Math 111
Exam 1
January 26, 2023

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:______________________________

- This exam consists of a cover, a summary of business terms, three pages of questions, and a scratch sheet. If you put work on the scratch sheet and you want it to be graded, you must clearly tell us in the problem to "see last page".
- You will have 50 minutes.
- You are allowed to use a non-graphing scientific calculator, a ruler, and one 8.5 by 11 inch sheet of handwritten notes (front and back). 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.
- Unless otherwise indicated, 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.
- There are multiple versions, you have signed an honor statement, and cheating is a hassle for everyone involved. If we find that you give an answer that is only appropriate for the other version of the exam and there is no work to support your answer, then you will get a zero on the entire exam and your work will be submitted to the academic misconduct board. JUST DO NOT CHEAT.

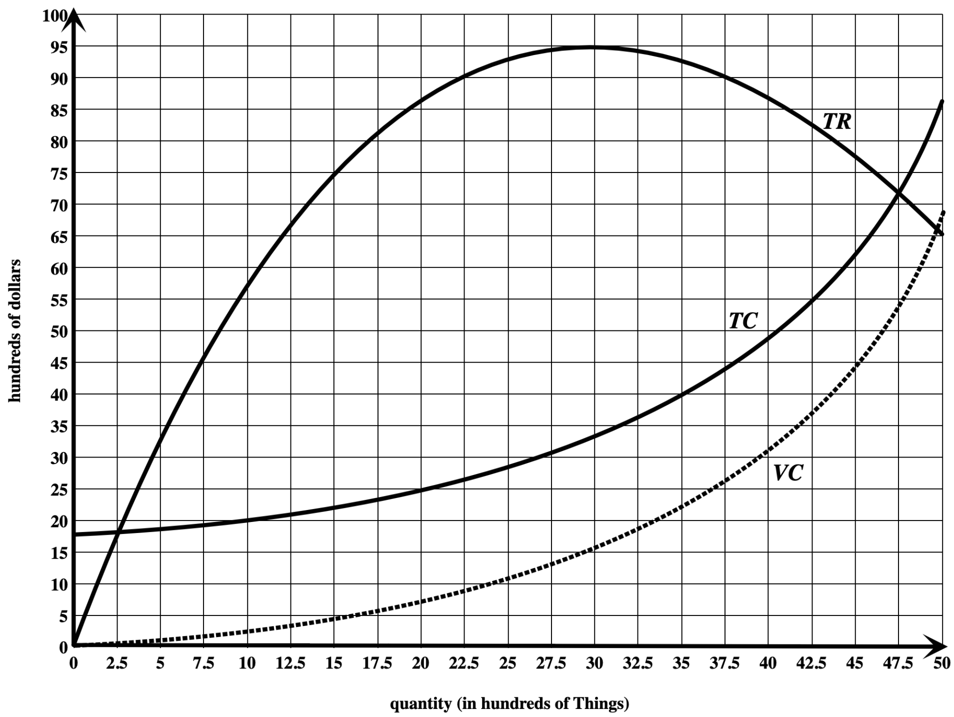
GOOD LUCK!

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 <u>marginal revenue</u> and <u>marginal cost</u> must be adjusted appropriately.

1. (14 pts) The graph below shows total cost, variable cost, and total revenue (in hundreds of dollars) for producing and selling q hundred Things.



Show some calculations in every problem and label your work in the graph.

(a) Find $TR(10) - TC(10)$.

ANSWER: ____________ hundred dollars

(b) Find the largest quantity at which profit is equal to zero.

ANSWER: ____________ hundred Things

(c) Estimate the marginal revenue at 15 hundred Things.

ANSWER: $MR(15) =$ ____________ dollar per Thing

(d) Find all quantities at which $\dfrac{TC(q)}{q}$ is equal to 1.50 dollars per Thing.
(If there is more than one, list all answers)

ANSWER $q =$ ________________ hundred Things

(e) Circle the **one** option that correctly completes the sentence:
On the interval from $q = 5$ to $q = 50$, the values of average cost..

