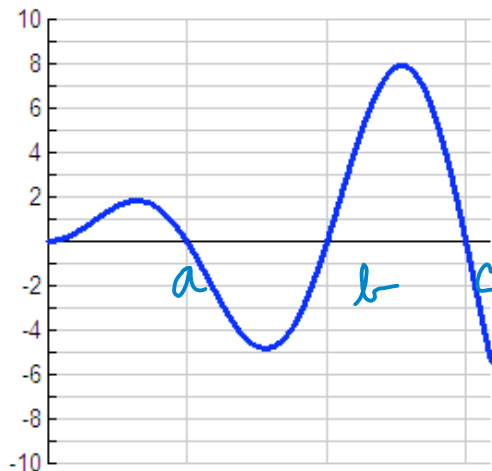


**My Chapter 3 Take-Home Project**

[All work/steps must be shown]

I, \_\_\_\_\_, claim that all work on this project is my own and that I have received NO help from anyone living, dead, or undead.

\_\_\_\_\_ [my signature]



GRAPH of  $f'$

1.

The graph of  $f'(x)$ , the derivative of a continuous function  $f$ , is shown above.

- (a) On the closed interval  $[a, b]$  where does the graph of  $f$  have critical values? [Explain fully]
  
  
  
  
  
  
  
  
  
  
- (b) On the open interval  $(0, c)$  where does the graph of  $f$  have any relative extrema. [Explain fully]

2. Let  $f(x)$  be the function defined by  $f(x) = k + 12x + 3x^2 - 2x^3$ , where  $k$  is a constant.

(a) On what interval is the function increasing? Justify your answer.

(b) If the relative maximum value of  $f$  is 4, then what is the value of  $k$ ? [Justify]

(c) Find the interval where the function  $f$  is concave up. [Justify]

3. Let  $g$  be a twice-differentiable function such that  $g(3) = 7$  and  $g(7) = 3$ .

Let  $h$  be the function given by  $h(x) = g(g(x))$ .

(a) Explain why there must be a value  $c$ ,  $3 < c < 7$ , such that  $h'(c) = 1$

(b) Show that  $h'(3) = h'(7)$ . Use this result to explain why there must be a value  $k$ ,  $3 < k < 7$ , such that  $h''(k) = 0$

4. It took 20 seconds for the temperature to rise from  $0^\circ F$  to  $212^\circ F$  when a thermometer was taken from a freezer and placed in boiling water. Explain [using Calculus] why at some moment in that interval the mercury in the thermometer was rising at exactly  $10.6^\circ F / \text{sec}$ .

5. A particle moves along a horizontal line with positive velocity  $v(t)$  where  $v$  is a differentiable function of time  $t$ . The velocity of the particle at selected times is given in the table below.

$t$ (sec)	0	2	4	6	8	10	12
$v(t)$ (cm/sec)	37	17	5	1	6	17	38

(a) Find the average acceleration of the particle over the time interval  $8 \leq t \leq 10$  seconds.

(b) Estimate a value for  $a(5)$ . Show correct units.

(c) Based on the values in the table, what is the smallest number of times at which the acceleration of the particle could equal zero on the open interval  $0 < t < 12$  seconds.

6. Sketch a continuous curve  $y = f(x)$  with the properties listed below. Label coordinates where possible.

$x$	$f(x)$	Properties
$x < 2$		$f' < 0, f'' > 0$
2	1	$f' = 0$
$2 < x < 4$		$f' > 0, f'' > 0$
4	4	$f'' = 0$
$4 < x < 6$		$f' > 0, f'' < 0$
6	7	$f' = 0$
$x > 6$		$f' < 0, f'' < 0$