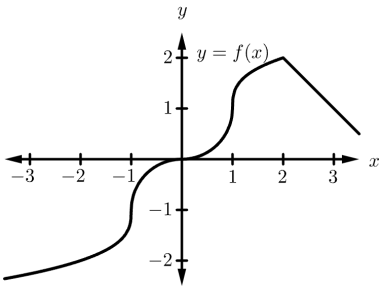
1)



The graph of the function f shown in the figure above has vertical tangents at $(-1,-1)$ and $(1,1)$, and a horizontal tangent at $(0,0)$. For what values of x, $-3 < x < 3$, is f not differentiable?

(A) 2 only

(B) 0 and 2 only

(C) -1 and 1 only

(D) -1, 1, and 2 only

(E) -1, 0, 1, and 2

2) $\lim_{n\to\infty} \dfrac{3n^3 - 5n}{n^3 - 2n^2 + 1}$ is

(A) -5 (B) -2 (C) 1 (D) 3 (E) nonexistent

3) $\lim_{x\to 0} \dfrac{5x^4 + 8x^2}{3x^4 - 16x^2}$ is

(A) $-\dfrac{1}{2}$ (B) 0 (C) 1 (D) $\dfrac{5}{3}$ (E) nonexistent

4) If f is a continuous function defined by $f(x) = \begin{cases} x^2 + bx, & x \le 5 \\ x, & x > 5 \end{cases}$ then $b =$

(A) -6

(B) -5

(C) -4

(D) 4

(E) 5

5) If $y = 7$ is a horizontal asymptote of a rational function f, then which of the following must be true?

(A) $\lim_{x \to 7} f(x) = \infty$

(B) $\lim_{x \to -\infty} f(x) = -7$

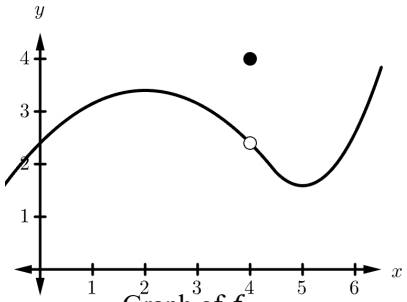
(C) $\lim_{x \to 0} f(x) = 7$

(D) $\lim_{x \to 7} f(x) = 0$

(E) $\lim_{x \to \infty} f(x) = 7$

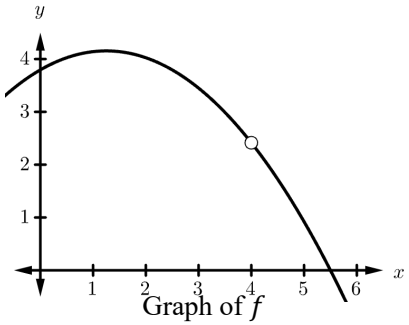
6) For which of the following does $\lim_{x \to 4} f(x)$ exist?

I.



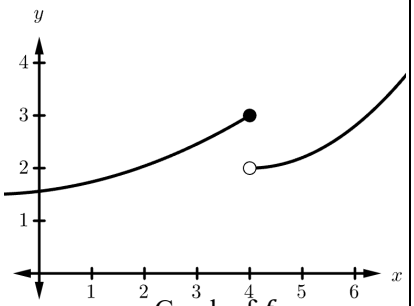
Graph of f

II.



Graph of f

III.



Graph of f

(A) I only

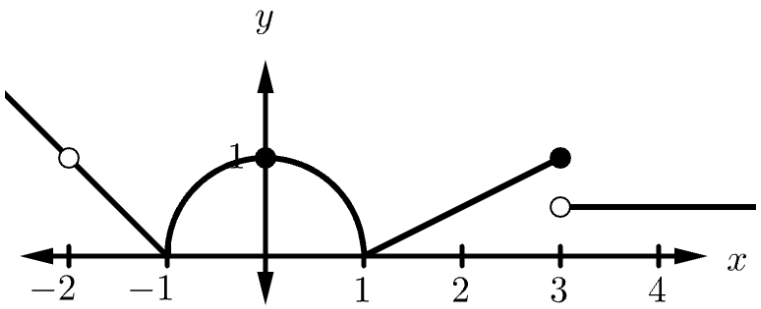
(B) II only

(C) III only

(D) I and II only

(E) I and III only

7)



Graph of f

The graph of a function f is shown above. For which of the following values of c does $\lim_{x \to c} f(x) = 1$?

