

MATH 111  
Final Exam  
December 10, 2011

Name \_\_\_\_\_

Student ID # \_\_\_\_\_

Section \_\_\_\_\_

HONOR STATEMENT

“I affirm that my work upholds the highest standards of honesty and academic integrity at the University of Washington, and that I have neither given nor received any unauthorized assistance on this exam.”

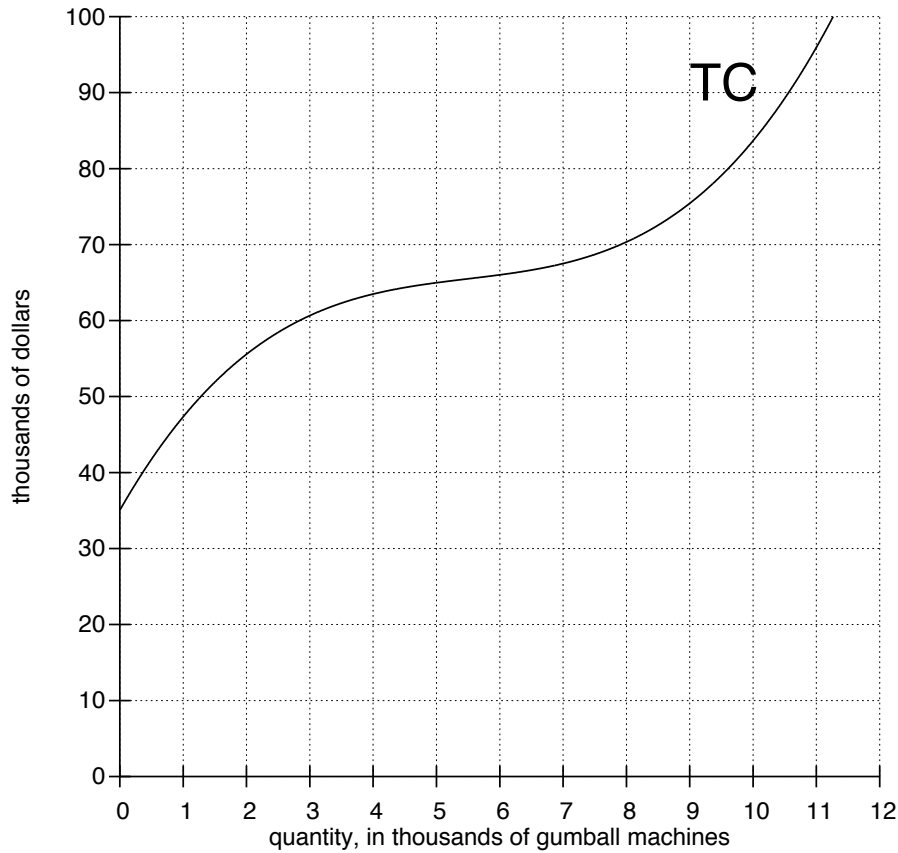
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1	14	
2	11	
3	16	
4	14	
5	32	
6	13	
Total	100	

- This exam consists of this cover sheet followed by six problems on seven pages. Please check that you have a complete exam.
- Turn your cell phone OFF and put it away for the duration of the exam.
- You may not listen to headphones or earbuds during the exam.
- Unless otherwise indicated, you must show your work or write a few words to justify your answers. Clearly show all calculations. The correct answer with no supporting work may result in no credit.
- On problems that require you to work with a graph, show your work clearly by marking all lines and points that you use.
- If you use a guess-and-check method or read a value from a graph on your calculator when an algebraic method is available, you may not receive full credit.
- Unless otherwise specified, you may round your **final answer** to two digits after the decimal.

GOOD LUCK!

1. (14 points) You make and sell gumball machines. The figure below shows you total cost versus quantity. Total cost is in thousands of dollars.



- (a) What is your fixed cost?

ANSWER: \_\_\_\_\_ thousand dollars

- (b) What is your breakeven price?

