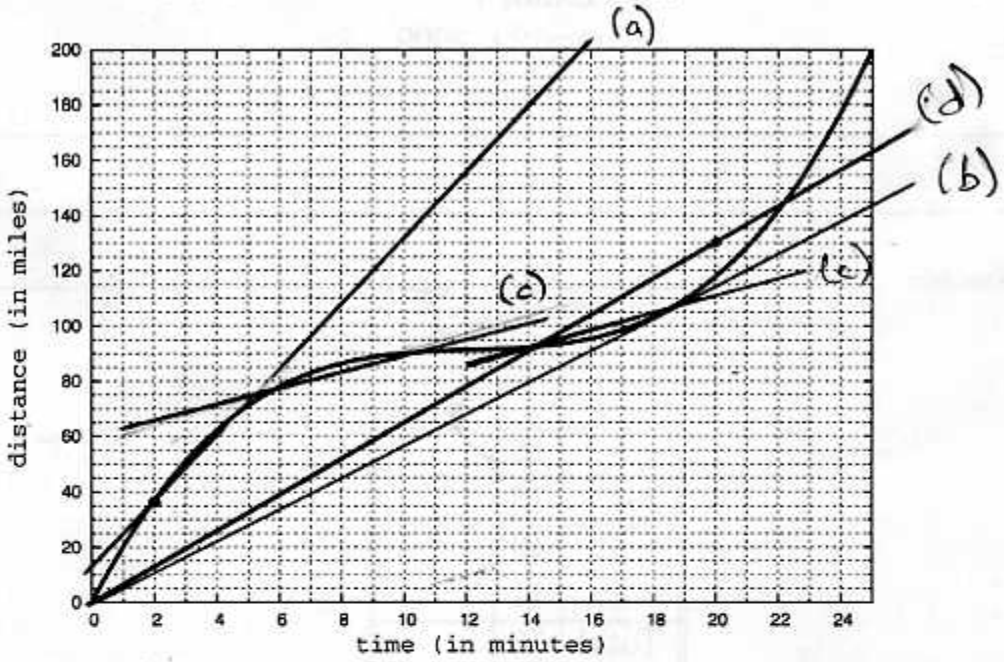
1. (13 points) The following graph shows the total distance, $D(t)$, traveled by a moving object after t minutes.



(a) (3 pts) Compute the average speed during the 3-minute interval staring at $t = 2$ minutes?

AS = SLOPE OF SECANT LINE FROM 2 TO 5 $\approx \frac{200-15}{16-0} \approx 11.5625$

POINTS: (0,15) (16,200)

ANSWER: 11.6 miles per minute

(b) (3 pts) What is the smallest value of average trip speed?

ATS = SLOPE OF DIAGONAL LINE $\approx \frac{40-0}{7-0} = 5.71429$

OCCURS AT $q_8 \approx 18.5$

POINTS: (0,0) (7,40)

ANSWER: 5.7 miles per minute

(c) (3 pts) Find a 4-minute interval over which the average speed is the same as the average speed from $t = 6$ to $t = 10$.

WANT 4-MIN. INTERVAL WHEN SLOPE OF THE SECANT IS THE SAME AS THE SLOPE FROM 6 TO 10.

ANSWER: From $t =$ 14 to $t =$ 18 minutes

(d) (4 pts) Translate the following into English and find the answer(s):

"Find all values of t such that $\frac{D(t)}{t} = 6.5$."

TRANSLATION: "FIND ALL TIMES WHEN ATS IS 6.5 MILES PER MINUTE."

REFERENCE LINE WITH SLOPE = 6.5

(0,0) (10,65) (20,130)

ANSWER: $t =$ 14.2, 22.2 minutes

2. (13 points) You sell Fronzies. The following chart gives the values of marginal revenue and marginal cost at different quantities.

q (in Fronzies)	0	1	2	3	4	5	6	7	8	9
MR (in dollars)	22	19	16	13	10	7	4	1	-2	-5
MC (in dollars)	8	7	6	5	5	5	5	5	5	5

(a) (3 pts) What is your total revenue if you sell 3 Fronzies?

$TR(3) = 22+19+16 = \boxed{57}$

ANSWER: $t =$ 57 dollars

(b) (3 pts) Which quantity will maximize profit?

PROFIT INCREASES WHEN MR > MC ($q=0$ TO $q=6$)
(OVER NEXT ITEM)
PROFIT DECREASES WHEN MR < MC ($q=6$ TO $q=10$)

MAXIMUM OCCURS AT $q=6$

ANSWER: $q =$ 6 Fronzies

(c) (3 pts) Recall that $AVC(q) = \frac{VC(q)}{q}$. What is average variable cost at $q = 2$ Fronzies?

