

|                                |   |     |      |     |      |     |
|--------------------------------|---|-----|------|-----|------|-----|
| $t$<br>(seconds)               | 0 | 60  | 90   | 120 | 135  | 150 |
| $f(t)$<br>(gallons per second) | 0 | 0.1 | 0.15 | 0.1 | 0.05 | 0   |

1. A customer at a gas station is pumping gasoline into a gas tank. The rate of flow of gasoline is modeled by a differentiable function  $f$ , where  $f(t)$  is measured in gallons per second and  $t$  is measured in seconds since pumping began. Selected values of  $f(t)$  are given in the table.

- (a) Using correct units, interpret the meaning of  $\int_{60}^{135} f(t) dt$  in the context of the problem. Use a right

Riemann sum with the three subintervals  $[60, 90]$ ,  $[90, 120]$ , and  $[120, 135]$  to approximate the value of

$$\int_{60}^{135} f(t) dt.$$

- (b) Must there exist a value of  $c$ , for  $60 < c < 120$ , such that  $f'(c) = 0$ ? Justify your answer.

- (c) The rate of flow of gasoline, in gallons per second, can also be modeled by  $g(t) = \left(\frac{t}{500}\right) \cos\left(\left(\frac{t}{120}\right)^2\right)$  for

$0 \leq t \leq 150$ . Using this model, find the average rate of flow of gasoline over the time interval  $0 \leq t \leq 150$ .

Show the setup for your calculations.

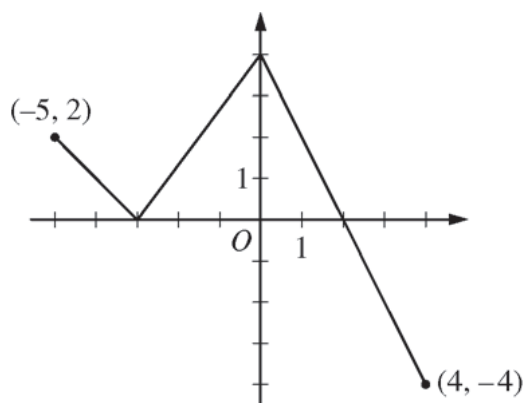
- (d) Using the model  $g$  defined in part (c), find the value of  $g'(140)$ . Interpret the meaning of your answer in the context of the problem.

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**Write your responses to this question only on the designated pages in the separate Free Response booklet. Write your solution to each part in the space provided for that part.**

**CALCULUS BC**  
**SECTION II, Part B**  
**Time—60 minutes**  
**Number of problems—4**

**No calculator is allowed for these problems.**



Graph of  $f$

3. The function  $f$  is defined on the closed interval  $[-5, 4]$ . The graph of  $f$  consists of three line segments and is shown in the figure above. Let  $g$  be the function defined by  $g(x) = \int_{-3}^x f(t) dt$ .
- (a) Find  $g(3)$ .
- (b) On what open intervals contained in  $-5 < x < 4$  is the graph of  $g$  both increasing and concave down? Give a reason for your answer.
- (c) The function  $h$  is defined by  $h(x) = \frac{g(x)}{5x}$ . Find  $h'(3)$ .
- (d) The function  $p$  is defined by  $p(x) = f(x^2 - x)$ . Find the slope of the line tangent to the graph of  $p$  at the point where  $x = -1$ .
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