Math 120 - Autumn 2003
Final Exam
December 13, 2003

Name: _____   Student I.D. Number: _____

Signature: _____   Section: _____

- Complete all questions.

- You may use a calculator during this examination. Other electronic devices are not allowed.

- If you use a trial-and-error or guess-and-check method, or read a numerical solution from a graph on your calculator when an algebraic method is available, you will not receive full credit.

- You may use one hand-written 8.5 by 11 inch page of notes.

- Show all work for full credit.

- Raise your hand if you have a question.

- You have 3 hours to complete the exam.

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
Total	80	

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1. The population of woodpeckers in a state park is declining at a constant rate. In 1990, a population estimate found that there were 1,250 woodpeckers. By 1996, the population had decreased to 800. At the same time, the number of rabbits in the park was increasing at a constant rate. In 1980, there were 250 rabbits and in 1995 there were 1000.

   (a) (3 points) Find a linear function that describes the number of woodpeckers in the park as function of time.

   (b) (3 points) Find a linear function that describes the number of rabbits in the park as function of time.

   (c) (2 points) When will there be no woodpeckers left in the park?

   (d) (2 points) When will there be the same number of woodpeckers as there are rabbits?

2. Dewey the Duck walks at a rate of 44 feet per minute and swims at a rate of 90 feet per minute. Dewey starts at a point 200 feet west and 50 feet north of the center of a circular pond. The pond has a radius of 34 feet. Dewey heads in a straight line toward the center of the pond. How long does it take Dewey to get to the center of the pond?

3. A doorway has the shape of a parabolic arch, as shown. At its highest point, the doorway is 9 feet high while at the base it is 6 feet wide. If a rectangular box 8 feet high must fit through the doorway, what is the maximum width the box can have?
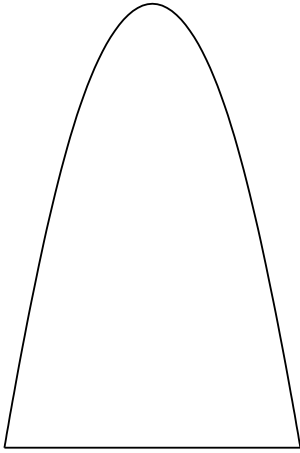
4. Pioneer Power has a coal-fired plant for producing electricity. A report from a consultant says that if they spend no money on pollution control, the plant will put 10 tons of pollution into the air each year. If the company spends $10,000, they will reduce this to 5 tons per year. No matter how much money the company spends on pollution control, they cannot reduce the pollution below one half ton per year.

   (a) (6 points) Express the amount of pollution per year as a function
$$p(x) = \frac{ax + b}{x + c}$$
   where x is the number of thousands of dollars spent, and a, b, and c are constants.

   (b) (4 points) How much must be spent to reduce pollution to 1 ton per year?

5. A ferris wheel has a radius of 50 feet and rotates at a constant 4 revolutions per minute. You start the ride at its lowest point, which is 8 feet off the ground. How far off the ground are you after 3.1 minutes on the ride?

6. Let $f(x) = 6\sin(2x - 10) + 9$.

(a) (5 points) Find the amplitude, period, phase shift and mean of $f(x)$.

(b) (5 points) Find all solutions x to the equation

$$f(x) = 7$$

with $0 \le x \le 5$.

7. The countries of Elbonia and Kneebonia both had populations of 12 million in 1980. In 1990, Elbonia had 13 million people while Kneebonia had 16 million. If the population of each country is growing exponentially, when will Kneebonia have twice as many people as Elbonia?

8. A particle moves along the line $y = -2x + 7$ in such a way that its location at time t (in seconds) is $(x(t), y(t))$ where $x(t) = 0.3t - 0.5$.

   (a) (5 points) How fast is the particle moving along the line?

   (b) (5 points) At what time t is the particle closest to the origin?