

8. The function  $f$  is twice differentiable with  $f(3) = 8$ ,  $f'(3) = 22$ , and  $f''(3) = 18$ . What is the value of the approximation of  $f(2.9)$  using the line tangent to the graph of  $f$  at  $x = 3$ ?

(A) 5.5 (B) 5.8  
(C) 5.9 (D) 6.1

**Section 1, Part B, Multiple Choice, Technology Permitted**

9. Let  $f(x) = x^3 + 4x^2 + 3x - \cos x$ . For what value(s) of  $x$  does the graph of  $f$  have a point of inflection?

(A)  $-1.500$  only (B)  $-1.367$  only  
(C)  $-1.287$  only (D)  $-2.342$  and  $-0.383$

10.  $\lim_{x \rightarrow \infty} \frac{x^3}{\sqrt{x^2 + 4}}$  is

(A)  $-\infty$ . (B) 0.  
(C) 4. (D)  $\infty$ .

**Section 2, Part A, Free Response, Technology Permitted**

11. Consider the function  $f(x) = \frac{1}{2}x^3 - \sin x + 1$ .

- (a) Approximate the relative extrema of  $f$ .  
(b) Find the tangent line approximation of  $f$  at  $x = \pi/2$ .  
(c) Use your tangent line approximation to approximate the value of  $f(1.5)$ . Is your approximation an underestimate or an overestimate of the actual value of  $f(1.5)$ ? Justify your answer.

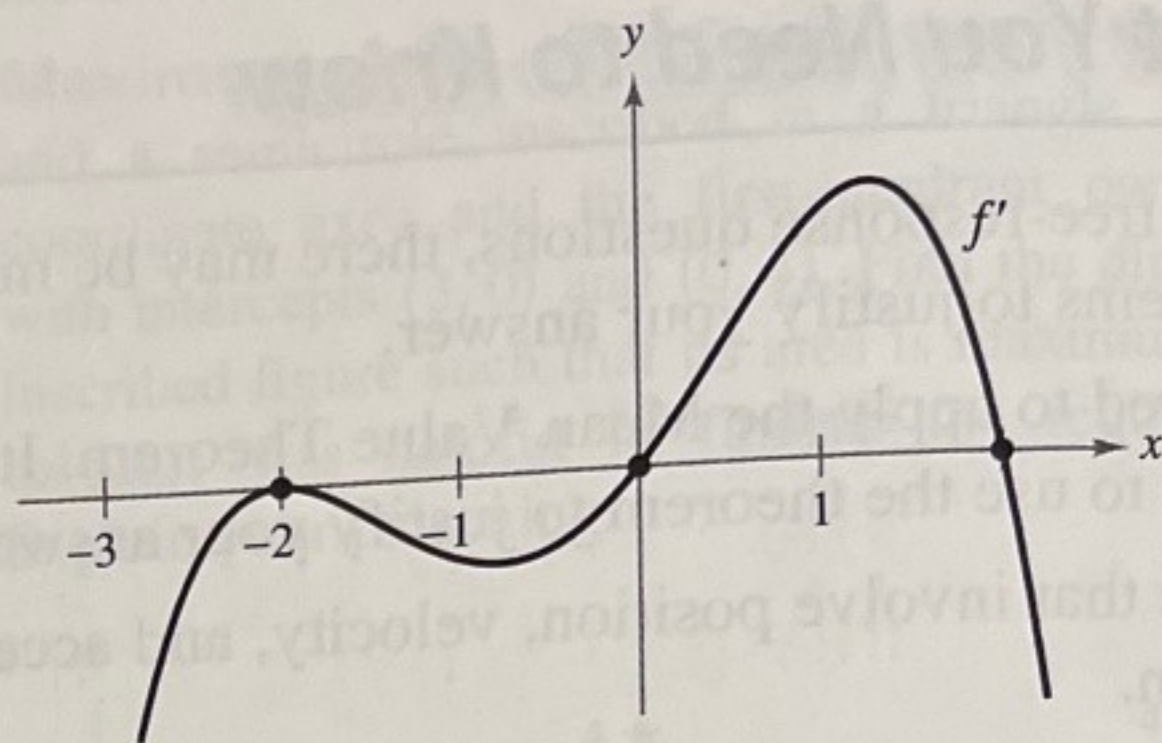
**Section 2, Part B, Free Response, No Technology**

12. The table shows the behavior of a function  $f$  that is continuous on the entire real number line with  $f(2) = 4$  and  $\lim_{x \rightarrow \infty} f(x) = 0$ .

