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 $q=400$?

$$VC(400) = TC(400) - FC$$
$$\approx 325 - 125$$

**ANSWER:** $VC(400) = 200$ dollars

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

$$BEP = \frac{325}{650} = 0.5$$

**ANSWER:** $BEP = 0.5$ dollars

(c) (4 pts) What is the additional cost of producing the 201st Flumpit?

$$MC(200) = \frac{500 - 400}{200 - 200} = \frac{20}{0} = 0$$

**ANSWER:** $MC(200) = 0$ dollars

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

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

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

**PROFIT** = $90, \quad Recovered \ 475 of FC$

**ANSWER:** $175$ dollars

ii. (3 pts) What is Profit if $q=350$ Flumpits are sold? $525$

$$P = TR - TC$$

$$\text{TR}(350) = 525, \quad \text{TC}(350) \approx 325$$

**ANSWER:** $200$
3. (16 points) 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) (4 pts) Name the longest time interval over which the average overall rate of flow into the reservoir is decreasing.

**SLOPE OF DIAGONAL TO $I(t)$ COVERS**

**DOWN**

**ANSWER:** from $t = 0$ to $t = 3.1$ hours

(b) (4 pts) 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 $O(t) > I(t)$**

**ANSWER:** $12.2$ thousand gallons

(c) (4 pts) Give all time intervals in which $t$ satisfies \[ \frac{O(t+0.1) - O(t)}{0.1} > \frac{I(t+0.1) - I(t)}{0.1} \]

**SLOPE OF TANGENT > SLOPE OF TANGENT**

**ANSWER:** $t = 1 + 4.5$ and $t = 9.7 + 10$

(d) (4 pts) Translate the following into functional notation and give the value(s) of $t$ that make it true:

"The (incremental) rate of flow into the reservoir from time $t$ to two hours later is 1 thousand gallons per hour."

**Translation:**

\[ \frac{O(t+2) - O(t)}{2} = 1 \]

**Range:** $t = 3.2$
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.

(a) (4 pts) Find a 2-hour time interval over which the average (incremental) speed for Car A is 30 mph. 
Reference Line: \( \text{slope } = 30 \) \( \text{Range}: 0.5 - 0.8 \) 
Want secant from \( t \) to \( t + 2 \) with slope = 2 
\[ \text{ANSWER: from } t = \frac{11.6}{6} \text{ to } t = \frac{12.6}{6} \text{ hours} \]

(b) (4 pts) Find a one-hour interval over which Car A and Car B have the same average speed? 
Slopes of secants are parallel from \( t \) to \( t + 1 \) \( \text{Range}: 1.4 \text{ to } 1.7 \) 
\[ \text{ANSWER: from } t = \frac{11.6}{6} \text{ to } t = \frac{12.6}{6} \text{ hours} \]

(c) (4 pts) What is the lowest average (overall) trip speed for Car A? 
SLOPE OF THE LOWEST DIAGONAL LINE 
\[ \frac{112.5}{6} = 18.75 \] 
\[ \text{ANSWER: } \frac{112.5}{6} \text{ miles per hour} \]

(d) (4 pts) 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 larger than the AS for car A from \( t = 3 \) to \( t = 5 \), 
\[ \text{TRUE} \]