AP CALCULUS NAME ____________________________

RATE – IN/OUT PROBLEMS

1. A commericial fish processing company has 400 pounds that have been delivered to it by early-morning fishermen. During the workday, starting a 8 AM, the rate in hundreds of pounds per hour at which fish is delivered to the plant is given by $f(t) = 7 + 3\sin\left(\frac{t^2}{12}\right)$ where t is measured in hours and $0 \le t \le 8$. During the same period of time, the company processes the fish (washes, scales, cuts, packages) at a rate of 800 pounds per hour.

a) Find $f'(5)$. Using correct units, interpret your answer in the context of the problem.

b) How many more pounds of fish arrive in the morning (before 12 noon) than the afternoon?

c) Is the amount of unprocessed fish increasing or decreasing at 1 P.M.? Explain your answer.

d) What is the maximum amount of unprocessed fish at the company during the workday? Approximately when does this occur? Justify your answers.

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RATE – IN/OUT PROBLEMS

2. A small car dealership in Lebaville has 29 cars on the lot at time $t = 0$. During the time interval $0 \leq t \leq 20$ days, new cars are added to the lot at the rate $N(t) = -0.018t^2 + 11$ cars per day. During the same time interval, cars are sold and removed from the lot at the rate $S(t) = 0.013t^2 - 0.25t + 8$ cars per day.

(a) Is the amount of cars on the lot increasing or decreasing at time $t = 11$? Explain your reasoning.

(b) To the nearest whole number, how many cars are on the lot at time $t = 20$?

(c) At what time t, for $0 \leq t \leq 20$, is the amount of cars on the lot a maximum? Justify your answer.

(d) If the dealership has less than 10 cars on the lot, the owner will penalize the manager of the lot. Set up, but do not solve, an inequality involving one or more integrals that could be used to find the time w when the amount of cars on the lot is less than or equal to 10.

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RATE – IN/OUT PROBLEMS

3. A large tank contains 40 gallons of water at time $t = 0$. During the time interval $0 \le t \le 3$ hours, water is being poured into the tank at the rate $W(t) = 0.6e^{t^2-1}$ gallons per hour

During the same time interval, water is leaking from a small hole that is being fixed. The rate that water leaks out is given by: $L(t) = 6\cos(0.7t)$ gallons per hour

(a) How much water has been poured into the tank after 2 hours?

(b) Find the time t, on $0 \le t \le 3$ hours, when the amount of water in the tank is a minimum. Justify your answer.

(c) Is the amount of water in the tank increasing or decreasing at $t = 1$? Give a reason for your answer.

(d) The tank holds up to 300 gallons of water. For $t > 2$, water continues to be poured into the tank at a rate of $W(t)$. However, water leaks out of the tank at a constant rate of 1.02 gallons per hour. Set up, but do not evaluate, an equation involving one or more integrals that could be used to find the time w when the tank first becomes full.

4. The number of a particular species of rabbits, in hundreds, in a wooded area is modeled by a differentiable function R of time t, where $R(t)$ is the number of rabbits, in hundreds, and t is measured in months, for $0 \leq t \leq 50$. There are 1500 rabbits in the wooded area at time $t = 0$. The birth rate for the rabbits in the wooded area is modeled by $B(t) = 1.3\ln(t+1)$ hundreds of rabbits per month and the death rate for the rabbits in the wooded area is modeled by $D(t) = \frac{5}{1+52e^{-0.3t}} - \frac{5}{53}$ hundreds of rabbits per month.

(a) Is the population of rabbits in the wooded area increasing or decreasing at time $t = 10$? Explain your reasoning.

(b) To the nearest whole number, what is the population of rabbits in the wooded area at time $t = 50$?

(c) To the nearest whole number, determine the maximum and minimum population of rabbits in the wooded area for $0 \leq t \leq 50$. Justify your answer.

(d) On what interval(s), for $0 \leq t \leq 50$, is the population of rabbits in the wooded area increasing? Give a reason for your answer.