	$x < 4$	$x = 4$	$x > 4$
$f'(x)$	positive	does not exist	negative
$f''(x)$	negative	does not exist	positive

- (a) For what values of  $x$  is  $f$  increasing? Justify your answer.  
(b) Does  $f$  have a relative maximum at  $x = 4$ ? Explain.  
(c) If possible, find the  $x$ -coordinate of each inflection point of the graph of  $f$ . Justify your answer.  
(d) Does the Mean Value Theorem apply over the interval  $[3, 5]$ ? Justify your answer.  
(e) Sketch a possible graph of  $f$ .

13.



The figure above shows the graph of  $f'$ , the derivative of  $f$ . The function  $f$  is a twice differentiable function on the entire real number line with  $f''(-0.8) = 0$  and  $f''(1.3) = 0$ .

- (a) For what values of  $x$  is  $f$  increasing?  
(b) For what values of  $x$  is the graph of  $f$  concave downward? Justify your answer.

(c) Is

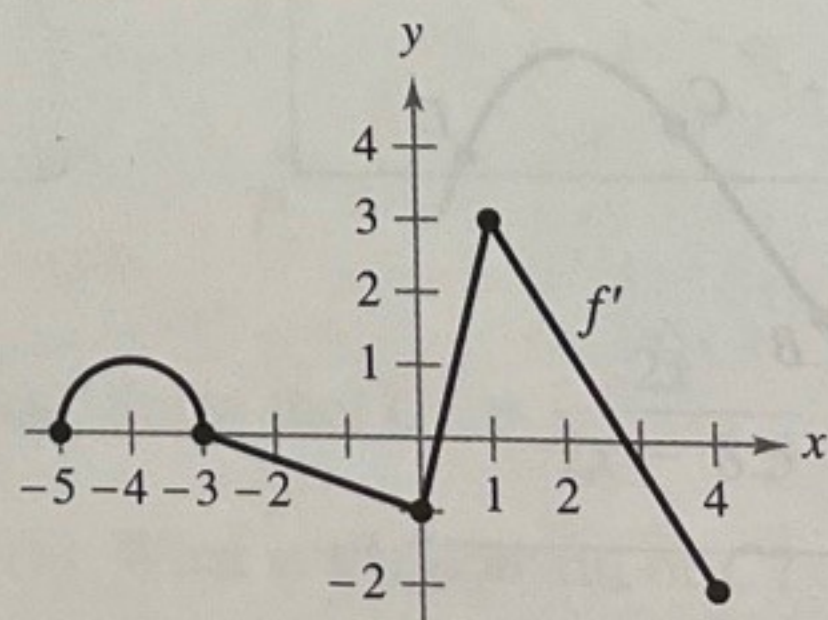
$$\frac{f(-0.5) - f(0)}{-0.5 - 0}$$

positive or negative? Justify your answer.

14. Consider the function  $f(x) = \frac{1 - 4x^2}{x}$ .

- (a) For what values of  $x$  is  $f$  decreasing?  
(b) For what values of  $x$  is the graph of  $f$  concave downward? Justify the answer.  
(c) Does the graph of  $f$  have any points of inflection? Justify your answer.

15.



The figure above shows the graph of  $f'$ , the derivative of  $f$ , on the interval  $[-5, 4]$ . The function  $f$  is differentiable on the interval and  $f''(-4) = 0$ .

- (a) Find  $f'(-1)$  and  $f''(-1)$ .  
(b) Identify the relative extrema of  $f$  on the interval  $(-5, 0)$ . Justify your answer.  
(c) Find the  $x$ -coordinate of each inflection point of the graph of  $f$ . Justify your answer.  
(d) Given  $g(x) = f(x) + \sin^2 x$ , is  $g$  increasing or decreasing at  $x = -\pi/4$ ? Justify your answer.