Math 120 - Autumn 2010
Final Exam
December 11, 2010

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 eight 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 180 minutes to complete the exam.

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1. A radar buoy detects any boats within a radius of 12 miles. A tugboat starts at a location 18 miles SOUTH and 10 miles EAST of the radar buoy. The tugboat travels at a constant speed of 15 mph. The tugboat travels on a straight line toward the NORTHERNMOST point of the radar region. When the tugboat is directly EAST of the buoy, it turns and travels DUE NORTH until it exits the radar region.

   How long (in hours) is the tugboat in the radar region?

2. Thelma and Louise are each going for a jog around a circular track of radius 80 feet. They start jogging from different locations on the circle.

   Thelma starts at the EASTERNMOST point and jogs 10 feet/second around the track in the clockwise direction.

   Louise runs counterclockwise at 14 feet/second and passes Thelma for the first time in 16 seconds.

   Find Louise's x and y coordinates in 12 minutes.

3. The treadmill at Felix's gym is run by a belt and wheel system. A motor spins wheel A which is attached by a belt to wheel B. Wheel B is fixed by an axle to wheel C which spins the conveyor that Felix runs on. The machine is set to run the conveyor at a pace of 1 mile every 8 minutes.
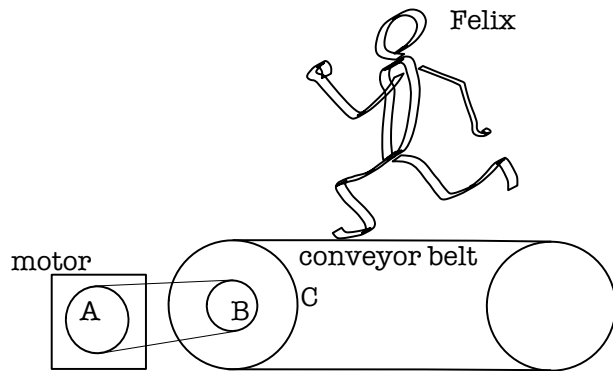
The figure is not to scale.

The radius of wheel A is 0.9 inches, the radius of wheel B is 0.75 inch, and the radius of wheel C is 3 inches.

At what angular speed is the motor rotating Wheel A? Give your final answer in revolutions per minute.

4. The value of Goofy's dog house started to decline at the beginning of 2008 according to a **quadratic model**.

   At the start of 2008, his house is worth $300. At the start of 2009, the value is $240. At the start of 2013, the value will be $260.

   (a) What is the lowest value that the house reaches? (Round to the nearest cent).

   (b) At the beginning of 2013, the value of the house starts to grow according to an **exponential model**. After that time, the value of the home doubles every 30 years.

   In what year will the value of the home reach $1,000? (Give your answer as the year with two digits after the decimal).

5. Anna and Burt are moving at constant speeds along straight lines in the xy-plane. They both start moving at the same time. Anna starts from the origin and reaches the point $(4, 3)$ in 1 second. Burt starts from the point $(1, 2)$ and reaches the point $(5, 8)$ in 2 seconds.

(a) Give Anna's parametric equations of motion.

(b) Give Burt's parametric equations of motion.

(c) Determine the time when Anna and Burt will be closest together.

6. The population of deer in a forest is a sinusoidal function of time. The population oscillates between 5000 and 9000 deer. In 1998, there were 7000 deer. The population then increased, reaching the maximum, 9000 deer, in 2002.

Between the years 1995 and 2014, how much time will the population of deer be less than 5500?

7. The height of a certain tree is a linear to linear rational function of time. In 1970, the tree was 40 feet tall. In 1980, the tree was 50 feet tall. In 2000, the tree was 65 feet tall.

   When will the tree be 75 feet tall? Give your answer in years after 1970.

8. (a) Let $f(x) = \dfrac{3x+1}{x-2}$ and $g(x) = \dfrac{2}{x-1}$. Let $h(x) = f(g(x))$. Find $h^{-1}(x)$.

(b) Let $k(x) = 2x^2 - 4x + 7$ restricted to $x \le 1$. Find $k^{-1}(x)$.