February 16, 2007. **Math 121A** Name ______________________

Instructor: ______________________ Lab Section time______________________

Midterm #2
THEORETICAL EXAM

PRACTICE VERSION of the index card and simple scientific calculators only portion.

1. **(20 pts)** Given that $\exp(a) = 2, \exp(b) = 3, \ln(c) = 6$, and $\ln(d) = 4$, find

- $\frac{e^0+e^a}{e^b}$
- e^{a+b}
- e^{3a+b}
- $\ln(\sqrt{d})$
- $\ln(c/d)$

2. **(10 pts)** The volume of an animal is 300 cm^3. What is the volume of a similarly shaped animal that is twice the height?

3. **(10 pts)** The lifetime of an erythrocyte is allometrically related to the weight of the animal. If $T = 3 * w^{1/2}$, find k and r such that $w = k * T^r$.

4. **(20 pts)** The population of Botsylvania is 10 million as measured by the 1990 census and 20 million as measured by the 2000 census. Assuming that the population follows a Malthusian growth law, $P_{n+1} = (1 + r)P_n$, where n is in years, find the *annual* growth rate r for Botsylvania over this time period.

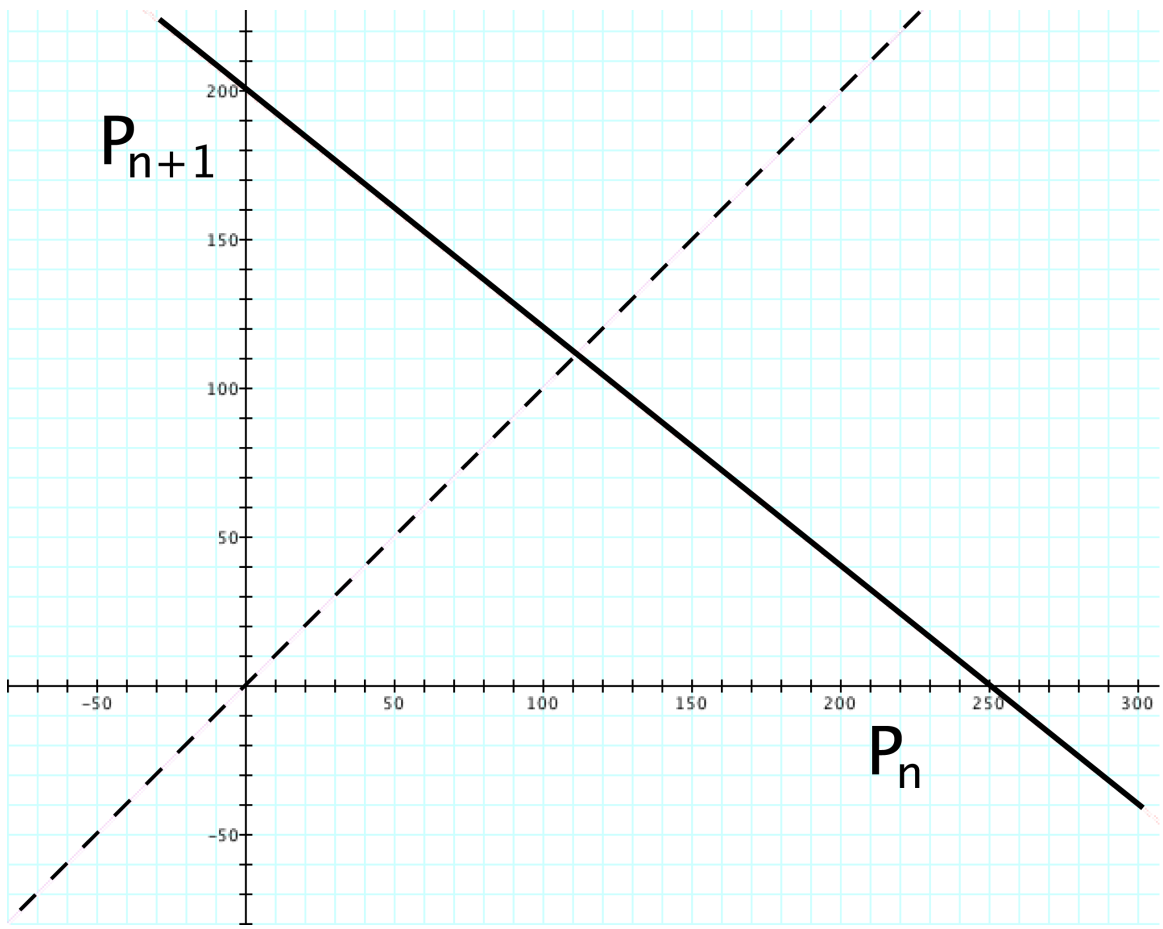
5. **(20 pts)** Given the following table of weights of a culture taken at the recorded times, which hour shows the largest growth rate?

t in hours	weight in grams
0	6.03
2	7.00
3	7.43
4	7.75
7	8.15

6. **(20 pts)** A population evolves according to the linear growth law including immigration

$$P_{n+1} = -0.8P_n + 200.$$

The graph below shows a graph of this update rule along with the $y = x$ line. Draw at least four steps of the cobweb diagram for this population starting from $P_0 = 200$.



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Midterm #1
LABORATORY EXAM

PRACTICE VERSION of the full computational aids and open notes portion.

For data, go to the website for this course and click on the link that gives the data for the practice final. Use the data you get to do the following problems.

1. **(40 pts)** The data you downloaded shows the population of a colony of dingbats as a function of n in years. Assume that the population follows a linear growth law
$P_{n+1} = (1 + r)P_n + m$,

- Use EXCELS trendline to find r and m to 4 significant figures.
- Predict the population for $t = 25$.
- Find the equilibrium population size?
- Is it stable? How do you know?

2. **(30 pts)** The second dataset in your download shows the population of Mauritania as a function of n in decades. Assume that the population follows a non-autonomous growth law

$$P_{n+1} = (1 + k(n))P_n$$

where n is in years. Assume that k(n) is a linear function of n and use EXCELS trendline on the annual values of $P_{n+1}/Pn - 1$ to find m and b such that

$$k(n) = m * n + b.$$

3. **(30 pts)** A population is growing according to the non-autonomous growth law

$$P_{n+1} = (1 + k(n))P_n$$

where n is in hours and

$$k(n) = \begin{cases} 0.1 & \text{if } n \leq 1 \\ 0.05 & \text{if } n > 1 \end{cases}$$

When does this population reach twice its initial size?

Data for problem 1			Data for problem 2		
n	Pn		n	P_n prob 2	
0	200.00		0	200.00	
1	238.61		1	206.20	
2	277.71		2	216.72	
3	319.84		3	232.10	
4	362.56		4	253.22	
5	408.01		5	281.33	
6	451.39		6	318.19	
7	496.50		7	366.23	
8	543.26		8	428.86	
9	590.42		9	510.77	
10	638.91		10	618.54	
11	692.77		11	761.43	
12	746.66		12	952.55	
13	801.89		13	1210.69	
14	859.36		14	1562.99	
15	917.42		15	2049.09	
16	979.69		16	2727.33	
17	1042.04		17	3684.63	
18	1107.01		18	5051.62	