ANSWER: \_\_\_\_\_ dollars per gumball machine

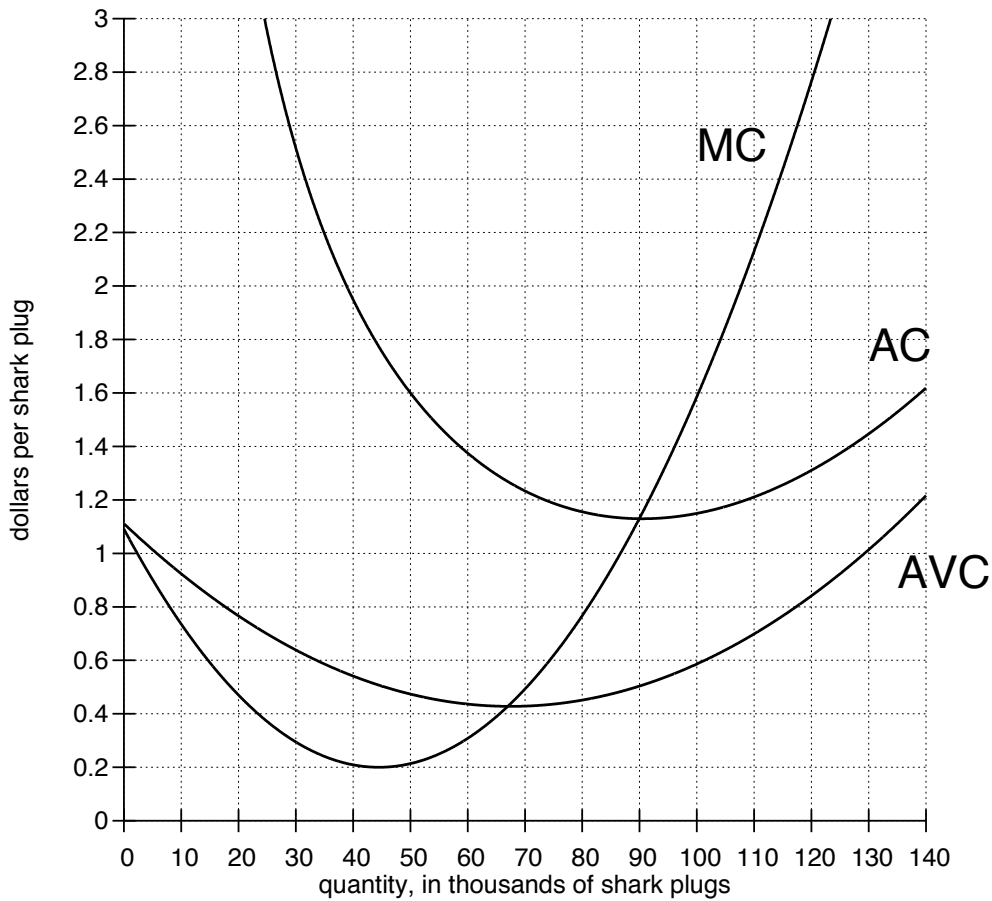
- (c) Find all quantities at which the marginal cost is \$5.

ANSWER: (list all)  $q =$  \_\_\_\_\_ thousand gumball machines

- (d) What quantity will maximize profit if you sell the gumball machines at a price of \$10 each?

ANSWER:  $q =$  \_\_\_\_\_ thousand gumball machines

2. (11 points) You make and sell shark plugs. Your average cost (AC), average variable cost (AVC) and marginal cost (MC) functions are graphed below.



- (a) What is the lowest value of average cost?

ANSWER: \_\_\_\_\_ dollars per plug

- (b) What is your shutdown price?

ANSWER: \_\_\_\_\_ dollars per plug

- (c) If you sell 100 thousand shark plugs at a market price of \$1.40 each, what is your profit? Include units.

ANSWER: \_\_\_\_\_ UNITS: \_\_\_\_\_

- (d) If you instead sell the plugs at a market price of \$2.80 each, at what quantity will profit be maximized?

ANSWER: \_\_\_\_\_ thousand plugs

3. (16 points) In each of the following, your total revenue and total cost are linear functions of quantity  $q$ .
- (a) You make and sell hydraulic refrigerator lifts. You sell the lifts for \$995 each. (That is, the market price is \$995 per lift.) Each lift costs \$340 to produce and your fixed cost is \$136,895. At what quantity will you break even?

ANSWER: \_\_\_\_\_ lifts

- (b) You make and sell dishwashers. Each dishwasher costs \$280 to produce. You sell each one for \$1200. (That is, the market price is \$1200 per dishwasher.) What would your fixed cost need to be to break even at a quantity of 100 dishwashers?

