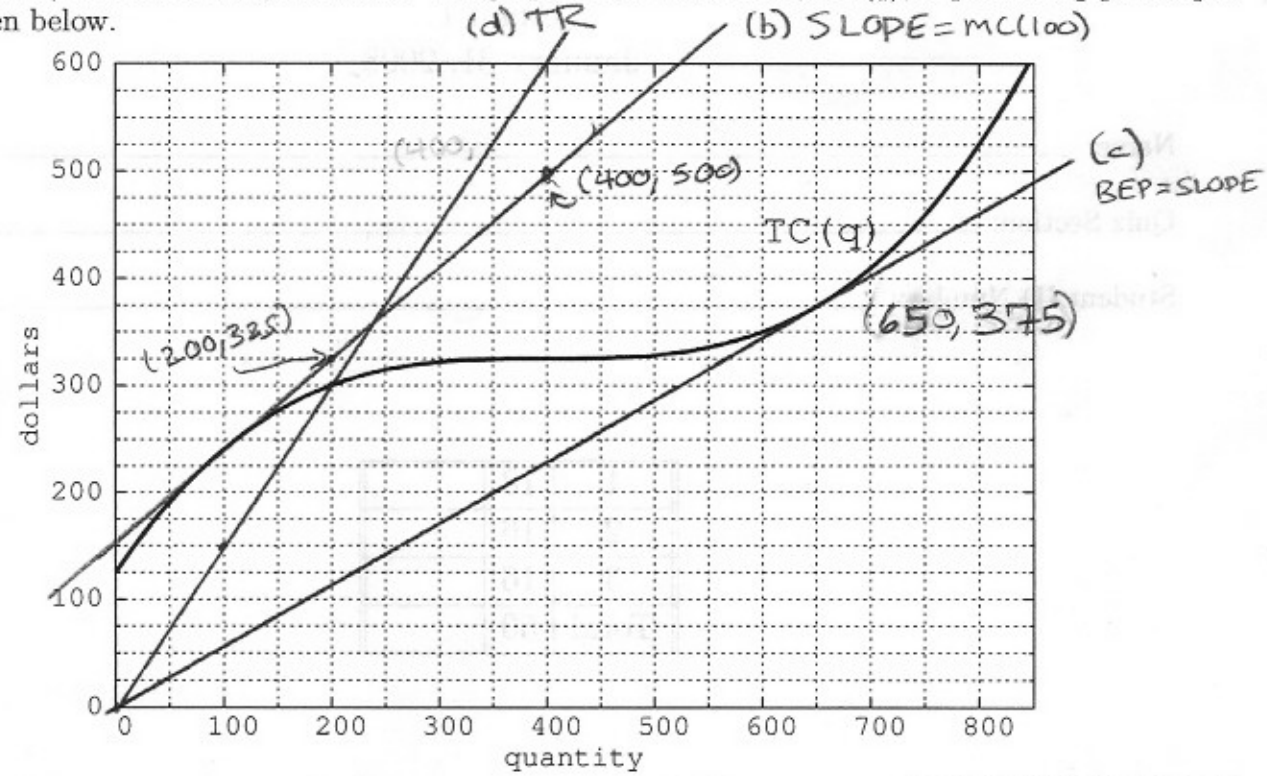
1. (18 points) Harry is selling Flumpits. The graph of the Total Cost, $TC(q)$, of producing q Flumpits is given below.



(a) (4 pts) What is the value of the Variable Costs (VC) at q=600?

ACCEPTABLE RANGE 220 - 230

$VC(600) = TC(600) - FC$

$\approx 350 - 125$

ANSWER: VC(600) = 225 dollars

(b) (4 pts) What is the additional cost of producing the 101st Flumpit?

$MC(100)$ = SLOPE OF SECANT FROM 100 to 101

$\approx$ SLOPE OF TANGENT AT 100

ACCEPTABLE RANGE 0.7 - 0.925

$\frac{500 - 325}{400 - 200} = 0.875$

ANSWER: MC(100) = 0.875 dollars

(c) (4 pts) What is the Breakeven Price (BEP)?

BEP = SLOPE OF LOWEST DIAGONAL LINE TO TC

ACCEPTABLE RANGE 0.5 to 0.65

$\frac{375}{600} \approx 0.58$

ANSWER: BEP = 0.58 dollars

(d) Assume the market price is p = \$1.50 per Flumpit and answer the following questions.

i. (3 pts) What is Profit if q=300 Frumpits are sold?