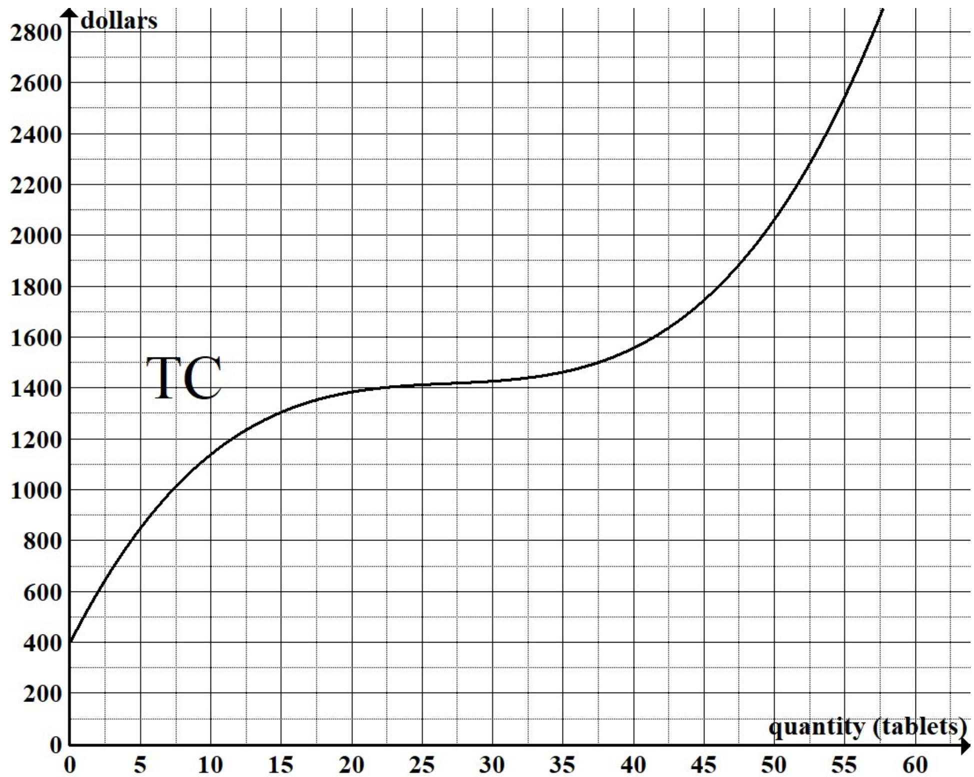
(a) decrease and then increase

(b) increase and then decrease

(c) are always decreasing

(d) are always increasing

2. (13 pts) The graph of **total cost** for producing a certain type of tablet are given. The x-axis is in tablets and the y-axis is in dollars.



Show some calculations in every problem and label your work in the graph.

(a) Find the Breakeven Price (BEP).

$BEP =$ ____________________ dollars per tablet

(b) Find the average variable cost at $q = 15$ tablets.

$AVC(15) =$ ____________________ dollars per tablet

(c) Give the interval over which marginal cost is less than or equal to 20 dollars/tablet.

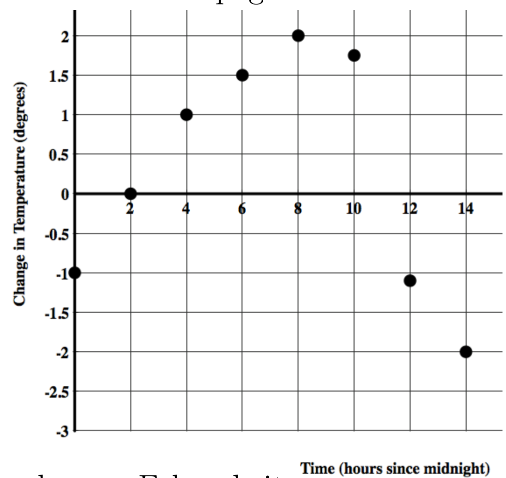
from $q =$ ____________________ to $q =$ ____________________ tablets

(d) Suppose the market price is \$55.00 per tablet. Find the quantity that maximizes profit and give the value of maximum profit.

$q =$ ____________________ tablets and Profit $=$ ____________________ dollars

NOTE: Enlarged versions of the graphs on this page are given on the next page.

3. (5 pts)



The graph shows the **change in temperature**, in degrees Fahrenheit, every two hours beginning at midnight. Each dot on the graph represents the change in temperature over the *next* two hours.

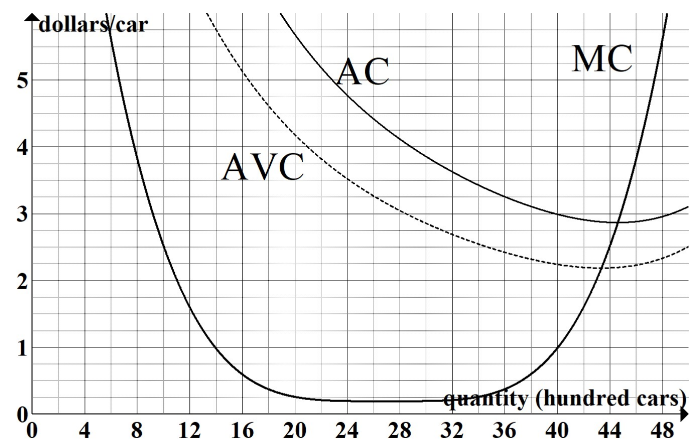
(a) If the temperature is 50 degrees at 6am, then what is temperature at noon?

ANSWER: Temp at $t = 12$ equals ________________ degrees Fahrenheit

(b) Is the temperature at $t = 12$ higher or lower than the temperature at $t = 14$? And by how much?

CIRCLE ONE: HIGHER or LOWER by ________________ degrees Fahrenheit

4. (8 pts)



The graphs of **marginal cost**, **average cost**, and **average variable cost** for producing toy cars are given. The quantities are in hundreds of cars and MC, AC, and AVC are in dollars per item.

(a) Give the Breakeven Price.

$BEP =$ ____________ dollars/item

(b) The current selling price is \$5.00 per item. What *quantity* maximizes profit?

____________ hundred toy cars

(c) Use the graph and our business definitions to compute the total cost at $q = 24$, the variable cost at $q = 24$ hundred cars and the fixed costs.

$TC(24) =$ ____________ hundred dollars

$VC(24) =$ ____________ hundred dollars

$FC =$ ____________ hundred dollars

You may use this page for scratch-work or extra room. There are no questions here, the graphs below are enlargements of the graphs from the previous page.

All work on this page will be ignored unless you write and circle "see last page" on the problem and you label your work.