(A) 0 only

(B) 0 and 3 only

(C) -2 and 0 only

(D) -2 and 3 only

(E) $-2, 0$, and 3

8) If f is a continuous function on the closed interval $[a, b]$, which of the following must be true?

(A) There is a number c in the open interval (a, b) such that $f(c) = 0$.

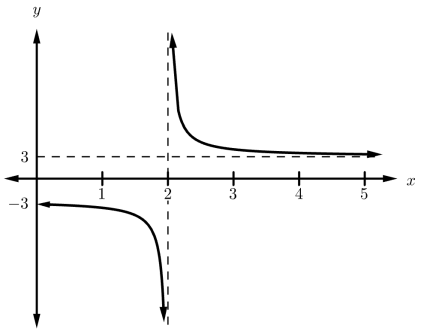
(B) There is a number c in the open interval (a, b) such that $f(a) < f(c) < f(b)$.

(C) There is a number c in the closed interval $[a, b]$ such that $f(c) \geq f(x)$ for all x in $[a, b]$.

(D) There is a number c in the open interval (a, b) such that $f'(c) = 0$

(E) There is a number c in the open interval (a, b) such that $f'(c) = \frac{f(b)-f(a)}{b-a}$

9)



The function f is given by $f(x) = \frac{ax^2+12}{x^2+b}$. The figure above shows a portion of the graph of f. Which of the following could be values of the constants a and b ?

(A) $a = -3, b = 2$

(B) $a = 2, b = -3$

(C) $a = 2, b = -2$

(D) $a = 3, b = -4$

(E) $a = 3, b = 4$

10) If $a \neq 0$, then $\lim_{x \to a} \frac{x^2 - a^2}{x^4 - a^4}$ is

(A) $\frac{1}{a^2}$ (B) $\frac{1}{2a^2}$ (C) $\frac{1}{6a^2}$ (D) 0 (E) nonexistent

11) If $\lim_{x \to a} f(x) = L$, where L is a real number, which of the following must be true?

(A) $f'(a)$ exists

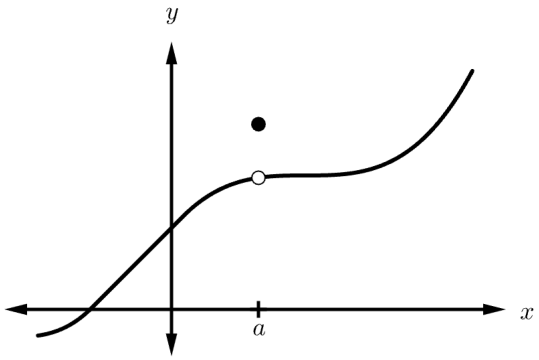
(B) $f(x)$ is continuous at $x = a$

(C) $f(x)$ is defined at $x = a$

(D) $f(a) = L$

(E) None of the above

12)



The graph of a function f is shown above. Which of the following statements about f is false?

(A) f is continuous at $x = a$

(B) $x = a$ is in the domain of f

(C) $\lim_{x \to a^+} f(x)$ is equal to $\lim_{x \to a^-} f(x)$

(D) $\lim_{x \to a} f(x)$ exists

13) What is the average rate of change of the function f given by $f(x) = x^4 - 5x$ on the closed interval $[0,3]$?

(A) 8.5

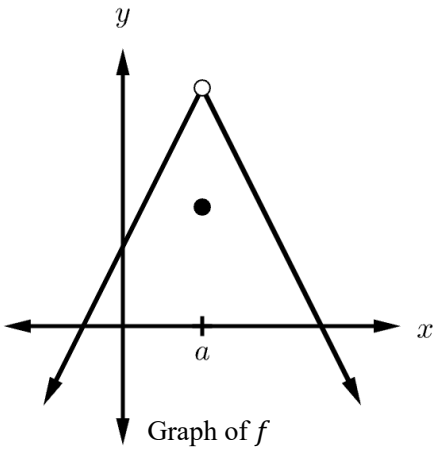
(B) 8.7

(C) 22

(D) 33

(E) 66

14)



Graph of f

The graph of the function f is shown above. Which of the following statements must be false?