ACCEPTABLE RANGE 122 - 131

$P = TR - TC$ $\quad P = 450 - 322 = 128$

$TR(300) = 450$ $\quad TC(300) = 322$

ANSWER: Profit = 128 dollars

ii. (3 pts) If Harry sells q=150 Frumpits, how much of his fixed cost does he recover?

$TR(150) = 225$ $\quad TC(150) = 275$ $\quad FC = 125$

PROFIT = \$ - 50 $\quad$ Recovers \$ 75

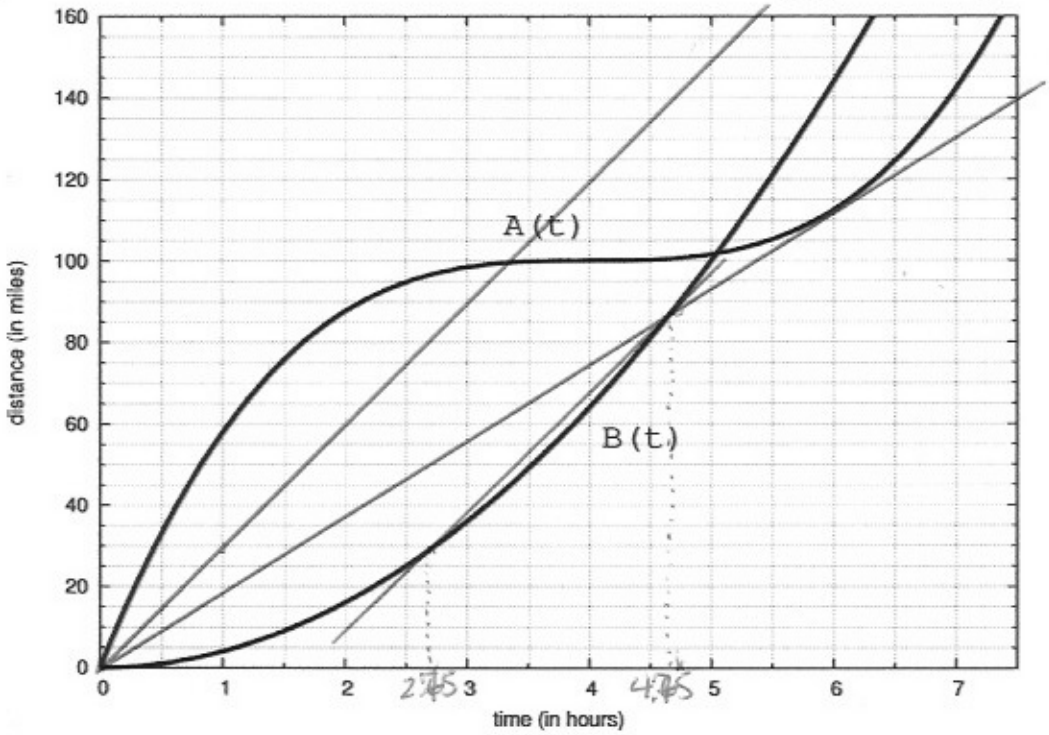
RANGE 70 - 80

V1

2 (16 points) Two cars, A and B, are traveling on the same road. Let $A(t)$ and $B(t)$ represent the distance at time t for Car A and Car B, respectively. At time $t = 0$, the distance between the cars is zero.

(b) Reference Line slope = 30

(a) lowest ATS = slope



(a) What is the lowest average (overall) trip speed for Car A?

slope of the lowest diagonal line $= \frac{112.5}{6} = 18.75$

ANYTHING IN THE RANGE 18.25 to 19.25 IS OKAY

ANSWER: 18.75 miles per hours

(b) Find a 2-hour time interval over which the average (incremental) speed for Car B is 30 mph.

Reference line with slope = 30

Want secant from t to $t+2$ to have slope 30

ACCEPTABLE 2.5 to 3

ANSWER: from $t =$ 2.75 to $t =$ 4.75 hours

(c) Find a one-hour interval over which Car A and Car B have the same average speed?

