Math 120 - Autumn 2009
Final Exam
December 12, 2009

Name: _____   Student ID no. : _____

Signature: _____   Section: _____

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

- Complete all questions.

- You may use a scientific calculator during this examination. Graphing calculators are not allowed. Also, other electronic devices are not allowed, and should be turned off and put away for the duration of the exam.

- If you use a trial-and-error or guess-and-check method 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. Write your name on your notesheet and turn it in with your exam.

- Show all work for full credit.

- You have 180 minutes to complete the exam.

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1. Andy's weight fluctuates according to a sinusoidal function of time. Let $x = 0$ correspond to the beginning of the year (January, 1st). Because of his new year resolutions, Andy loses weight and reaches a minimum of 205 pounds at $x = 60$ days. Andy then stops exercising and dieting and his weight increases to a maximum of 250 pounds at $x = 140$ days.

   If summer starts on the day $x = 171$ and ends on the day $x = 265$, how many days of summer will Andy's weight be below 220 pounds (these are the days he fits into his bathing suit)?

2. The height of a certain tree is a linear-to-linear rational function of time. Today the tree is 8 feet tall. Two years from today, it will be 14 feet tall. Five years from today, it will be 16 feet tall.

How tall will the tree be 20 years from today?

3. You have a piece of cloth shaped as shown in the figure below. You wish to cut the cloth into two pieces with a vertical cut parallel to the left edge. You will make the cut a distance x from the left edge.

   Express the area of cloth to the left of the cut as a multipart function of x.

   8'

   6'

   10'
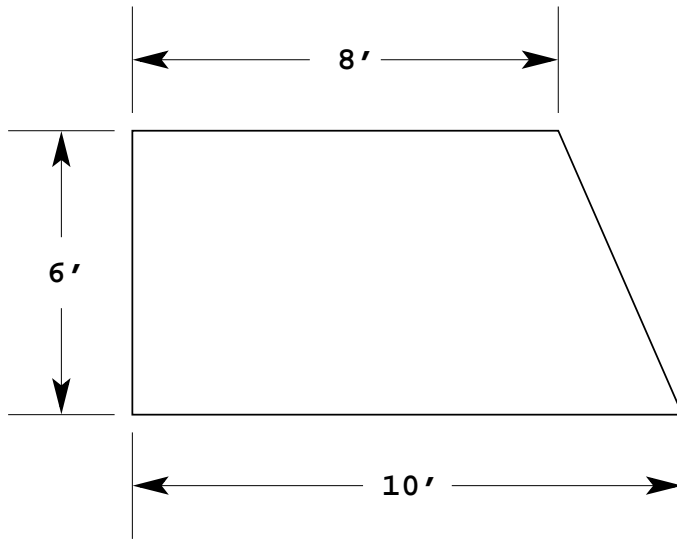
4. Let $f(x) = 4x + 1$ and $g(x) = (x - 5)^2 - 1$.

   (a) Let $h(x) = f(g(x))$ restricted to the domain $x \le 5$. Find $h^{-1}(x)$.

   (b) If $\dfrac{g(x + 5) - g(x)}{5} = 10$, what is the value of x?

5. Dora and Diego start jogging in the coordinate plane at the same time. They both exhibit **uniform linear motion**.

Dora starts at the point (-10,0). She jogs an a straight line path through the point (2,6) which she reaches in 4 seconds.

Diego starts at the point (1,0) and jogs on a straight line path through the point (-3,3) at a constant speed of 6 ft/sec. (All coordinates are in feet).

(a) Find the linear parametric equations for Dora's motion.

(b) Find the linear parametric equations for Diego's motion.

(c) Find the time when the distance between Dora and Diego is minimum.

6. Maggie is standing in her front yard and sees a balloon overhead traveling in and out of the clouds. The balloon is flying away from Maggie at a constant height and a constant speed of 15 feet/second.

When Maggie sees the balloon for the first time, she measures the angle between the balloon and the horizon to be 40 degrees. She sees the balloon again 10 seconds later, and measures the angle again: the angle is 30 degrees.

Find the height of the balloon.
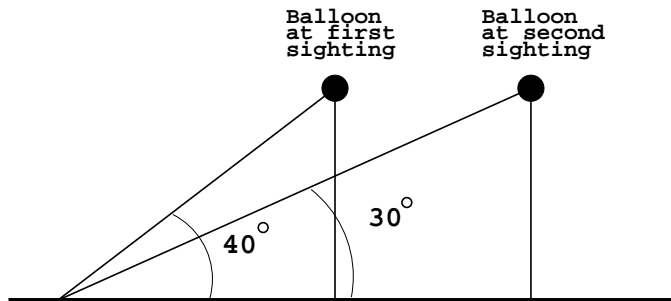
7. Boris and Stella are running on a circular track which has a radius of 300 meters. They start running at the same time. Boris starts at the northernmost point of the track, and Stella starts at the easternmost point. Boris runs clockwise. Stella runs counterclockwise, and she runs twice as fast as Boris runs. They pass each other for the first time after 85 seconds.

How far apart are Boris and Stella when they have been running for 800 seconds?

8. Imogene is sailing near a buoy with a radar antenna on it. She sails at a constant 6 miles per hour. The buoy's radar can detect her boat when she is within 5 miles of it. Imogene starts sailing from a point 8 miles EAST and 3 miles NORTH of the buoy. She sails due west for 1.5 hours, then turns and sails directly to a point 9 miles EAST and 4 miles SOUTH of the buoy.

   For how much time did Imogene spend within 5 miles of the buoy?