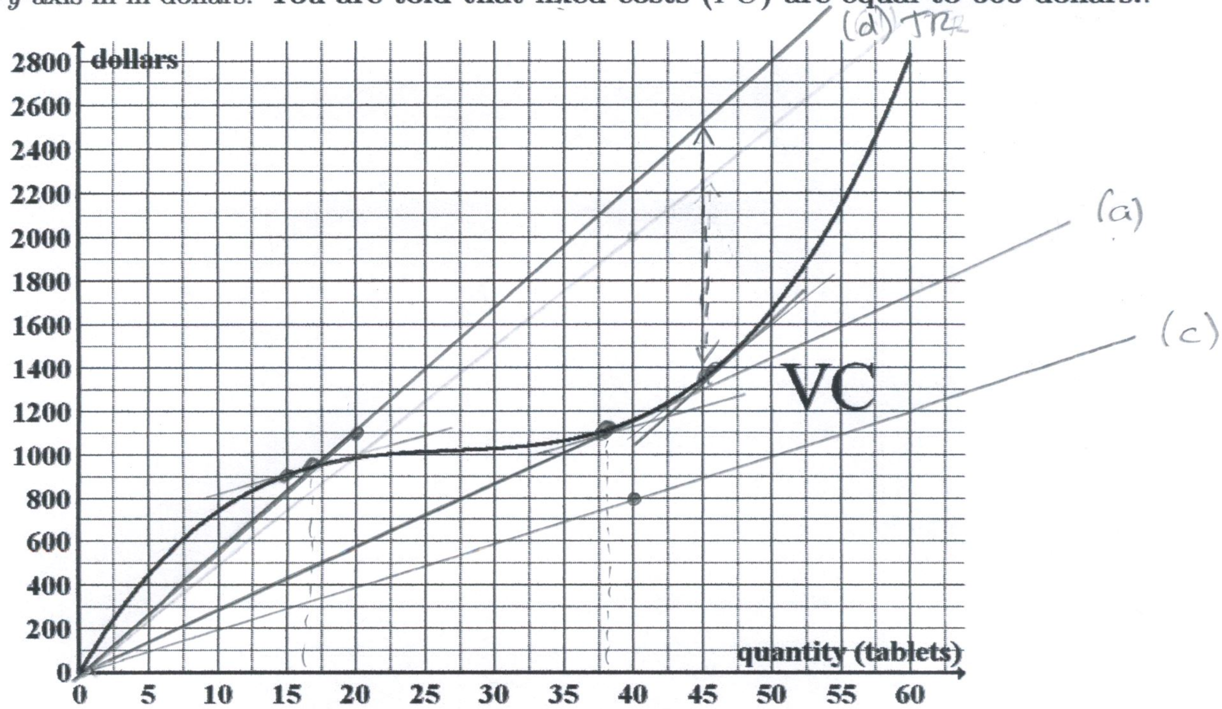
1. (14 points) The graphs of **variable cost** for producing tablets are given. The x-axis is in tablets and the y-axis in in dollars. **You are told that fixed costs (FC) are equal to 600 dollars!**.



Make sure to **read the description above the graph** before you do the problems! Show and label your work in the graph.

(a) Find the **Shutdown Price** (SDP).

SLOPE OF LOWEST DIAGONAL LINE TO VC

POINTS (0,0) (35, 1000)

SLOPE $= \frac{1000-0}{35-0} \approx 28.57$

$SDP =$ 28.57 dollars per tablet

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

$AC(15) = \frac{TC(15)}{15}$ = SLOPE OF DIAG. LINE TO TC AT 15

$AC(15) = \frac{1500}{15} = 100$

$TC(15) = FC + VC(15) = 600 + 900 = 1500$

$AC(15) =$ 100 dollars per tablet

(c) Give the longest interval of quantities over which marginal cost is **at most** 20 dollars per tablet.

FIRST DRAW REFERENCE LINE WITH SLOPE 20.