(A) $f(a)$ exists

(B) $f(x)$ is defined for $0 < x < a$

(C) f is not continuous at $x = a$

(D) $\lim_{x \to a} f(x)$ exists

(E) $\lim_{x \to a^-} f(x) \neq f(a)$

15)

x	0	1	2	3	4
$f(x)$	2	3	4	3	2

The function f is continuous and differentiable on the closed interval $[0,4]$. The table above gives selected values of f on this interval. Which of the following statements must be true?

(A) The minimum value of f on $[0,4]$ is 2

(B) The maximum value of f on $[0,4]$ is 4

(C) $f(x) > 0$ for $0 < x < 4$

(D) The slope is negative for $2 < x < 4$

(E) There exists c, with $0 < c < 4$, for which $f'(c) = 0$

16) The function f is given by $f(x) = \begin{cases} \ln 2x, & x < 2 \\ 2\ln x, & x \geq 2 \end{cases}$

The limit $\lim_{x \to 2} f(x)$ is

(A) 0

(B) $\frac{1}{2}$

(C) 1

(D) $2\ln 2$

(E) nonexistent

17) Let f be a continuous function on the closed interval $[-3,6]$.

If $f(-3) = -1$ and $f(6) = 3$, then the Intermediate Value Theorem guarantees that

(A) $f(0) = 0$

(B) $f'(c) = \frac{4}{9}$ for at least one c between -3 and 6

(C) $-1 \leq f(x) \leq 3$ for all x between -3 and 6

(D) $f(x) = 1$ for at least one c between -3 and 6

(E) $f(c) = 0$ for at least one c between -1 and 3

18) $\lim_{x \to \infty} \dfrac{x - \frac{1}{2x}}{2x + \frac{1}{6x}}$ is

(A) -3

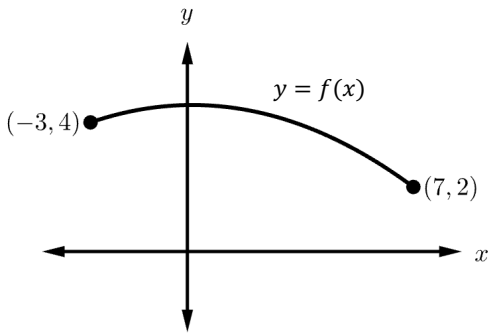
(B) $-\frac{1}{2}$

(C) $-\frac{1}{3}$

(D) $\frac{1}{2}$

(E) 2

19)



The graph of $y = f(x)$ on the closed interval $[-3,7]$ is shown in the figure above. If f is continuous on $[-3,7]$ and differentiable on $(-3,7)$, then there exists a c, $-3 < c < 7$, such that

(A) $f(c) = 0$

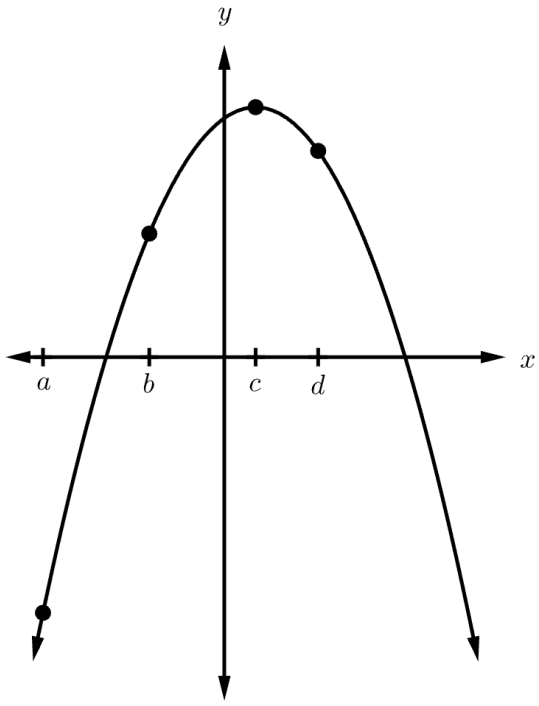
(B) $f'(c)$ is undefined

(C) $f'(c) = \frac{1}{5}$

(D) $f'(c) = -\frac{1}{5}$

(E) $f'(c) = -5$

20)



The figure above shows the graph of a continuous function f. Which of the following has the greatest value?

(A) $f(a)$ (B) $f'(a)$ (C) $f'(c)$ (D) $f(d) - f(c)$ (E) $\frac{f(b)-f(a)}{b-a}$