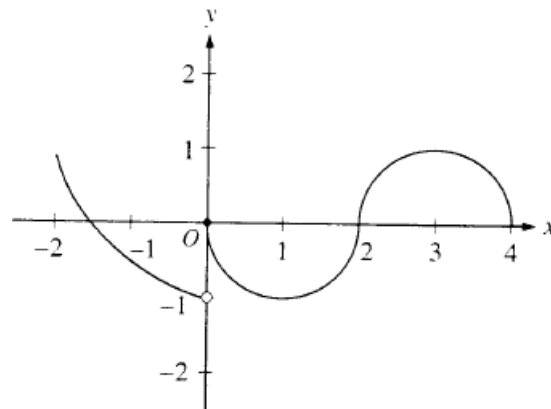


AB Calculus Practice 2.1
Intermediate, Mean, and Extreme Value Theorems

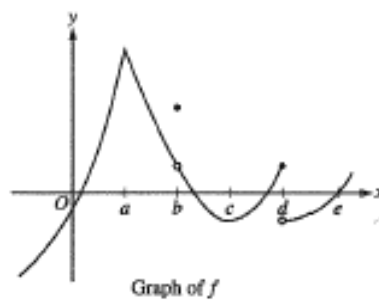
1. If you can draw a function without picking up your pencil, it's probably _____.
2. All _____ functions are _____, but not all _____ functions are _____.
3. For a function to be differentiable, it can't have any _____, _____, _____, nor any _____.
4. The Intermediate Value Theorem applies only to all _____ functions.
5. The Mean Value Theorem applies only to all _____ functions, which means they're also _____ functions.
6. The Extreme Value Theorem applies only to all _____ functions.
7. The Mean Value Theorem says that for any interval, there must be at least one point at which the _____ slope matches the _____ slope on the interval.
8. The average slope on an interval bound by $[x_1, x_2]$ is found with the formula _____.
9. A _____ line is a straight line between two points.
10. A _____ line is a straight line which matches the instantaneous slope at one point.
11. The Mean Value Theorem says the _____ and _____ lines will be _____ at least once.
12. The Extreme Value Theorem says on a closed interval, any _____ function will have an absolute _____ and an absolute _____ value.

13. Extrema frequently (but don't always) occur when the first derivative is equal to _____.

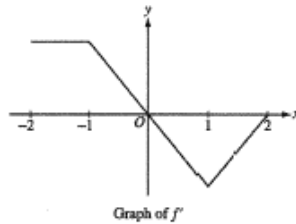
14. If the first derivative is never equal to zero, the absolute extrema will be at the _____ of the interval.



7. The graph of the function f shown in the figure above has a vertical tangent at the point $(2, 0)$ and horizontal tangents at the points $(1, -1)$ and $(3, 1)$. For what value(s) of x , $-2 < x < 4$, is f not differentiable?



8. In the above graph of $f(x)$, for which value of x is f continuous, but not differentiable?



9. The graph of f' , the derivative of the function f , is shown above. Which of the following statements is false about f ?

- (A) f has a local maximum at $x = 0$
- (B) f is differentiable at $x = -1$ and $x = 1$
- (C) f is decreasing for $0 \leq x \leq 2$
- (D) f is increasing for $1 \leq x \leq 2$
- (E) f is increasing for $-2 \leq x \leq 0$

10. Let f be a function that is differentiable on the open interval $(1, 10)$. If $f(1) = -4$, $f(5) = 5$, and $f(2) = 1$, which of the following must be true? *Circle all that apply*

- I. f has at least 2 zeros.
- II. The graph of f has at least one horizontal tangent.
- III. For some c , $2 < c < 5$, $f(c) = 3$.

11. The function f is defined by $f(x) = 2x^3 - 4x^2 + 1$. The application of the Mean Value Theorem to f on the interval $0 \leq x \leq 2$ guarantees the existence of a value c , where $0 < c < 2$, such that $f'(c) =$

12. Let f be a function with first derivative defined by $f'(x) = \frac{3x^2 - 8}{x^2}$ for $x > 0$. It is known that $f(1) = 9$ and $f(3) = 11$. What value of x in the open interval $(1, 3)$ satisfies the conclusion of the Mean Value Theorem for f on the closed interval $[1, 3]$?

13. The function f is continuous for $-2 \leq x \leq 1$ and differentiable for $-2 < x < 1$. If $f(-2) = -5$ and $f(1) = 4$, which of the following statements could be false?

- (A) There exists c , where $-2 < c < 1$, such that $f'(c) = 3$.
- (B) There exists c , where $-2 \leq c \leq 1$, such that $f(c) \geq f(x)$ for all x on the closed interval $-2 \leq x \leq 1$.
- (C) There exists c , where $-2 < c < 1$, such that $f(c) = 0$.
- (D) There exists c , where $-2 < c < 1$, such that $f'(c) = 0$.
- (E) There exists c , where $-2 < c < 1$, such that $f(c) = 3$.

14. 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.

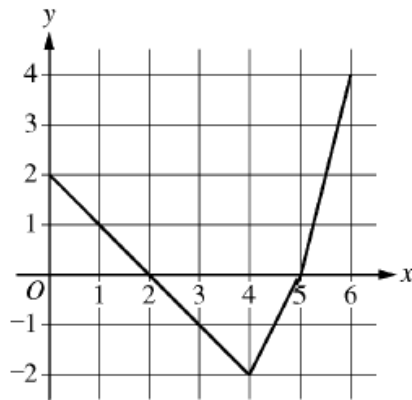
15. The first derivative of the function f is given by $f'(x) = \frac{\sin^2 x}{x} - \frac{1}{5}$. How many critical values does f have on the open interval $(0, 10)$?

16. The function f is defined for all x in the closed interval $[a, b]$. If f does not attain a maximum value on $[a, b]$, which of the following must be false?

- (A) f is continuous on $[a, b]$.
- (B) f is bounded on $[a, b]$.
- (C) f attains a minimum value on $[a, b]$.
- (D) The graph of f does not have a vertical asymptote in the interval $[a, b]$.
- (E) The equation $f'(x) = 0$ has a solution in the interval $[a, b]$.

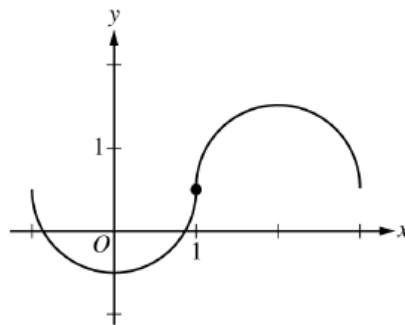
17. Let f be the function given by $f(x) = |x|$. Which of the following statements about f are false? (*circle all that apply*)

- I. f is continuous at $x = 0$.
- II. f is differentiable at $x = 0$.
- III. f has an absolute minimum at $x = 0$.



Graph of f

18. The graph of the function f , shown above, consists of three line segments. If the function g is an antiderivative of f such that $g(2) = 9$, for how many values of c , where $0 \leq c \leq 6$, does $g(c) = 7$?



Graph of h'

19. The function h is defined on the closed interval $[-1, 3]$. The graph of h' , the derivative of h , is shown above. The graph consists of two semicircles with a common endpoint at $x = 1$. Which of the following statements about h must be false, if any?

- I. $h(-1) = h(3)$
- II. h is continuous at $x = 1$.
- III. h is differentiable at $x = 1$.
- IV. The graph of h has a vertical asymptote at $x = 1$.