# Math 120 - Spring 2011
## Final Exam
### June 4, 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.

- You have 170 minutes to complete the exam.

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1. Toshiro is walking near the Circular Forest, which has the shape of a perfect circle, and radius of 8 km. He begins from a point 10 km WEST and 3 km SOUTH of the center of the forest. He heads directly toward a point 20 km EAST and 4 km NORTH of the center of the forest. However, when he reaches a point due EAST of the center of the forest, he turns and walks due SOUTH until he leaves the forest.

   Toshiro walks at a constant 5 km per hour. How much time did he spend in the forest?

2. Arnoldo and Hamda are running around a circular track. Arnoldo starts from the north-ernmost point of track and runs clockwise. Arnoldo takes 23 second to run each lap of the track. Hamda runs counterclockwise, and takes 27 seconds to run each lap of the track. Arnoldo and Hamda start running at the same time, and pass each other for the first time after 8 seconds.

   (a) How long have Arnoldo and Hamda been running (i.e., time since they started running) when they pass each other for the second time?

   (b) Let $R$ be the radius of the track. With the origin at the center of the track, express Hamda's $x$- and $y$-coordinates as functions of the time, $t$, since Hamda started running (your answers will involve $R$).

3. The volume of a certain weather balloon is a sinusoidal function of time. At 1 AM today, the volume was at a minimum, 2 m³. The volume then increased, reaching a maximum of 22 m³ at 5 AM today.

(a) Express the volume of the balloon as a sinusoidal function of time, $t$, where $t$ is hours after midnight today.

(b) In the first 14 hours after midnight, for how much time was the balloon's volume less than 6 m³?

4. You wish to cut a piece of steel shaped as shown in the figure below. All dimensions are in centimeters.

   A vertical cut will be made $x$ centimeters from the left-most edge.

   Express the area to the left of the cut as a multipart function of $x$.
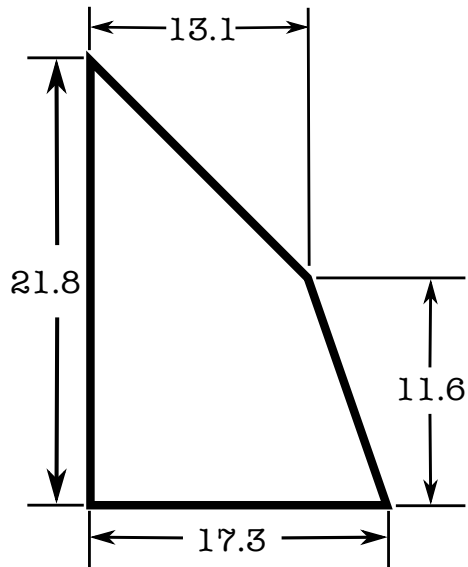
5. A tree is growing. Its height is a linear-to-linear rational function of time. Today, the tree is 5 feet tall. Twenty years from today it will be 40 feet tall, and 21 years from today it will be 41 feet tall.

   (a) Express the tree's height as a linear-to-linear function of $t$, where $t$ is years from today.

   (b) When (in years from today) will the tree be 50 feet tall?

6. The population of city A increase by $2.38\%$ per year. City B doubles in the length of time it takes city A to increase from a population of 4,000 to a population of 9,500. In the year 2000, city B had a population of 11,000.

   When will city B's population reach 30,000? Express your answer in years after the year 2000.

7. Let $f(x) = x + 3|x + 1|$, and $g(x) = 2x + 4$.

   (a) Express $f(g(x))$ as a multipart function.

   (b) Find all solutions to the equation $f(g(x)) = 12x$.