SLIDE PARALLEL TO FORM TANGENTS TO VC.

from $q =$ 17 to $q =$ 38 tablets

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

TR = A DIAG. LINE WITH SLOPE 55

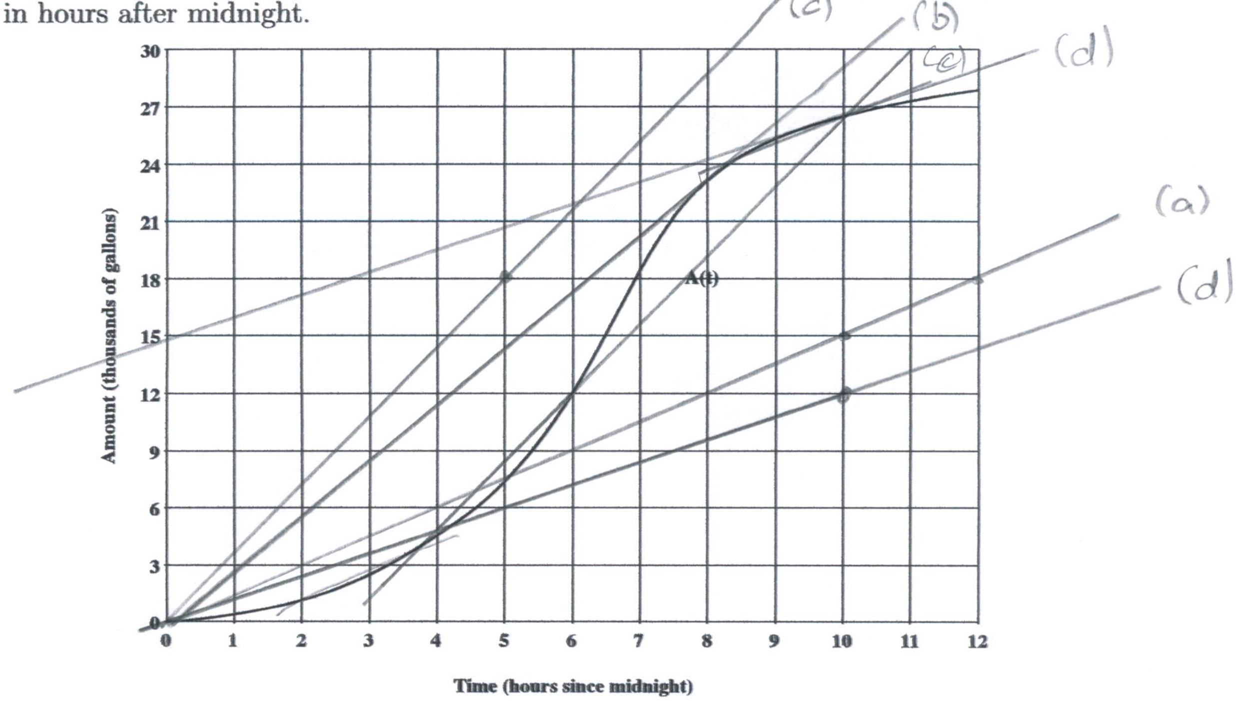
MATCH SLOPES!

$\underbrace{TR(45)}_{2475} - TC(45)$

$2475 - (1350 + 600) =$

$q =$ 45 tablets and Profit = 525 dollars

2. (13 points) The graph below gives the amount of water, $A(t)$, that flows out of a reservoir over a 12-hour period beginning at midnight. The amount, $A(t)$, is in thousands of gallons and the time t is in hours after midnight.



Show and label your work in the graph.

(a) During how many one-hour intervals is water flowing out at an average rate of 1.5 thousand gallons per hour?

number of one-hour intervals with average rates of 1.5 (Circle one): 0 1 2 3 4 5

(b) Find the largest overall rate of flow out of the reservoir.

SLOPE OF LARGEST DIAG. LINE TO A(t)
POINTS (0,0) (10, 29)

$$\text{SLOPE} = \frac{29-0}{10-0} = 2.9$$

$\boxed{2.9}$ thousand gallons per hour

(c) Find a value of t such that $\dfrac{A(t) - A(6)}{t-6} = 3.6$.

