Math 120 - Spring 2007
Final Exam
December 8, 2007

Name: _____ Student ID no. : _____

Signature: _____ Section: _____

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	15	
Total	95	

- Complete all questions.
- You may use a calculator during this examination. Other electronic devices are not allowed, and must be turned off for the duration of the exam.
- If you use a trial-and-error or guess-and-check method, or read a numerical solution from a graph on your calculator 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.
- Show all work for full credit.
- You have 180 minutes to complete the exam.

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1. Isobel is an Econ professor. In 2001 she earned \$68,000 and in 2007 she earned \$75,000. Clovis fries chicken at Ezell's. In 2002 he earned \$16,000 and in 2006 he earned \$19,000. Take $t = 0$ in 2001.

   (a) Give a linear model relating Clovis' salary C to the year t. (Use \$1000 units for C).

   (b) Give a linear model relating Isobel's salary I to the year t. (Use \$1000 units for I).

   (c) In what year will Isobel's earnings be three times those of Clovis?

2. The technicians at Hanford put 15 grams of plutonium-238 in Vat #43 back in 1982. In 2007, a clean up crew checked the vat and found that 8 grams of plutonium-238 remained. This is because radioactive materials decay exponentially with time. The crew closed the vat and left it alone.

   (a) Find an exponential function $y = Ab^t$ that gives the amount y of plutonium-238, in grams, as a function of the year t. Take $t = 0$ in 1982.

   (b) How much plutonium-238 was left in the vat in 1996?

   (c) In what year will there only be 2 grams of plutonium-238 left?

3. When Tafu and Isobel first got married, Isobel had 4 pairs of shoes. After 3 years of marriage, she owned 10 pairs of shoes. On their 6th anniversary, Isobel's shoe collection had reached 22 pairs.

   Assume that the number of pairs of shoes that Isobel owns is a linear-to-linear function of time.

   When will she own 202 pairs of shoes?

4. Romeo and Juliet are moving in the xy-plane. Juliet starts at the point (10,20) and moves in a straight line at a constant speed. She will pass through the origin in exactly 5 seconds. Romeo starts at the same time from the point (30,0) and moves in a straight line at a constant speed. He will pass through the origin in exactly 2 seconds.

   (a) Give parametric equations for Juliet's location t seconds after she starts moving.

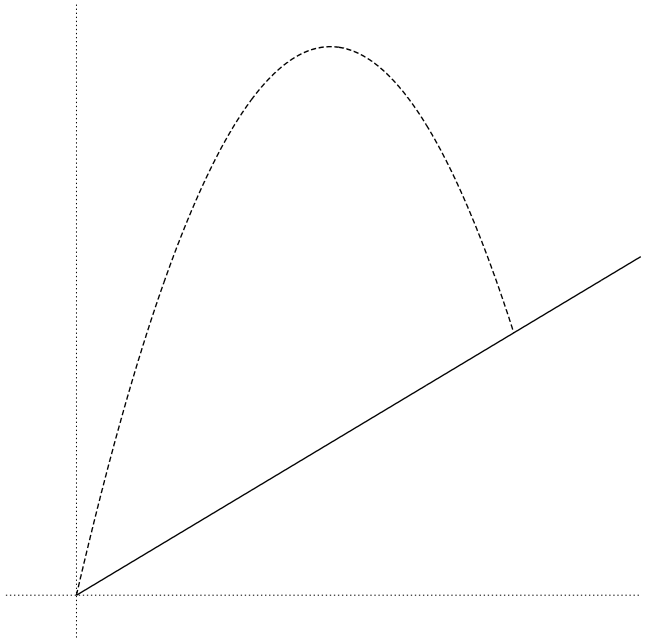
   (b) Give parametric equations for Romeo's location t seconds after he starts moving.

   (c) When will Romeo and Juliet be closest to each other?

5. Anna is searching for buried treasure. At noon, she starts walking due East at 2 km per hour. She walks due East for 3 hours, and then turns and walks due North at 3 km per hour for 1 hour. She then turns and walks due East again at 5 km per hour for 4 hours.

   Express her distance from her starting point as a multipart function of t, the time since she started walking.

6. A hot air balloon takes off from the bottom of a hill. The hill rises at a constant rate of 5 vertical feet for each 1 horizontal foot. This situation is illustrated below (the figure may not be to scale):



The path of the balloon is given by $y = f(x) = -5x^2 + 36x$. Answer the following questions:

(a) Give the coordinates where the balloon lands on the sloping ground.

(b) What is the maximum height of the balloon above the sloping ground?

7. Danny is measuring the loudness of a police siren. At t=2 seconds, the siren's loudness is at its maximum of 112 dB for the first time. At t=7 seconds, the siren's loudness is at its minimum of 88 dB for the first time.