ANSWER: \_\_\_\_\_ dollars

- (c) You make and sell fancy fish tanks. Suppose your marginal cost is a constant  $m$  dollars per tank. Your fixed cost is \$27,000, the market price is \$1150 per tank, and you break even at a quantity of 300 tanks. What is your marginal cost?

ANSWER: \_\_\_\_\_ dollars

- (d) You make and sell crab gymnasiums. Each gym costs \$200 to produce and your fixed cost is \$95,000. What would the market price have to be in order for you to break even at a quantity of 1000 gyms?

ANSWER: \_\_\_\_\_ dollars

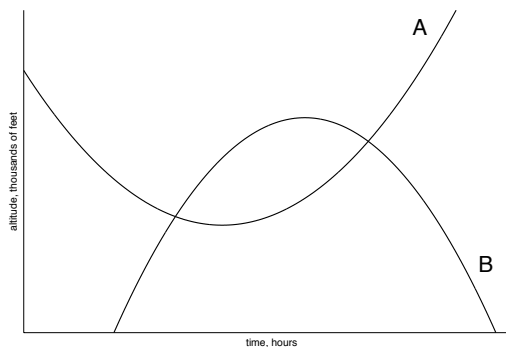
4. (14 points)

Two balloons,  $A$  and  $B$ , have altitudes, in thousands of feet, given by the functions

$$A(t) = 0.1t^2 - 2.4t + 24.4 \text{ and}$$

$$B(t) = -0.15t^2 + 5.1t - 23.35,$$

where  $t$  is in hours. The graphs of these two functions are shown at right.



(a) Find all times when balloon  $A$  is 1000 feet higher than balloon  $B$ .

ANSWER: (list all)  $t =$  \_\_\_\_\_ hours

(b) Find the time when balloon  $B$ 's altitude exceeds balloon  $A$ 's altitude by the greatest amount.

ANSWER:  $t =$  \_\_\_\_\_

(c) Find a three hour period during which balloon  $B$ 's incremental rate of change of altitude is 1.2 thousand feet per hour.

ANSWER: from  $t =$  \_\_\_\_\_ to  $t =$  \_\_\_\_\_

5. (32 points)

- (a) In an account paying 7% annually, compounded monthly, how long does it take to increase your principal by 45%?

ANSWER: \_\_\_\_\_ years

- (b) If you deposit \$10,000 today in an account paying 5% annually, compounded daily, what is the balance 50 years from now? (Use  $n = 365$ .)

ANSWER: \$ \_\_\_\_\_

- (c) In an account compounded continuously, what annual interest rate results in an APY of 6.4%?

ANSWER: \_\_\_\_\_%

- (d) In an account earning 3% annually, compounded quarterly, how much must you deposit today to have \$5000 four years from now?

ANSWER: \$ \_\_\_\_\_

THIS PROBLEM CONTINUES ON THE NEXT PAGE.

- (e) In an account earning 6.3% annually, compounded continuously, what is the proportionate change in the balance over a 7-month period? (Give at least 5 digits after the decimal in your final answer.)

ANSWER: \_\_\_\_\_

- (f) What is the value of \$1 fifteen months after being placed in an account, compounded semi-annually, with an APY of 9.7%?

ANSWER: \$ \_\_\_\_\_

- (g) How much interest does \$4000 earn in 20 years in an account earning 3.2%, compounded three times per year?

ANSWER: \$ \_\_\_\_\_

- (h) A bacteria colony triples its population every 10 minutes. If the colony contains 10,000 bacteria now, how many will it contain 45 minutes from now?

ANSWER: \_\_\_\_\_ bacteria

6. (13 points) Alice, Bernard, and Cecelia begin new jobs today. Each has a starting salary of \$35,000 per year. As long as they are employed at their respective companies, they will receive raises according to the following schedule:

**Alice:** salary will increase by \$800 every year

**Bernard:** salary will increase by 2% every year

**Cecelia:** salary will increase by 1% every year **except** every fifth year, when her salary will increase by 10%.

As always, you must show all work. A correct answer with no justification will receive no credit.

- (a) Whose salary is highest after 3 years of employment?

ANSWER: \_\_\_\_\_

- (b) Whose salary is highest after 10 years of employment?

ANSWER: \_\_\_\_\_

- (c) What is the percentage change in Alice's salary over the first five years of her employment?

ANSWER: \_\_\_\_\_%

- (d) How many years does it take for Bernard's salary to exceed \$75,000? (Your answer should be a whole number of years.)

ANSWER: \_\_\_\_\_ years