MATH 111
Final Exam
March 13, 2004

Name _____

Student ID #_____

Section _____

1	24	
2	14	
3	11	
4	24	
5	15	
6	12	
Total	100	

- Check that you have a complete exam. Your exam consists of one cover sheet, followed by six problems on eight pages.
- Check that your cell phone is OFF and put it away for the duration of the exam.
- There are multiple versions of the exam. It will be apparent if you copy someone else's work. Students found engaging in academic misconduct will receive a 0 on this exam.
- You are allowed to use a calculator, a ruler, and one sheet of handwritten notes.
- We can only give you credit for computations that appear on your exam. Show **all** your work.
- If you use a trial and error method when an algebraic method is available, you will not receive full credit.
- Write your answers in the specified locations.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so. If you still need more paper, please ask for some.
- Raise your hand if you have a question.
- You have 3 hours to complete the exam.

GOOD LUCK!

1. (24 points – 4 points each) Consider four different bank accounts.

   Account A: annual interest rate of 2%, compounded continuously
   Account B: annual interest rate of 2.015%, compounded quarterly
   Account C: annual interest rate of $(r \times 100)\%$, compounded semi-annually
   Account D: annual interest rate of $(r \times 100)\%$, compounded continuously

   (a) If you deposit \$5175 in account A, how much interest will you earn in 9 months?

   ANSWER: _____dollars

   (b) How much must you deposit into account B in order to have \$60,000 in 15 years?

   ANSWER: _____dollars

   (c) You deposit $\$P$ into account B. How long does it take to double your principal?

   ANSWER: _____years

(d) Bob deposits \$4800 in account B on the same day that Chuck deposits \$5000 in account C. In 42 months, Bob's balance is the same as Chuck's. What is Chuck's interest rate?

ANSWER: _____%

(e) You deposit \$7000 in account A today. What is the percentage change in the balance from $t = 5$ to $t = 6.25$ years?

ANSWER: _____%

(f) A balance in account D grows from \$600 to \$1080 in 10 years. What is the interest rate?

ANSWER: _____%

2. (14 points) You manufacture and sell *Things*. The average cost (AC, in dollars) of manufacturing q of your Things is given by

$$AC(q) = 23 + \frac{7300}{q}.$$

The total revenue (TR, in dollars) from selling q of your Things is

$$TR(q) = 106q - q^2.$$

(a) (3 points) Write out a formula for total cost (TC) as a function of q. Write it in the form $TC = mq + b$.

ANSWER: $TC =$_____

(b) (3 points) What is the value of your fixed costs (FC)?

ANSWER: $FC =$_____dollars

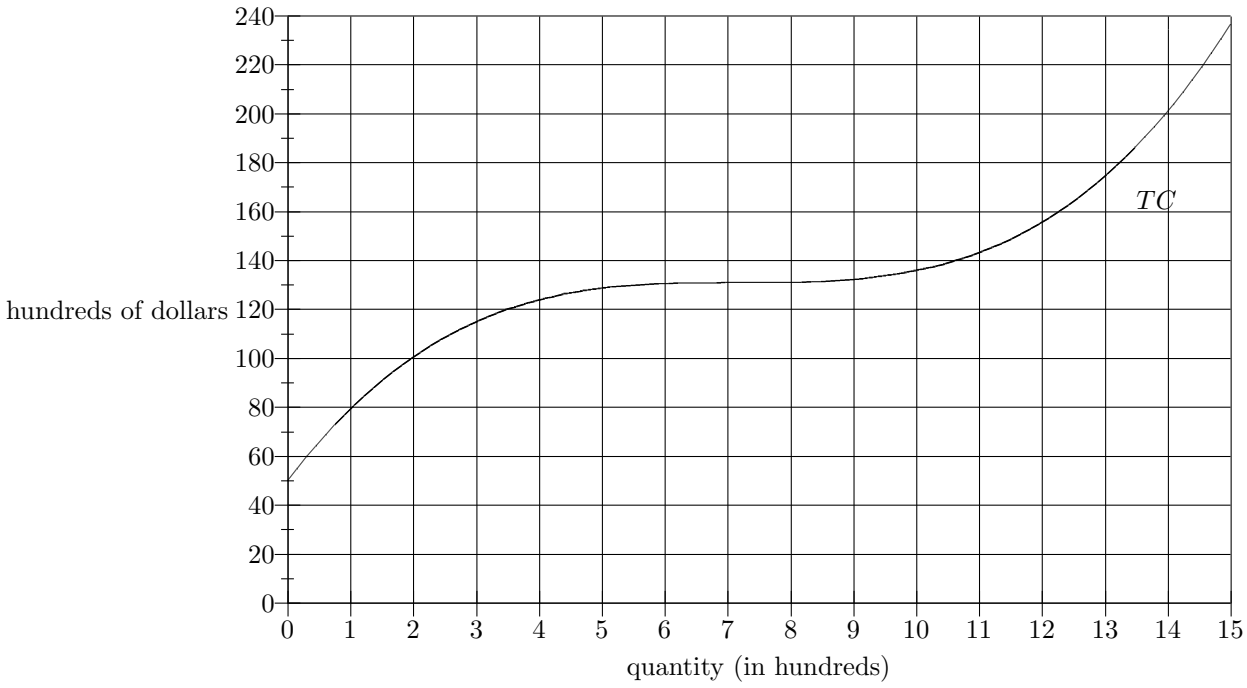
(c) (3 points) What is the marginal revenue (MR) at $q = 20$ Things?

