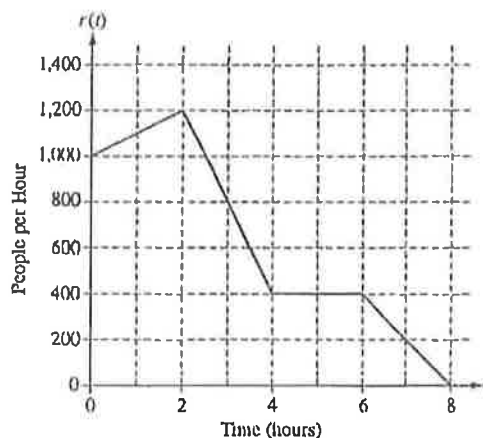


**AP<sup>®</sup> CALCULUS AB**  
**2010 SCORING GUIDELINES**

**Question 3**

There are 700 people in line for a popular amusement-park ride when the ride begins operation in the morning. Once it begins operation, the ride accepts passengers until the park closes 8 hours later. While there is a line, people move onto the ride at a rate of 800 people per hour. The graph above shows the rate,  $r(t)$ , at which people arrive at the ride throughout the day. Time  $t$  is measured in hours from the time the ride begins operation.



- (a) How many people arrive at the ride between  $t = 0$  and  $t = 3$ ? Show the computations that lead to your answer.
- (b) Is the number of people waiting in line to get on the ride increasing or decreasing between  $t = 2$  and  $t = 3$ ? Justify your answer.
- (c) At what time  $t$  is the line for the ride the longest? How many people are in line at that time? Justify your answers.
- (d) Write, but do not solve, an equation involving an integral expression of  $r$  whose solution gives the earliest time  $t$  at which there is no longer a line for the ride.

(a)  $\int_0^3 r(t) dt = 2 \cdot \frac{1000 + 1200}{2} + \frac{1200 + 800}{2} = 3200$  people

2 :  $\begin{cases} 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$

- (b) The number of people waiting in line is increasing because people move onto the ride at a rate of 800 people per hour and for  $2 < t < 3$ ,  $r(t) > 800$ .

1 : answer with reason

- (c)  $r(t) = 800$  only at  $t = 3$   
For  $0 \leq t < 3$ ,  $r(t) > 800$ . For  $3 < t \leq 8$ ,  $r(t) < 800$ .  
Therefore, the line is longest at time  $t = 3$ .  
There are  $700 + 3200 - 800 \cdot 3 = 1500$  people waiting in line at time  $t = 3$ .

3 :  $\begin{cases} 1 : \text{identifies } t = 3 \\ 1 : \text{number of people in line} \\ 1 : \text{justification} \end{cases}$

(d)  $0 = 700 + \int_0^t r(s) ds - 800t$

3 :  $\begin{cases} 1 : 800t \\ 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$