Math 120AB Winter 2004
Final Exam
March 13, 2004

Name: _____   Section: _____

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
Total	100	

- Complete all questions.

- You may use a calculator during this examination. Other calculating 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.

- You have 170 minutes to complete the exam.

1. An ant is heading toward a circular region of pancake batter. The ant cannot breathe while walking through the batter. The batter has a radius of 4 cm. The ant is going to walk from a point 6 cm due north of the batter's center to a point 5 cm due west of the batter's center.

   If the ant moves at 0.8 cm/sec, how long will it have to hold its breath?

2. The populations of the cities of Alexandria and Springfield are growing exponentially. In 1980, the population of Alexandria was $120,000$ and the population of Springfield was $85,000$. In 1995, the population of Alexandria was $185,000$. The population of Springfield triples every 25 years.

   In what year will there be twice as many people in Springfield as in Alexandria?

3. Suppose the value of my shoehorn collection is growing according to a linear model. In 2000, it was worth $4.80. In 2002, it was worth $5.03.

My toothpaste collection is also growing in value according to a linear model. In 1990, the collection was worth $2.22, while in 1995, it was worth $3.19.

When will my toothpaste collection be worth $5.00 more than my shoehorn collection?

4. The amount of radiation from a star is observed to be a sinusoidal function of time. You measure the radiation output at its maximum of 400 megawatts at 3 AM one morning. It then drops to its minimum of 180 megawatts at 8 PM that evening. What percentage of the time is the radiation from the star greater than 350 megawatts?

5. Susie starts running at a constant speed in a straight line from a point 20 meters due south of a light post in a park to a bench that is 40 meters due east of the light post. It will take her 15 seconds to get to the bench. Express her distance from the light post as a function of the time t since she started running.

6. Find all values of d so that the quadratic function

$$f(x) = x(x + d) + 2d$$

has its vertex on the x-axis.

7. Let $g(x) = \dfrac{3x + 6}{5x - 7}$.

   Find $g^{-1}(x)$.

8. Let $f(x) = \dfrac{(x+3)(2x-5)}{x^2 - 5x - 6}$.

(a) Find the zeros of $f(x)$.

(b) Find the horizontal asymptote of $f(x)$ or state that it has none.

(c) Find all vertical asymptotes of $f(x)$.

9. Patrick is riding his bicycle around a circular track. The track has a radius of 50 meters.

   (a) If a ray from the center of the track to Patrick sweeps out area at the rate of 150 square meters per second, how fast is Patrick moving?

   (b) Patrick's coach is standing at the edge of the track. Patrick passes her while riding at a constant 11 meters per second. What is the straight-line distance between Patrick and his coach 12 seconds later?

10. Find the coordinates of the point labelled A in the figure below.