$VC(2) = 8+7 = 15$

$AVC(2) = \frac{15}{2} = 7.5$

ANSWER: $AVC(2) =$ 7.50 dollars per Fronzy

(d) (4 pts) Translate the following into functional notation and determine if it is true or false: "The change in total cost from $q = 3$ to $q = 6$ is greater than 18."

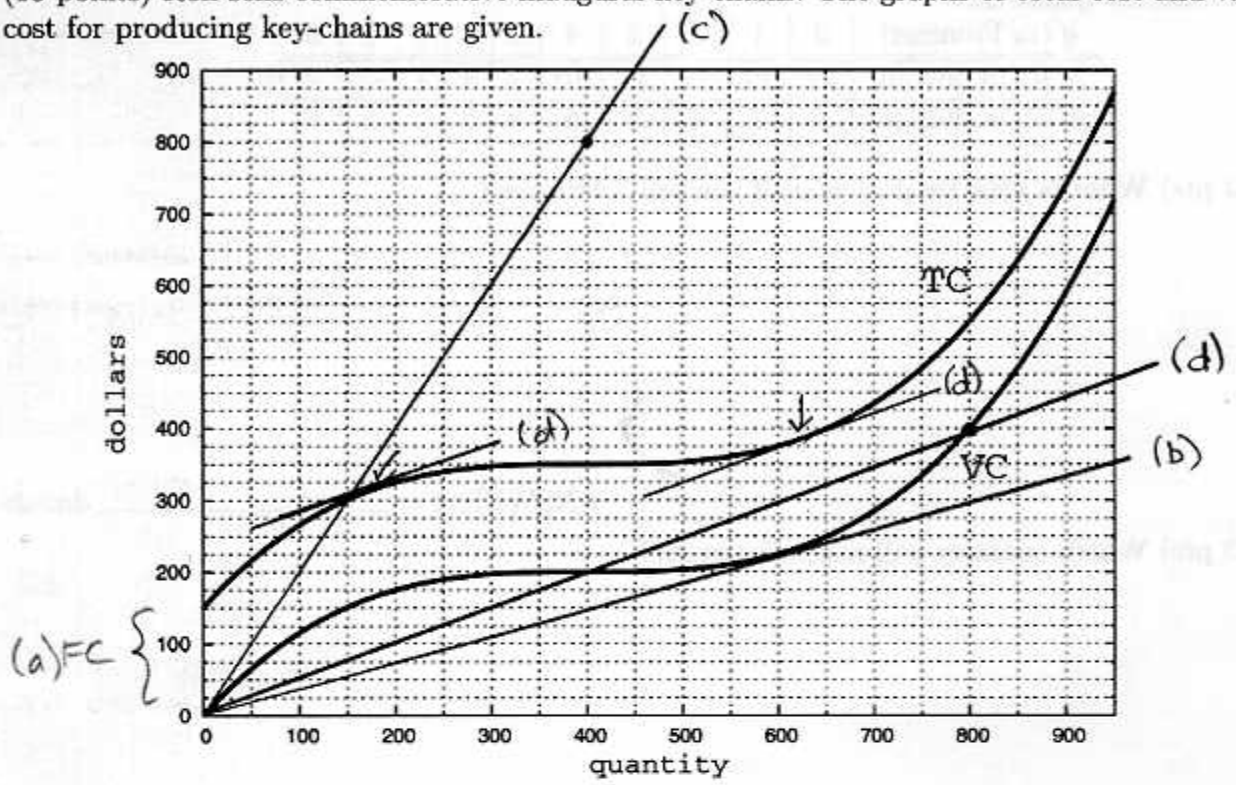
TRANSLATION:

$TC(6) - TC(3) > 18$

$TC(6) - TC(3) = 5+5+5 = 15$ NOT MORE THAN 18

ANSWER: (circle one) TRUE **FALSE**

3. (13 points) Ron sells commemorative inaugural key-chains. The graphs of total cost and variable cost for producing key-chains are given.



(a) (2 pts) Find the fixed costs (FC).

$FC = TC(0) = 150$

ANSWER: $FC =$ 150 dollars

(b) (3 pts) Compute the Shut Down Price (SDP).

SDP = SLOPE OF LOWEST DIAGONAL LINE TO VC

POINTS: (0,0) (950, 350)

SLOPE $\approx \frac{350-0}{950-0} = 0.3684$

ANSWER: 0.37 dollars

(c) (4 pts) Recall that $AC(q) = \frac{TC(q)}{q}$.
At what quantity is the average cost equal to 2 dollars per key-chain?

SLOPE OF DIAGONAL LINE TO TC = 2

REFERENCE LINE WITH SLOPE = 2 ← (0,0) (100, 200) (400, 800)

INTERSECTION AT $q = 150$

ANSWER: $q =$ 150 key-chains

(d) (4 pts) Give all quantities at which the cost of the next item (MC) is 0.50 dollars.

