

**2015 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS****CALCULUS AB  
SECTION II, Part B  
Time—60 minutes  
Number of problems—4**

No calculator is allowed for these problems.

$t$ (minutes)	0	12	20	24	40
$v(t)$ (meters per minute)	0	200	240	-220	150

3. Johanna jogs along a straight path. For  $0 \leq t \leq 40$ , Johanna's velocity is given by a differentiable function  $v$ . Selected values of  $v(t)$ , where  $t$  is measured in minutes and  $v(t)$  is measured in meters per minute, are given in the table above.

(a) Use the data in the table to estimate the value of  $v'(16)$ .

(b) Using correct units, explain the meaning of the definite integral  $\int_0^{40} |v(t)| dt$  in the context of the problem.

Approximate the value of  $\int_0^{40} |v(t)| dt$  using a right Riemann sum with the four subintervals indicated in the table.

(c) Bob is riding his bicycle along the same path. For  $0 \leq t \leq 10$ , Bob's velocity is modeled by

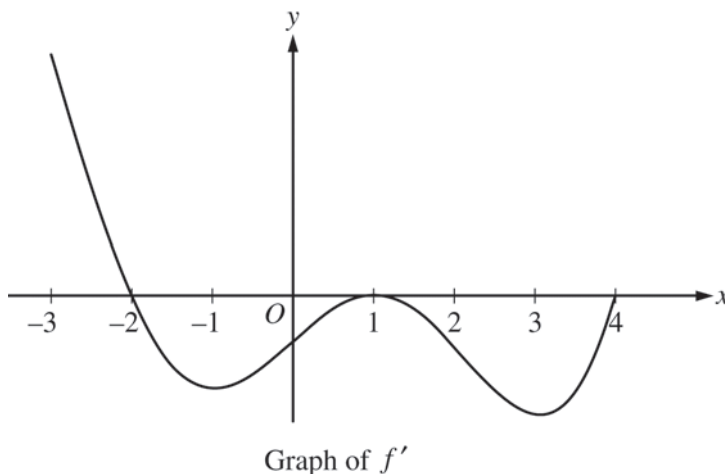
$$B(t) = t^3 - 6t^2 + 300, \text{ where } t \text{ is measured in minutes and } B(t) \text{ is measured in meters per minute.}$$

Find Bob's acceleration at time  $t = 5$ .

(d) Based on the model  $B$  from part (c), find Bob's average velocity during the interval  $0 \leq t \leq 10$ .

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5. The figure above shows the graph of  $f'$ , the derivative of a twice-differentiable function  $f$ , on the interval  $[-3, 4]$ . The graph of  $f'$  has horizontal tangents at  $x = -1$ ,  $x = 1$ , and  $x = 3$ . The areas of the regions bounded by the  $x$ -axis and the graph of  $f'$  on the intervals  $[-2, 1]$  and  $[1, 4]$  are 9 and 12, respectively.
- Find all  $x$ -coordinates at which  $f$  has a relative maximum. Give a reason for your answer.
  - On what open intervals contained in  $-3 < x < 4$  is the graph of  $f$  both concave down and decreasing? Give a reason for your answer.
  - Find the  $x$ -coordinates of all points of inflection for the graph of  $f$ . Give a reason for your answer.
  - Given that  $f(1) = 3$ , write an expression for  $f(x)$  that involves an integral. Find  $f(4)$  and  $f(-2)$ .
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