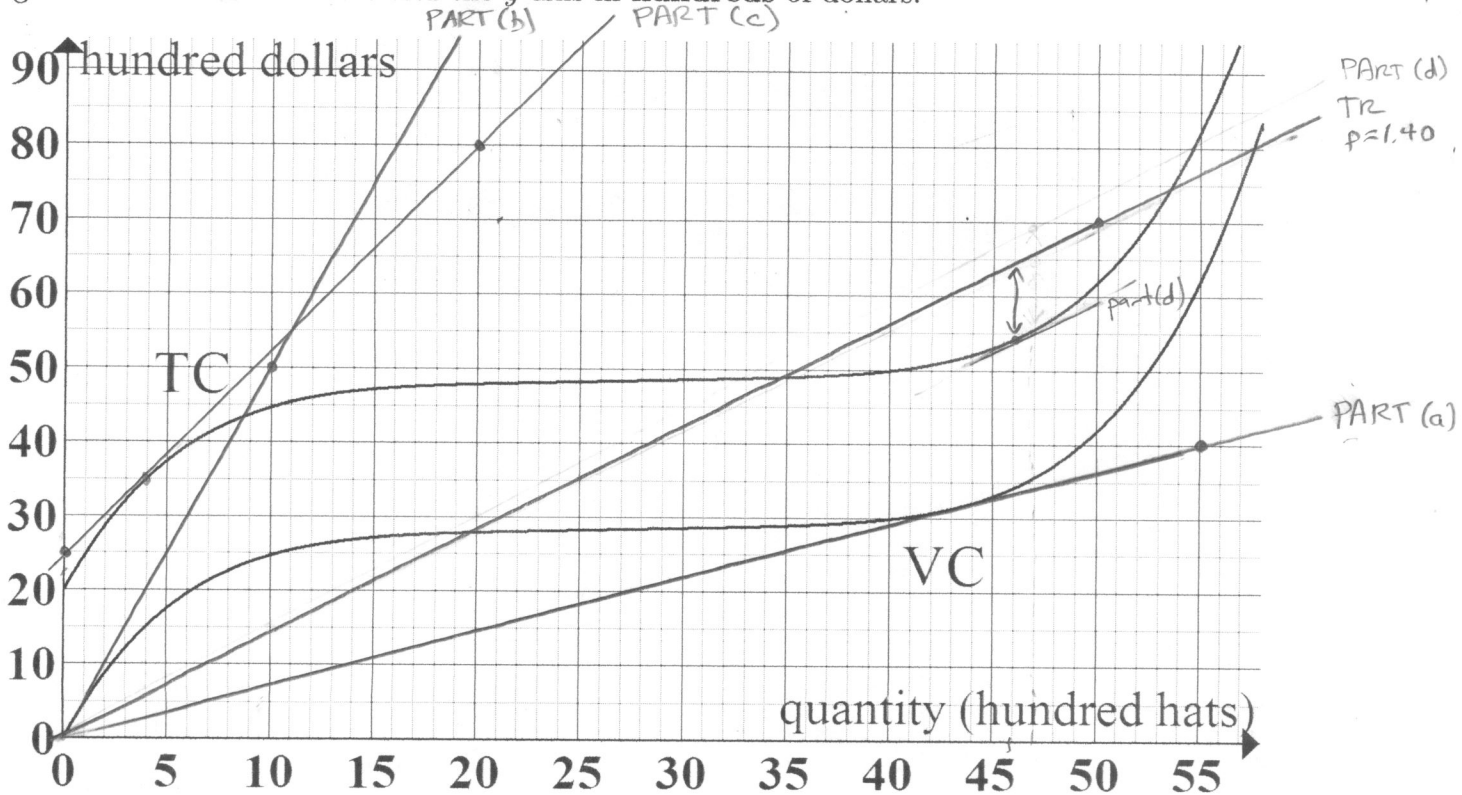1. (14 pts) The graph of **total cost** and **variable cost** for producing hats are given. The x-axis is given in **hundreds** of hats and the y-axis in **hundreds** of dollars.

