Math 120 - Autumn 2014
Final Exam
December 6, 2014

Name: ______________________________ Student ID no. : ____________________

Signature: ______________________________ Quiz Section (e.g., AB, CA, etc.): ______

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

- Complete all eight questions.
- Show all work for full credit.
- 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.
- You have 170 minutes to complete the exam.

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1. You are lost in the desert when, in the distance, you notice a very large tower. You measure the angle between the top of the tower and the ground, and it is 6°.

   Then you walk towards the tower at a constant speed of 80 meters per minute. After 4 minutes, you stop and measure the angle again; this time it is 7°.

   If you keep walking towards the tower at a constant speed of 80 meters per minute, how much longer will it take you to get there?

2. Denise stands 28 feet east and 120 feet south of Aaron. Timothy stands 80 feet east and 78 feet north of Denise.

   First, Aaron walks due south until he is exactly 100 feet from Denise. Then, he turns and walks in a straight line towards Timothy.

   When Aaron is closest to Denise, how far from Denise is he?

3. (a) Every 5 seconds, the number of cursed goblets in Bellatrix's vault doubles!
Right now, there are 70 goblets.
Write a function $g(t)$ for the number of goblets t seconds from now.

(b) Oh no, this vault is also full of cursed coins! The number of coins is increasing exponentially.
10 seconds from now, there will be twice as many goblets as coins.
5 seconds ago, there were 20 more goblets than coins.
Write a function $c(t)$ for the number of coins t seconds from now.

(c) Each coin weighs 2 ounces, and each goblet weighs 9 ounces.
When will the total weight of the coins equal the total weight of the goblets?

4. In the year 2000, Adam invested \$8000 and his investment increased at a constant rate of \$120 a year for the first 5 years. In 2005, the value of Adam's investment started to decrease and it reached \$8495 in 2012. Assume that the investment decreased linearly from 2005 to 2012.

   (a) Write a formula for A(t), the value of Adams's investment t years after 2000, valid for $0 \leq t \leq 12$.

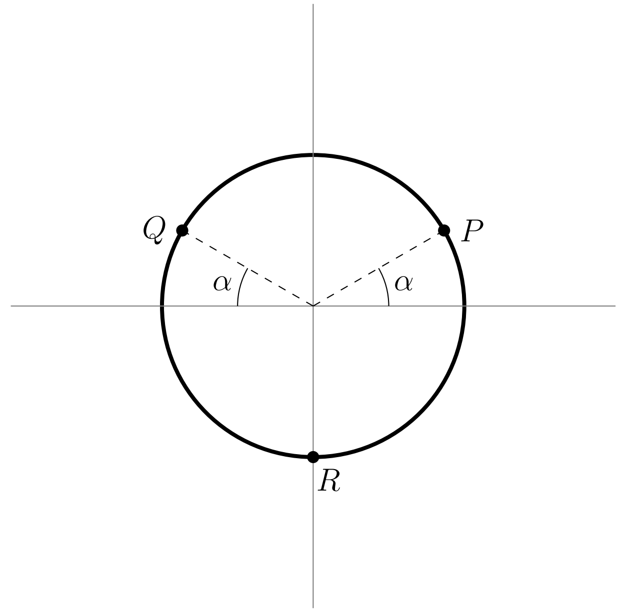
   (b) Find all solutions to the equation $A(t) = 8540$.

5. Bob is running counterclockwise around a circular track with a radius of 2 km.

Bob's angular speed is 1.6π rad/hr .

Bob starts at position P and it takes him 0.5 hr to reach position Q.

(a) When will Bob reach position R ?



(b) Find the coordinates of Bob at time t with respect to a coordinate system with the origin at the center of the circular track.

(c) How far (in a straight line) is Bob from the point $(2, 0)$ after running for 2.6 hours?

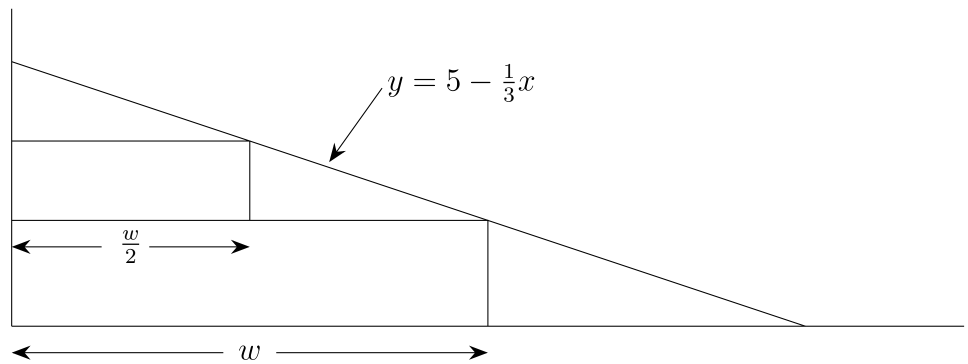
6. You plan to put two rectangles into the triangle formed by $y = 5 - \frac{1}{3}x$ and the x- and y-axes.

   The first rectangle will have one vertex at the origin, one side extending along the positive x-axis, one side extending along the positive y-axis, and one vertex lying on the line $y = 5 - \frac{1}{3}x$.

   The second rectangle will sit on top of the first one and be half as wide (horizontal dimension). The second rectangle will also have a corner on the line $y = 5 - \frac{1}{3}x$.

   Let w be the width of the lower rectangle.

   Find the value of w that maximizes the combined area of the two rectangles.



7. The height of a certain cactus is a linear-to-linear rational function of time. Today, the cactus is 10 feet high.

   Over the next 30 years, the height of the cactus will increase by 25 feet.

   The cactus will always increase in height, and the height will approach, but not exceed, 60 feet.

   (a) Express the height of the cactus as a function of time.

   (b) Find the inverse of the function you found in part (a).

8. Marika has a fever. This causes her temperature to be a sinusoidal function of time. At 3 AM today, her temperature was at a maximum of 40 degrees celsius. Her temperature dropped, reaching a minimum of 36 degrees celsius at 10 AM today.

   (a) Give the function $f(t)$ that yields Marika's temperature t hours after midnight last night.

   (b) For how much of today (from midnight to midnight) will Marika's temperature be above 38.2 degrees celsius?