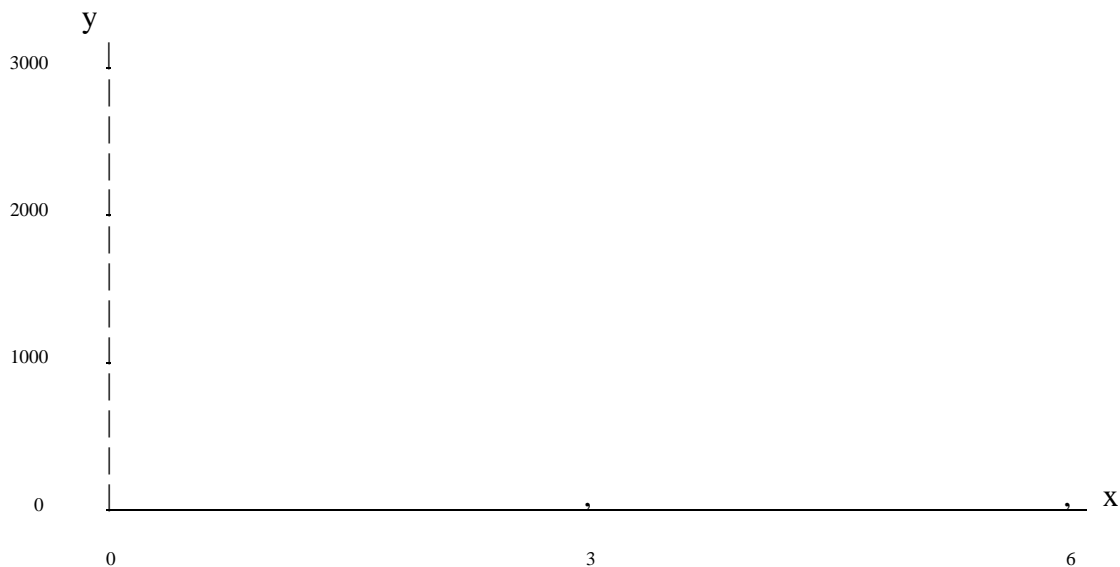
- b. Describe what is happening to each of the three populations from year to year.  
[8]

Fox

Dear

Otter

- c. On the  $xy$ -axes below, graph all three of these functions. **Be sure to indicate the size of each population after 3 years and 6 years.**  
[12]



- d. Suppose the resources of Wabash County cannot support more than 3,000 dear. State the type of growth model that would be more appropriate to represent the dear population and add a sketch of the appropriate curve to your graph above.  
[5]

EXTRA CREDIT: [+5]

A nation had 50,000,000 people in 1980 with an annual birth rate of 10 per 1,000 people, and an annual death rate of 15 per 1,000 people. Use the Malthusian population model,  $P = P_0 e^{kt}$ , to estimate what size the population was in 1990.