PART (b)   PART (c)

90 hundred dollars

80

70

60

50   TC

40

30

VC

20

10

0

quantity (hundred hats)

0   5   10   15   20   25   30   35   40   45   50   55

PART (d)
TR
p=1.40

part(d)

PART (a)

(a) Find the Shutdown Price. (include units)   PRICE AT WHICH IT NO LONGER BECOMES POSSIBLE TO RECOVER ANY FIXED COSTS.

LOWEST DIAGONAL SLOPE TO VC   →OR DOLLARS   OR   HUNDRED DOLLARS
                                                                    HUNDRED HAT

$$SLOPE \approx \frac{40-0}{55-0} = 0.7272 \quad [0.65 - 0.80]$$

$$SDP = \underline{\quad 0.73 \quad} \quad Units = \underline{\quad \frac{DOLLARS}{HAT} \quad}$$

(b) At what quantity is the **average cost** equal to 5 dollars per hat?

DRAW REFERENCE LINE WITH SLOPE 5

INTERSECTS TC AT $q \approx 8.7$ $[8 - 9.5]$

$$q = \underline{\quad 8.7 \quad} \text{ hundred hats}$$

(c) Compute the **marginal cost** at 400 hats.

SLOPE OF SECANT FROM 4 TO 4.01 $\approx$ SLOPE OF TANGENT AT 4

$\left. \begin{array}{c} (0,25) \\ (20,80) \end{array} \right\}$ SLOPE $\approx \frac{80-25}{20-0} = 2.75$ $[2 - 3.5]$

$$MC(4) = \underline{\quad 2.75 \quad} \text{ dollars per hat}$$

(d) The market price is $1.40 per hat. Find the maximum profit. (include units)
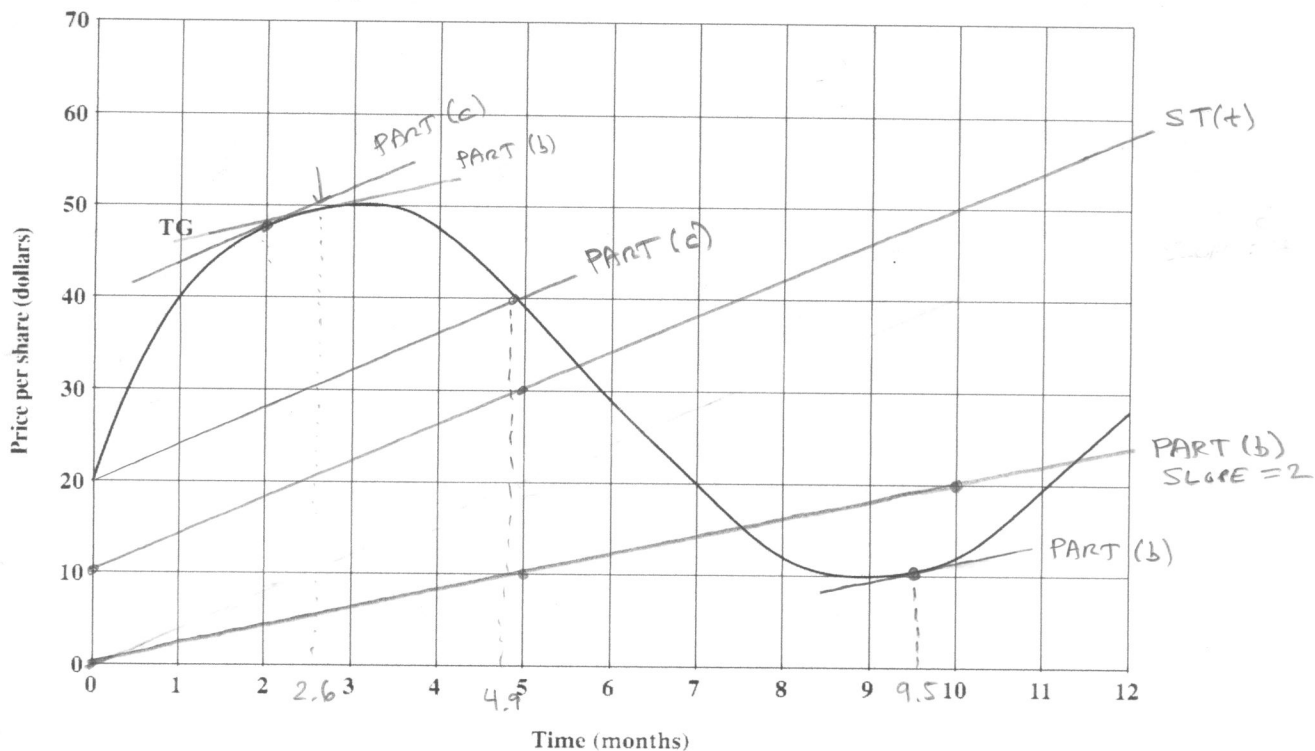
TR IS A DIAGONAL LINE WITH SLOPE 1.40 $50 \cdot 1.40 = 70$