Slope of the secants from t to $t+1$ are the same

ACCEPTABLE 1.4 to 1.7

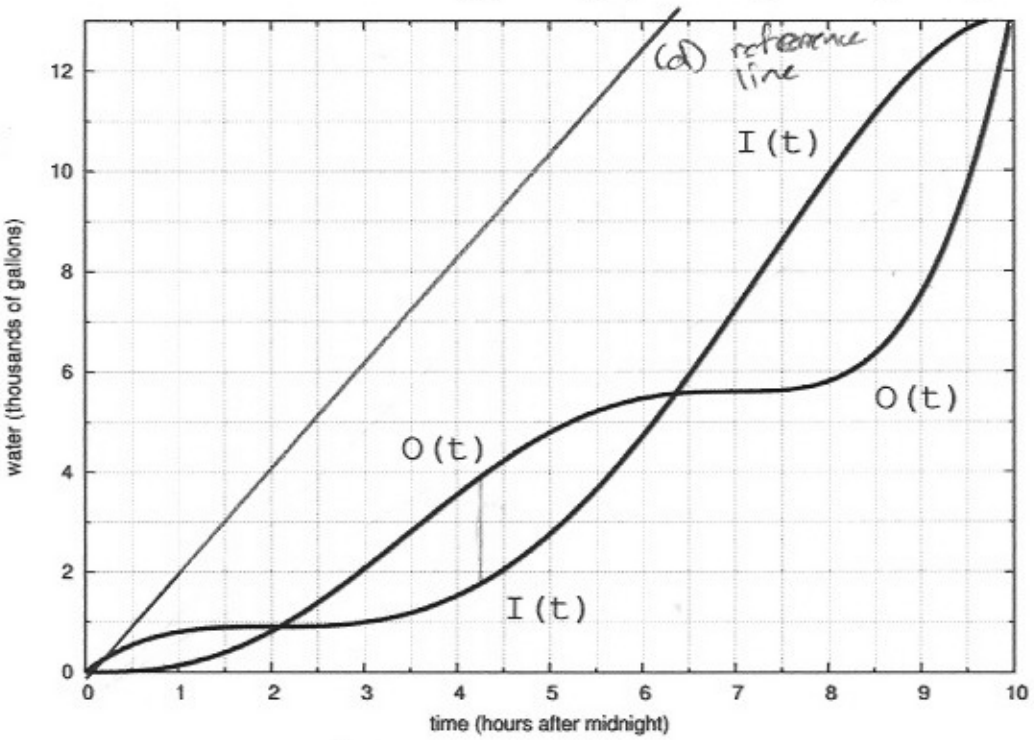
ANSWER: from $t =$ 1.6 to $t =$ 2.6 hours

(d) Translate the following into English: $\frac{B(4)}{4} < \frac{A(5) - A(3)}{2}$. And determine if the statement is true or false.

Translation: The ATS for car B at $t=4$ is smaller than the AS for car A from $t=3$ to $t=5$

FALSE

3. Ron estimates the total flow into and out of a water reservoir that will occur after midnight. The total amount of water that has flowed into a reservoir at time t is denoted $I(t)$ and the total amount of water that has flowed out is $O(t)$. The graphs of $O(t)$ and $I(t)$ are given below.



(a) What is the least amount of water needed in the reservoir at midnight to guarantee the reservoir has enough water for the whole ten hours?

LARGEST GAP WHERE $O(t)$ IS ABOVE $I(t)$ ACCEPTABLE 2 to 2.3

ANSWER: ≈ 2.17 thousand gallons

(b) Name the longest time interval over which the overall rate at which flow *into* the reservoir is decreasing. SLOPE OF DIAGONAL TO $I(t)$ IS GOING DOWN

ACCEPTABLE 3 to 3.3

ANSWER: from $t=$ 0 to $t=$ 3.16 hours

(c) Give all time intervals in which t satisfies $\dfrac{O(t+0.1)-O(t)}{0.1} > \dfrac{I(t+0.1)-I(t)}{0.1}$.

slope of tangent to $O(t)$ > slope of tangent to $I(t)$ (the graph)

ANSWER: (give) $t=1$ to $t=4.5$ AND $t=8.7$ to $t=10$

(d) Translate the following into functional notation and the value(s) of t that make it true: "The (incremental) rate of flow *out* of the reservoir from time t to two-hours later is 2 thousand gallons per hours."

Translation: $\dfrac{O(t+2)-O(t)}{2} = 2$

ACCEPTABLE $t=7.25$ to 7.75

$t=7.5$