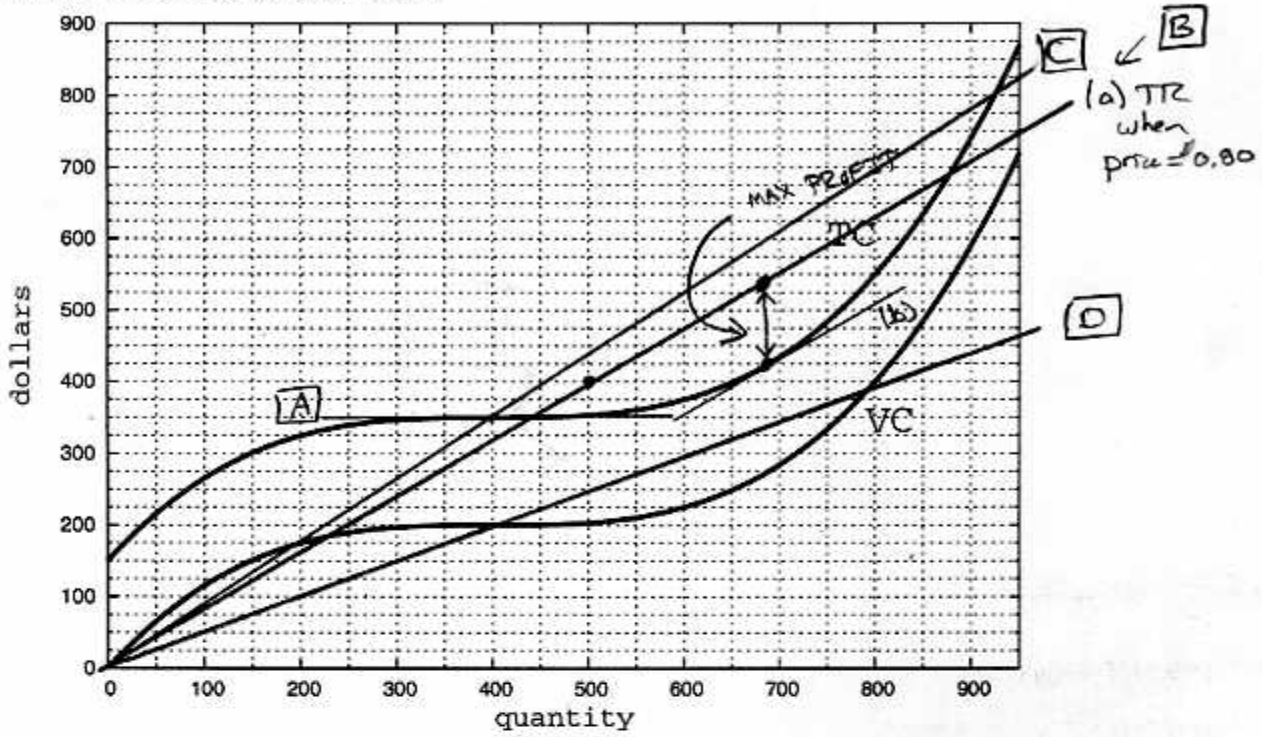
MC = SLOPE OF SECANT TO TC FROM q TO $q+1 \approx$ SLOPE OF TANGENT AT $q = 0.50$

DRAW REFERENCE LINE WITH SLOPE = 0.50 ← (0,0) (800, 400)

SLIDE RULER PARALLEL TO "TOUCH" TC

ANSWER: $q =$ 175, 625 key-chains

4. (11 pts) The following question pertains to the same graphs as the previous page. For your convenience, here are the graphs again.



In addition, for all questions below, the **market price is set at 0.80 dollars per key-chain.**

(a) (4 pts) Draw and label the total revenue graph that corresponds to this market price, then give the longest interval over which profit is positive.

(0,0) (100, 80) (500, 400) PROFIT POSITIVE WHEN TR>TC

ANSWER: From $q =$ 440 to $q =$ 875 key-chains

(b) (3 pts) Give the value of the maximum profit.

LARGEST GAP WHEN TR>TC
ALSO CAN MATCH SLOPES TO FIND LOCATION OF MAX PROFIT.
OCCURS AT ABOUT $q = 690$
GAP SIZE = 535 − 425 = 110

ANSWER: 110 dollars

(c) (4 pts) Of the four values below indicate which is largest and which is smallest? (Write the letter for your answers on the lines below and explain your work)

LEAST STEEP → A. Marginal Cost at $q = 400$. ← ≈ SLOPE OF TANGENT TO TC at 400 ≈ 0

B. Marginal Revenue at $q = 400$. ← = SLOPE OF TANGENT TO TR at 400 = 0.80

STEEPEST → C. Average Cost at $q = 400$. ← SLOPE OF DIAG. TO TC at 400

D. Average Variable Cost at $q = 400$. ← SLOPE OF DIAG. TO VC at 400

ANSWERS : SMALLEST = A and LARGEST = C