

Extrema: AP M.C. No Calc

1 What are all values of  $x$  for which the function  $f$  defined by  $f(x) = x^3 + 3x^2 - 9x + 7$  is increasing?

- (A)  $-3 < x < 1$
- (B)  $-1 < x < 1$
- (C)  $x < -3$  or  $x > 1$
- (D)  $x < -1$  or  $x > 3$
- (E) All real numbers

2 If  $g$  is a differentiable function such that  $g(x) < 0$  for all real numbers  $x$  and if  $f(x) = (x^2 - 4)g(x)$ , which of the following is true?

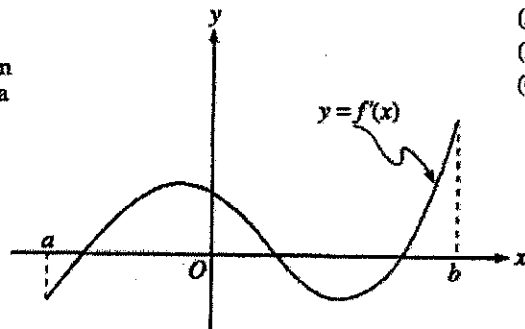
- (A)  $f$  has a relative maximum at  $x = -2$  and a relative minimum at  $x = 2$ .
- (B)  $f$  has a relative minimum at  $x = -2$  and a relative maximum at  $x = 2$ .
- (C)  $f$  has relative minima at  $x = -2$  and at  $x = 2$ .
- (D)  $f$  has relative maxima at  $x = -2$  and at  $x = 2$ .
- (E) It cannot be determined if  $f$  has any relative extrema.

3 The function  $f$  is given by  $f(x) = x^4 + x^2 - 2$ . On which of the following intervals is  $f$  increasing?

- (A)  $(-\frac{1}{\sqrt{2}}, \infty)$
- (B)  $(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$
- (C)  $(0, \infty)$
- (D)  $(-\infty, 0)$
- (E)  $(-\infty, -\frac{1}{\sqrt{2}})$

4 The graph of  $f'$ , the derivative of  $f$ , is shown in the figure above. Which of the following describes all relative extrema of  $f$  on the open interval  $(a, b)$ ?

- (A) One relative maximum and two relative minima
- (B) Two relative maxima and one relative minimum
- (C) Three relative maxima and one relative minimum
- (D) One relative maximum and three relative minima
- (E) Three relative maxima and two relative minima



5 The function  $f$  given by  $f(x) = 3x^5 - 4x^3 - 3x$  has a relative maximum at  $x =$

- (A)  $-1$
- (B)  $-\frac{\sqrt{5}}{5}$
- (C)  $0$
- (D)  $\frac{\sqrt{5}}{5}$
- (E)  $1$

6 What are all values of  $x$  for which the function  $f$  defined by  $f(x) = (x^2 - 3)e^{-x}$  is increasing?

- (A) There are no such values of  $x$ .
- (B)  $x < -1$  and  $x > 3$
- (C)  $-3 < x < 1$
- (D)  $-1 < x < 3$
- (E) All values of  $x$

7 If  $f(x) = x^2e^x$ , then the graph of  $f$  is decreasing for all  $x$  such that

- (A)  $x < -2$
- (B)  $-2 < x < 0$
- (C)  $x > -2$
- (D)  $x < 0$
- (E)  $x > 0$

8 If  $f(x) = 1 + x^{\frac{2}{3}}$ , which of the following is NOT true?

- (A)  $f$  is continuous for all real numbers.
- (B)  $f$  has a minimum at  $x = 0$ .
- (C)  $f$  is increasing for  $x > 0$ .
- (D)  $f'(x)$  exists for all  $x$ .
- (E)  $f''(x)$  is negative for  $x > 0$ .

9 How many critical points does the function  $f(x) = (x+2)^5(x-3)^4$  have?

- (A) One
- (B) Two
- (C) Three
- (D) Five
- (E) Nine

10 If  $f(x) = \frac{\ln x}{x}$ , for all  $x > 0$ , which of the following is true?

- (A)  $f$  is increasing for all  $x$  greater than 0.
- (B)  $f$  is increasing for all  $x$  greater than 1.
- (C)  $f$  is decreasing for all  $x$  between 0 and 1.
- (D)  $f$  is decreasing for all  $x$  between 1 and  $e$ .
- (E)  $f$  is decreasing for all  $x$  greater than  $e$ .

11 For what value of  $k$  will  $x + \frac{k}{x}$  have a relative maximum at  $x = -2$ ?

- (A)  $-4$
- (B)  $-2$
- (C)  $2$
- (D)  $4$
- (E) None of these