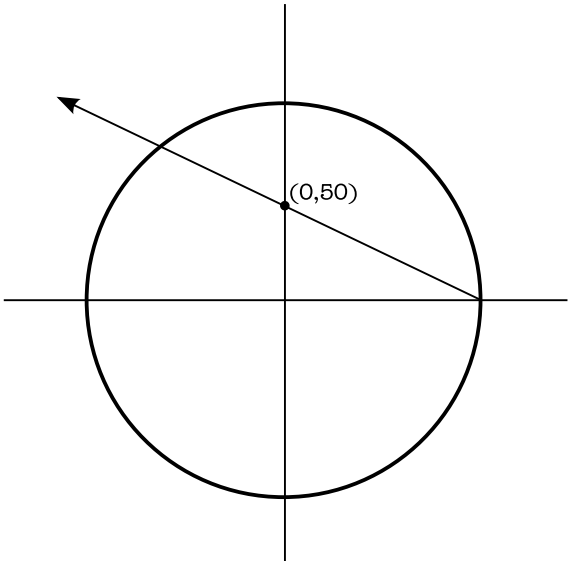
   The loudness is a sinusoidal function of time, t.

   In the first 13 seconds, how much of the time will the loudness be above 94 dB?

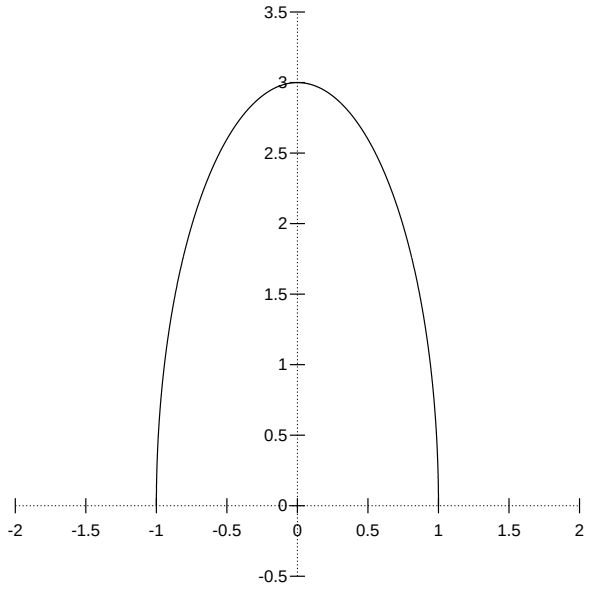
8. A cowboy rides his horse on a circular track with a radius of 100 feet. Impose a coordinate system with the origin at the center of the track.

   (a) If the horse starts at the point (0, -100), and runs **clockwise** around the track at a velocity of 20 ft/sec, what are the horse's coordinates after 3 minutes?

   (b) Suppose the horse is stung by a bee at the point (100, 0) and starts galloping wildly at 40 ft/sec along a straight line with y-intercept 50, as shown in the figure.
   How long does it take the crazed horse to reach the other side of the track?

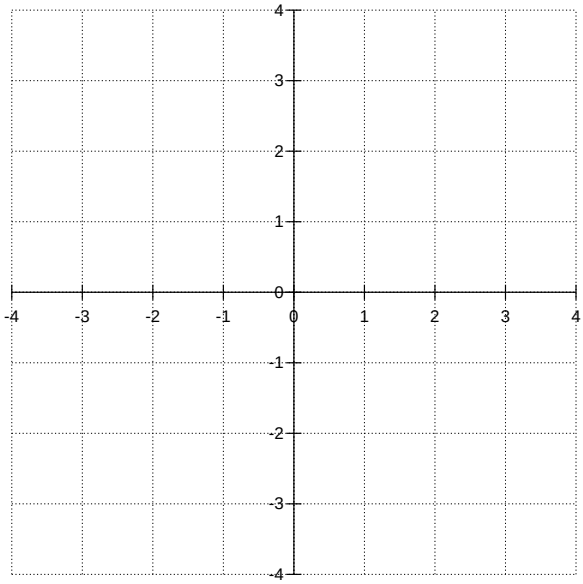


9. The picture below shows the graph of a function $y = f(x)$ with domain $-1 \leq x \leq 1$.



Define a new function $g(x) = -\frac{1}{3}f(2x)$

(a) Draw the graph of $g(x)$.



(b) What is the domain of $g(x)$?

(c) What is the the range of $g(x)$?

This problem continues on the next page.

(d) Restrict the domain of $f(x)$ in such a way that $f(x)$ is invertible on the restricted domain you selected. Draw the graph of $f(x)$ on that restricted domain, and draw the graph of the corresponding inverse function, $f^{-1}(x)$. Clearly lable which graph is which.