Math 120 - Winter 2011
Final Exam
March 12, 2011

Name: ______________________________ Student ID no. : ________________

Signature: ______________________________________ Section: ____________

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
Total	70	

- Complete all questions.
- Show all work for full credit.
- You may use a scientific calculator during this examination. Graphing calculators are not allowed. 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.
- You have 170 minutes to complete the exam.

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1. A producer is figuring out how much to charge for tickets to a show. If she charges \$0 per ticket, she will make \$0. If she charges \$5 per ticket, she will make \$1775. If she charges \$15 per ticket, she will make \$975.

   If the amount of money she makes is a quadratic function of the ticket price, what is the maximum possible amount of money she can make from the sale of the tickets?

2. The pressure inside an artery is varying sinusoidally. With a heart beat at a rate of 60 beats per minute, the period of this sinusoidal function is 1 second. The maximum pressure is 16000 pascals, and the minimum pressure is 11000 pascals.

   At time $t = 0$, you begin to measure the pressure. A maximum is attained for the first time at $t = 0.23$ seconds.

   Between $t = 0$ and $t = 1.3$, how much time (in seconds) is the pressure above 15000 pascals?

3. Kurt and Lotte are running around a circular track at constant speeds. They start running at the same time.

   Kurt runs clockwise, and starts from the northernmost point. He takes 11 seconds to reach the easternmost point for the first time.

   Lotte runs counterclockwise, starting from the westernmost point. She passes Kurt for the first time after 19 seconds.

   (a) How long does Lotte take to complete one lap of the track?

   (b) Suppose the track has a radius of 20 meters. Find the distance between Lotte and Kurt after they have been running for 25 minutes.

4. Amy and Hans are moving at constant speeds along lines in the xy-plane.

   Amy starts at $(0,4)$ and moves along the line $y = 4 - 0.2x$. She will reach the x-axis in 5 seconds.

   Hans starts at the same time as Amy. He starts from the origin, heads directly toward the point $(8,12)$, and will reach it in 4 seconds.

   (a) Give Amy's equations of motion (i.e., her x- and y-coordinates as functions of time, t).

   (b) Give Hans' equations of motion (i.e., his x- and y-coordinates as functions of time, t).

   (c) When will Amy and Hans be closest together?

5. Bob is 40 km east and 18 km north of a radio tower. Bob walks in a straight line toward a point 30 km due west of the tower, and then continues in the same direction on to his destination.

   How close does Bob come to the radio tower on his walk?

6. The more hours Matt puts into his training, the faster he will be able to complete an upcoming 200 km bicycle ride. If he puts in 30 hours of training, he will be able to complete it in 9 hours. If he trains for 40 hours, he will be able to complete the ride in 8 hours. No matter how much he trains, he will never be able to complete the ride in less than 6 hours.

   Assume that the time Matt will take to complete the ride is a linear-to-linear rational function of the time he spends training.

   If Matt wants to finish the ride in 8.5 hours, how much training should he do?

7. The crew of a helicopter needs to land temporarily in a forest. They spot a flat horizontal piece of ground (a clearing in the forest) as a potential landing site, but are uncertain whether it is wide enough. They make two measurements from point A (see figure) and find $\alpha = 19^o$ and $\beta = 60^o$.

   They then rise vertically 100 feet to point B and measure $\gamma = 53^o$.

   Determine the width of the clearing.