$q \approx 46$

$TR(46) - TC(46)$ $[8 - 12]$

$\approx 64 - 54$

$1.4 \cdot 46 = 64.4$

$$\text{Max Profit} = \underline{\quad 10 \quad} \quad Units = \underline{\quad HUNDRED\ DOLLARS \quad}$$

or   1000   DOLLARS

2. (12 pts) The graph shows the price per share (in dollars) of the stock Technigraphics (TG) over a 12-month period. Let $TG(t)$ represent the value of the stock at t months.

(a) Translate the following statements into functional notation:

- "The slope of the diagonal line to the TG graph at t" = $\dfrac{TG(t)}{t}$

- "The rate of change of TG over the h-minute interval starting at 3 months"

$$= \dfrac{TG(3+h) - TG(3)}{h}$$

(b) Find all times, t, at which $\dfrac{TG(t+0.1) - TG(t)}{0.1} = 2.00$.

SLOPE OF SECANT FROM t TO $t+0.1$ IS 2
$\approx$ SLOPE OF TANGENT

REFERENCE LINE

$[2 - 3]$ $[9 - 10]$

Answer(s): $t = $ ___2.6___ & ___9.5___ months

(c) Sure-Thing stock (ST) starts at $10 per share and its price increases by $4.00 every month.

i. Give the time at which both stock prices have the same overall rate of change.

REFERENCE LINE WITH SLOPE 4.
"OVERALL" RATE ⟹ FROM START

$[4.7 - 5]$

$t = $ ___4.9___ months

ii. Find the time at which the price of the TG stock exceeds that of the ST stock by the largest amount.

MATCH SLOPE OF TG & ST

$[1.5 - 2.5]$

$t = $ ___2___ months

3. (5 pts) Your company produces *Things*.
Each dot in the graph at right gives the **change in costs to produce the next thing.** For example, the dot at $(0, 9)$ means that the costs go up by 9 dollars when you go from producing 0 things to 1 thing.
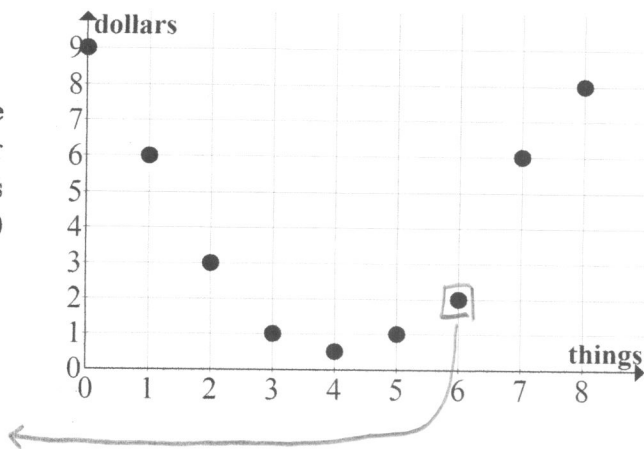
(a) What is the marginal cost at $q = 6$ things?

$$MC(6) = \text{"change in total cost from 6 things to 7 things"}$$

$$MC(6) = \underline{2} \text{ dollars}$$

(b) If fixed cost is 45 dollars, what is the total cost of producing 3 items?

$$TC(0) = 45 \,\Big\} +9$$
$$TC(1) = 54 \,\Big\} +6$$
$$TC(2) = 60 \,\Big\} +3$$
$$TC(3) = 63$$

$$TC(3) = \underline{63} \text{ dollars}$$

4. (6 pts) For a different business, the total revenue and total cost are given by:
$$TR(x) = \frac{50x}{3} \text{ and } TC(x) = 41 + \frac{25x}{2},$$
where x is in **hundreds** of items and $TR(x)$ and $TC(x)$ are in **hundreds** of dollars.

