AP® Calculus AB
2002 Sample Student Responses

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Work for problem 2(a)

$$\int_9^{17} E(t)\,dt = \int_9^{17} 15600/(t^2-24t+160)\,dt = 6004.27$$

$\approx$ 6004 people

Work for problem 2(b)

$$\int_9^{23} \left(\frac{15600}{t^2-24t+160}\right) dt = \text{TOTAL ENTERED}$$

$= 7275.55 \approx 7276$ people

7276

$-\ 6004$

AFTER 5 → 1272 BEFORE 5 6004

$\times\ \$11$ $\times\ \$15$

$\$13,992 + \$90,060 = \$104,052$ made on the given day

Work for problem 2(c)

$$H(17) = \int_9^{17} \left(\frac{15600}{t^2 - 24t + 160}\right) - \left(\frac{9890}{t^2 - 38t + 370}\right) dt = 3725$$

$$H'(17) = \left(\frac{15600}{(17^2) - 24(17) + 160}\right) - \frac{9890}{(17^2 - 38(17) + 370)}$$

$$= 380 - 760$$

$H'(17) = -380 \longrightarrow$ This is the rate of change at 5 o'clock that people are entering the park compared to those leaving the park more people leaving than entering at $t = 17$

$H(17) = 3725 \longrightarrow$ This is the amount of people instantaneously at the park.

Work for problem 2(d)

$$H'(t) = \frac{15600}{(t^2 - 24t + 160)} - \frac{9890}{t^2 - 38t + 370} = 0$$

$$t = 15.7948$$

Work for problem 2(a)

$$\int_9^{17} \frac{15600}{(t^2-24t+160)}\,dt = 6004 \text{ people}$$

Work for problem 2(b)

$$15\int_9^{17} \frac{15600}{(t^2-24t+160)}\,dt + 11\int_{17}^{23} \frac{4890}{(t^2-38t+370)}\,dt$$

$$90064 + 54950$$

$$\approx 145{,}014$$

Work for problem 2(c)

$H'(t) = E(t) - L(t)$

$H'(17) = 380.4878 - 760.7692$

$H'(17) = -452.2814$

$H(17)$ represents the number of people in the park at $t = 17$. $H'(17)$ represents the rate at which the population of the park is changing at $t = 17$

Work for problem 2(d)

$E(t) - L(t) = 0$

$\frac{15600}{(t^2 - 21t + 160)} - \frac{9840}{t^2 - 38t + 370} = 0; t = 15.79481$