MATH 111 A
Exam II
Autumn 2018

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."

SIGNATURE:_____

- Check that your exam contains **five** problems and put your name at the top of each page.
- You are allowed to use a TI-30XIIS calculator, a ruler, and a 3-inch-by-5-inch note card containing hand-written notes. All other sources are forbidden.
- 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.
- **You must show your work.** Clearly label lines and points that you are using and show all calculations. The correct answer with no supporting work may result in no credit.
- If you use a guess-and-check method when an algebraic method is available, you may not receive full credit.
- When rounding is necessary, you may round your final answer to two digits after the decimal.
- **Do not write within 1 centimeter of the edge!** Your exam will be scanned for grading.
- If you run out of room, write on the back of the last page and **indicate that you have done so**. If you still need more room, ask your TA for an extra page to staple to your exam.
- There are multiple versions of the exam, you have signed an honor statement, and cheating is a hassle for everyone involved. DO NOT CHEAT.

GOOD LUCK!

Suppose you produce and sell Things. The following table summarizes the terms we've learned so far relating to revenue and cost. Assume you are given a graph of total cost $TC(q)$ and total revenue $TR(q)$ for producing and selling q Things.

Term	**Definition**	**Related equations and formulas**	**Graphical Interpretation**
total cost $TC(q)$	the total amount you spend to produce q Things	$TC(q) = VC(q) + FC$	—
variable cost $VC(q)$	the money you spend to produce q Things without including fixed costs	$VC(q) = TC(q) - FC$	the graph of VC has the same shape as TC and goes through the origin
fixed cost FC	the money you must spend even if you produce 0 Things; also known as *overhead*	$FC = TC(q) - VC(q)$ $FC = TC(0)$	the vertical distance between the TC and VC graphs OR the "y"-intercept of the TC graph
average cost $AC(q)$	total cost averaged over the number of Things produced	$AC(q) = \frac{TC(q)}{q}$	the slope of the diagonal line through the TC graph at q
average variable cost $AVC(q)$	variable cost averaged over the number of Things produced	$AVC(q) = \frac{VC(q)}{q}$	the slope of the diagonal line through the VC graph at q
breakeven price BEP	the smallest value of average cost	—	the slope of the least steep diagonal line that intersects the TC graph
shutdown price SDP	the smallest value of average variable cost	—	the slope of the least steep diagonal line that intersects the VC graph
marginal cost $MC(q)$ (see footnote)	the incremental rate of change in TC from q to $q+1$ Things	$MC(q) = \frac{TC(q+1)-TC(q)}{1}$	the slope of the secant line through TC (or VC) at q and $q+1$
total revenue $TR(q)$	the total amount you receive when you sell q Things	—	—
average revenue $AR(q)$	total revenue averaged over the number of Things sold; also known as *price per Thing*	$AR(q) = \frac{TR(q)}{q}$	the slope of the diagonal line through the TR graph at q
marginal revenue $MR(q)$ (see footnote)	the incremental rate of change in TR from q to $q+1$ Things	$MR(q) = \frac{TR(q+1)-TR(q)}{1}$	the slope of the secant line through the TR graph at q and $q+1$
profit $P(q)$	the money you are left with after subtracting total cost from total revenue	$P(q) = TR(q) - TC(q)$	the vertical distance between TR and TC (when $TR > TC$)

NOTE: If q is measured in hundreds or thousands of Things, the definitions, formulas, and graphical interpretations of marginal revenue and marginal cost must be adjusted appropriately.

1. (14 points) You sell Things. The formula for total cost is

$$TC(q) = 0.1q^3 - 1.5q^2 + 8q + 36,$$

where q is in **hundreds of Things** and TC is in **hundreds of dollars.**

(a) Compute the **average cost** to produce 450 Things. Include units with your answer.

ANSWER: _____UNITS: _____

(b) Give the formula for **average variable cost** for producing q hundred Things.

ANSWER: AVC(q) = _____

(c) Find all values of q at which **average variable cost** is \$6.20 per Thing.

ANSWER: (list all) q =_____hundred Things

(d) Compute the shutdown price.

ANSWER: \$_____per Thing

(e) The graph of total revenue is a straight line and **profit** is 0 when $q = 24$ hundred Things. Find the formula for $TR(q)$.

ANSWER: $TR(q)$ =_____

2. (9 points) The altitude (in meters) of a balloon at time t seconds is given by

$$B(t) = 4t^2 - t + 7.$$

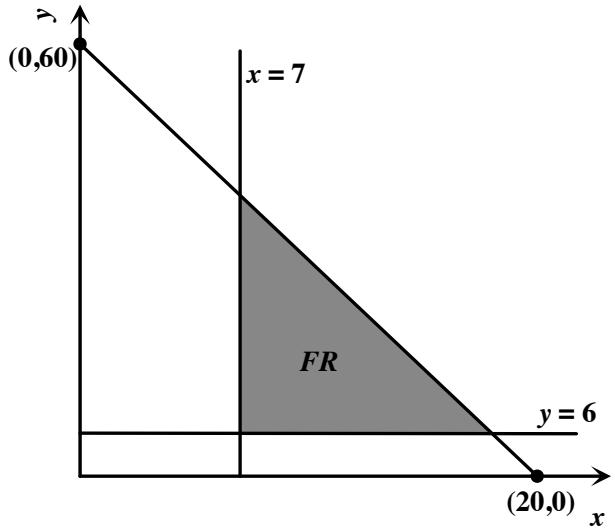
(a) On the interval from $t = 2$ to $t = 2.5$, what is the highest altitude the balloon reaches?

ANSWER: _____meters

(b) Compute $\dfrac{B(t+h) - B(t)}{h}$. Simplify as much as possible.

ANSWER: $\dfrac{B(t+h) - B(t)}{h} =$_____

3. (9 points) A linear programming problem has constraints that result in the following triangular feasible region. Find all the vertices of the feasible region and the maximum value of the objective function $P(x, y) = 31x + 10y$.



ANSWER: vertices: (list all) _____

maximum value of $P(x, y)$: _____

4. (9 points) For a certain product, the supply and demand curves are given by:

$$\text{supply} : 992 - p^2 + 4q = 0 \qquad \text{demand} : p^2 + 8q = 1904.$$

Find the market equilibrium point.

ANSWER: $(q, p) =$_____

5. (9 points) To earn a merit badge, a scout must raise \$1969 by selling a total of 500 candy bars. The scout sells Sparkle Bars for \$3.75 each and Charkle Bars for \$4.25 each. How many of each bar must the scout sell?

ANSWER: _____Sparkle Bars and _____Charkle Bars