At what quantity is profit equal to zero? Give your final answer to the nearest **item**.

$$\frac{50x}{3} \overset{P}{=} 41 + \frac{25x}{2}$$

$3 \cdot \Big\downarrow$

$$50x = 123 + \frac{75x}{2}$$

$2 \cdot \Big\downarrow$

$$100x = 246 + 75x$$

$-25x \Big\downarrow$

$$25x = 246$$

$\div 25 \Big\downarrow$

$$x = \frac{246}{25} \approx 9.84 \text{ hundred items}$$

profit is zero when you produce and sell $\underline{984}$ items.

5. (8 pts) Your company produces *items*. The graphs of **marginal cost**, **average cost**, and **average variable cost** for producing items are given. The quantities are in items and MC, AC, and AVC are in dollars per item.
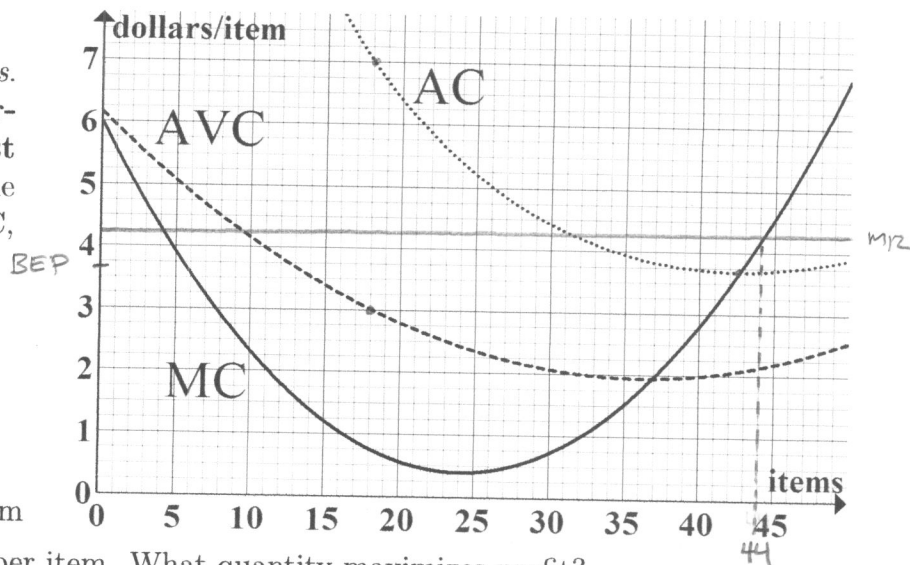
(a) Give the Breakeven Price.

LOWEST VALUE OF AC

$[3.5 - 3.75]$

$BEP = $ ___3.$\overset{70}{}$___ dollars/item

(b) The current selling price is \$4.25 per item. What quantity maximizes profit?

$MR = 4.25 \overset{?}{=} MC(q)$

NEED TO TRANSITION FROM $MR > MC$ TO $MR < MC$.

$[43.5 - 44.5]$

___44___ items

(c) Compute Variable Cost at 18 items **and** figure out the value of FC.

$AVC(18) \approx 3$ \$/item $\Rightarrow VC(18) = 3 \cdot 18 = 54$

$AC(18) \approx 7$ \$/item $\Rightarrow TC(18) = 7 \cdot 18 = 126$

$FC = TC(18) - VC(18)$
$= 126 - 54 = 72$

$[49 - 59]$

$VC(18) = $ ___54___ dollars

$[65 - 79]$

$FC = $ ___72___ dollars

6. (5 pts) Harry is taking a class that has 5 exams that are equally weighted (4 midterms and a final). The instructor says the lowest midterm score will be replaced with the final score. Harry's midterm scores are 32, 78, 94, and 60. What final exam score does Harry need to get in order to end the class with an 80 percent average on his tests? Show and explain your work!

$X = $ FINAL EXAM SCORE

$$\frac{X + 78 + 94 + 60 + X}{5} \overset{?}{=} 80$$

$\Rightarrow 2x + 232 = 400$

$2x = 168$

$x = 84$

Final Exam Score = ___84___