**CALCULUS AB**
**SECTION II, Part A**
**Time—45 minutes**
**Number of problems—3**

**A graphing calculator is required for some problems or parts of problems.**

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1. Let $f$ and $g$ be the functions given by $f(x) = e^x$ and $g(x) = \ln x$.

   (a) Find the area of the region enclosed by the graphs of $f$ and $g$ between $x = \dfrac{1}{2}$ and $x = 1$.

   (b) Find the volume of the solid generated when the region enclosed by the graphs of $f$ and $g$ between $x = \dfrac{1}{2}$ and $x = 1$ is revolved about the line $y = 4$.

   (c) Let $h$ be the function given by $h(x) = f(x) - g(x)$. Find the absolute minimum value of $h(x)$ on the closed interval $\dfrac{1}{2} \le x \le 1$, and find the absolute maximum value of $h(x)$ on the closed interval $\dfrac{1}{2} \le x \le 1$. Show the analysis that leads to your answers.

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

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

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

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

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 your 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 amusement 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?

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