DRAW REFERENCE WITH SLOPE 3.6.
SLIDE RULER PARALLEL TO A SECANT THROUGH GRAPH AT 6

EITHER ACCEPTED

$t =$ 4 OR 10 hours

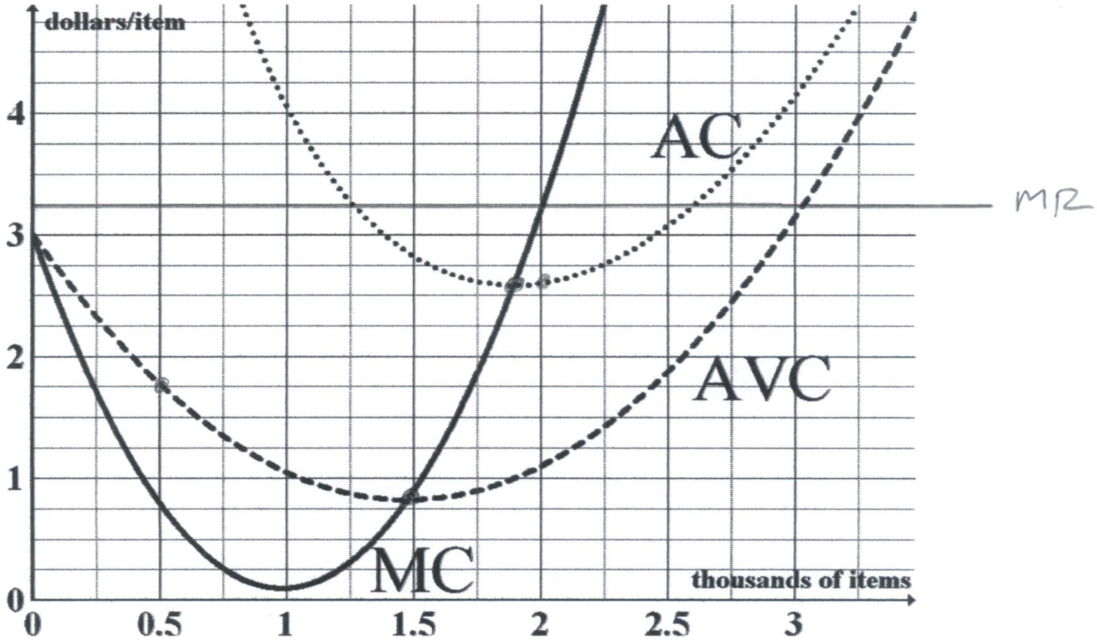
(d) Suppose water flows into the reservoir at a constant rate of 1.2 thousand gallons per hour. What is the smallest amount of water needed in the reservoir at midnight so that the reservoir never has a shortage in this 12-hour period?

DRAW THE "WATER IN" REFERENCE LINE.
MATCH SLOPES!

LARGEST GAP = ?

15 thousand gallons

3. (12 points) Below are the graphs of **marginal cost, average cost**, and **average variable cost** for producing items. The quantities are in thousands of items and MC, AC, and AVC are in dollars per item.



Show your work.

(a) Give the **variable cost** at 500 items.

$\underbrace{AVC(0.5)}_{} = \frac{VC(0.5)}{0.5}$ $q = 0.5$ \$ #/item thousand items

$1.75 = \frac{VC(0.5)}{0.5} \Rightarrow VC(0.5) = 1.75 \cdot 0.5 = 0.875$ thousand dollars

$VC(0.5) =$ 0.875 thousand dollars

(b) Give the breakeven price and the shutdown price.

BEP = "lowest y-value of AC"

SDP = "lowest y-value of AVC"

BEP = 2.60 dollars per item

SDP = 0.80 dollars per item

(c) Suppose the market price is \$3.25 per item. Find the quantity that maximizes profit and give the value of maximum profit. (Put your units in the space provided)

$MR = MC \Leftrightarrow q_s = 2$ thousand items

$TR(2) = 3.25 \cdot 2 = 6.5$ thousand dollars

$TC(2) = AC(2) \cdot 2 = 2.65 \cdot 2 = 5.3$ thousand dollars

$q =$ 2 units: thousand items

Profit = 1.2 units: thousand dollars

4. (11 points) (Show your work)

(a) Solve the inequality $\frac{x}{3} + 5 < \frac{3(x-1)}{2}$ (That is, get x by itself.)

$\frac{2x}{3} + 10 < 3(x-1)$

$2x + 30 < 9(x-1)$

$2x + 30 < 9x - 9$

$39 < 7x$

$\boxed{\frac{39}{7} < x}$

(b) The cost to rent a compact car from Budget is given by a linear function. You are told that the charge is \$65 for a 1 day rental and the charge is \$195 for an 11 day rental. Let x be the number of days you rent the car and $B(x)$ be the amount Budget will charge you.

i. Find the linear function for $B(x)$. (Give your answer in the form $B(x) = mx + b$).

$m = \frac{195-65}{11-1} = \frac{130}{10} = 13$

$\boxed{B(x) = 13(x-1) + 65 = 13x - 13 + 65 = 13x + 52}$

ii. Assume Thrifty rents a similar car with the rental charge given $T(x) = 19x$. After how many days, x, with the rental charge at Thrifty be \$50 more than the rental charge at Budget?
(You must translate the question to functional notation and solve the equation for full credit).

$T(x) = B(x) + 50$

$19x = 13x + 52 + 50$

$6x = 102$

$\boxed{x = \frac{102}{6} = 17 \text{ days}}$