ANSWER: $MR(20) =$_____dollars

(d) (5 points) Find all positive values of q at which marginal revenue (MR) is equal to marginal cost (MC).

ANSWER: $q =$_____Things

3. (11 points) You sell *Items*. The graph below is your total cost.



(a) (3 points) Compute your break even price.

ANSWER: _____dollars

(b) (2 points) Give the largest interval over which marginal cost is increasing.

ANSWER: from $q =$_____to $q =$_____hundred Items

(c) (3 points) Compute the average variable cost of producing two hundred Items.

ANSWER: $AVC =$_____dollars per item

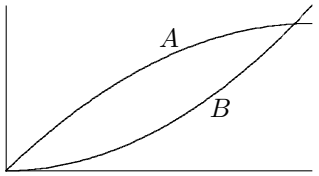
(d) (3 points) Your Items sell for \$20 each. What is the smallest quantity you can sell and not be forced to take a loss?

ANSWER: $q =$_____hundred Items

4. (24 points)

Two cars travel along a long, straight road. We have formulas for the distance traveled (in miles) by each car after t minutes:
$A(t) = -0.02t^2 + 2.4t$
$B(t) = 0.025t^2$

The distance graphs are given at right.



time (in minutes)

(a) (4 points) Find the time at which car B's distance is 42 miles.

ANSWER: $t =$_____minutes

(b) (4 points) Find the time at which car A is ahead of car B by the greatest distance.

ANSWER: $t =$_____minutes

(c) (4 points) Find the time at which car A's average trip speed is 1.27 miles per minute.

ANSWER: $t =$_____minutes

(d) (5 points) Find the *three* times at which the cars are 4 miles apart.

ANSWER: $t =$_____minutes

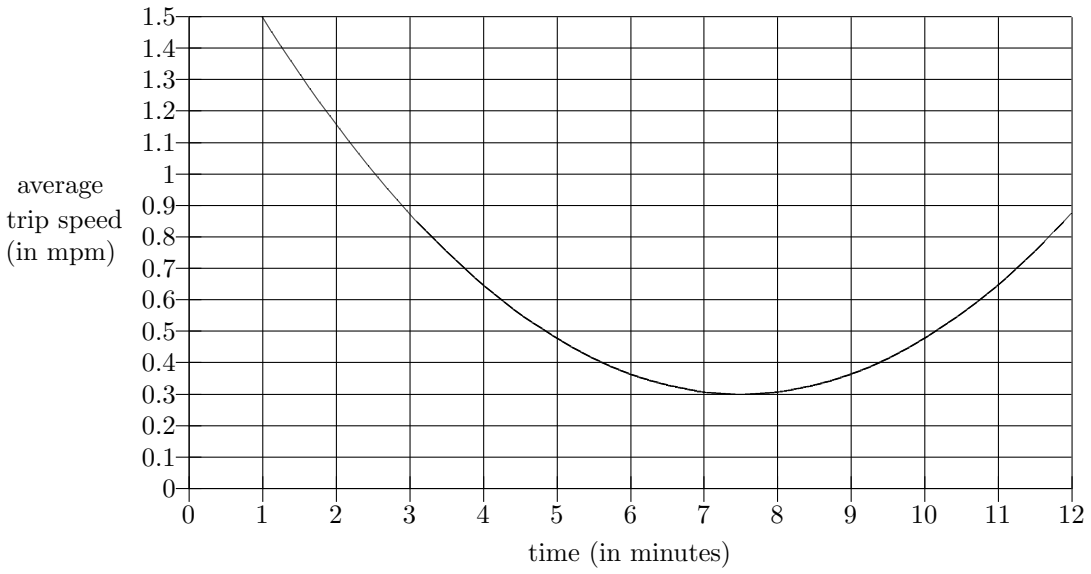
(e) (5 points) Find a formula for car A's average speed over a 2-minute interval, starting at time t.

ANSWER: average speed = _____

(f) (2 points) Find a 2-minute interval over which car A's average speed is 1.73 miles per minute.

ANSWER: from $t =$_____to $t =$_____minutes

5. (15 points) At time t minutes, a car is $D(t)$ miles from its starting location. The graph below shows the car's **average trip speed** at time t minutes. That is, the graph shown is of $\frac{D(t)}{t}$.



(a) (2 points) Find a time at which the car's average trip speed is 1.1 mpm.

ANSWER: $t =$_____minutes

(b) (3 points) How far has the car traveled when its average trip speed is at its lowest?

ANSWER: _____miles

(c) (5 points) How far does the car travel between the two times at which its average trip speed is 0.5 mpm?

ANSWER: _____miles

(d) (5 points) Compute the average (incremental) speed of the car over the interval from $t = 3$ to $t = 11$.

ANSWER: _____mpm

6. (12 points – 3 points each) You have a bacteria colony whose population at time t hours is $p = f(t) = k \cdot m^t$ million bacteria.

   (a) The population increases by 44% from time $t = 6$ hours to $t = 8$ hours. Find the value of m.

   ANSWER: $m =$_____

   (b) The population at $t = 5$ hours is 8.2 million bacteria. Find the value of k. (You'll need to use the answer to (a).)

   ANSWER: $k =$_____

   NOTE: You'll need the answers to parts (a) and (b) to do the rest of the problem. If you are unable to complete parts (a) and (b), you may use the values $m = 2.3$ and $k = 1.7$ to do parts (c) and (d) for partial credit.

   (c) How many bacteria are present at $t = 12$ hours?

   ANSWER: _____million bacteria

   (d) At what time will there be 16.5 million bacteria present?

   ANSWER: $t =$_____hours