

AP[®] CALCULUS AB 2002 SCORING GUIDELINES

Question 2

The rate at which people enter an amusement park on a given day is modeled by the function E defined by

$$E(t) = \frac{15600}{(t^2 - 24t + 160)}.$$

The rate at which people leave the same amusement park on the same day is modeled by the function L defined by

$$L(t) = \frac{9890}{(t^2 - 38t + 370)}.$$

Both $E(t)$ and $L(t)$ are measured in people per hour and time t is measured in hours after midnight. These functions are valid for $9 \leq t \leq 23$, the hours during which the park is open. At time $t = 9$, there are no people in the park.

- (a) How many people have entered the park by 5:00 P.M. ($t = 17$)? Round answer to the nearest whole number.
- (b) The price of admission to the park is \$15 until 5:00 P.M. ($t = 17$). After 5:00 P.M., the price of admission to the park is \$11. How many dollars are collected from admissions to the park on the given day? Round your answer to the nearest whole number.
- (c) Let $H(t) = \int_9^t (E(x) - L(x)) dx$ for $9 \leq t \leq 23$. The value of $H(17)$ to the nearest whole number is 3725. Find the value of $H'(17)$ and explain the meaning of $H(17)$ and $H'(17)$ in the context of the park.
- (d) At what time t , for $9 \leq t \leq 23$, does the model predict that the number of people in the park is a maximum?

(a) $\int_9^{17} E(t) dt = 6004.270$
6004 people entered the park by 5 pm.

(b) $15 \int_9^{17} E(t) dt + 11 \int_{17}^{23} E(t) dt = 104048.165$

The amount collected was \$104,048.

or

$$\int_{17}^{23} E(t) dt = 1271.283$$

1271 people entered the park between 5 pm and

11 pm, so the amount collected was

$$\$15 \cdot (6004) + \$11 \cdot (1271) = \$104,041.$$

(c) $H'(17) = E(17) - L(17) = -380.281$

There were 3725 people in the park at $t = 17$.

The number of people in the park was decreasing at the rate of approximately 380 people/hr at time $t = 17$.

(d) $H'(t) = E(t) - L(t) = 0$
 $t = 15.794$ or 15.795

$$\left\{ \begin{array}{l} 1 : \text{limits} \\ 3 \left\{ \begin{array}{l} 1 : \text{integrand} \\ 1 : \text{answer} \end{array} \right. \end{array} \right.$$

1 : setup

$$\left\{ \begin{array}{l} 1 : \text{value of } H'(17) \\ 2 : \text{meanings} \\ 3 \left\{ \begin{array}{l} 1 : \text{meaning of } H(17) \\ 1 : \text{meaning of } H'(17) \\ < -1 > \text{ if no reference to } t = 17 \end{array} \right. \end{array} \right.$$

$$2 \left\{ \begin{array}{l} 1 : E(t) - L(t) = 0 \\ 1 : \text{answer} \end{array} \right.$$