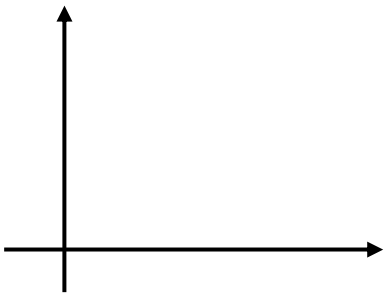
Calculus

1.16 Intermediate Value Theorem (IVT) **Notes**

Write your questions and thoughts here!

Intermediate Value Theorem (for continuous functions) - IVT



Justification with the IVT.

1. The function $f(x)$ is continuous on an interval [ ].
2. $f(\ ) < f(\ )$ or $f(\ ) > f(\ )$.
3. $f(\ )$ is between $f(\ )$ and $f(\ )$.

Conclusion: "According to the IVT, there is a value such that $f(\ ) =$ ___ and $\leq$ $\leq$."

Below is a table of values for a continuous function f.

x	0	3	4	8	9
$f(x)$	1	-5	3	7	-1

1. On the interval $0 \leq x \leq 9$ what is the minimum number of zeros?

2. On the interval $4 \leq x \leq 9$, what is the fewest possible times $f(x) = 1$?

3. On the interval $0 \leq x \leq 4$, ***must*** there be a value of x for which $f(x) = 2$? Explain.

4. On the interval $4 \leq x \leq 8$, ***could*** there be a value of x for which $f(x) = -2$? Explain.

5. Will the function $f(x) = x^2 - x + 1$ ever equal 8 on the interval $[-1, 5]$? Explain.

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Practice

Below is a table of values for a continuous function f.

x	-5	1	3	8	14
$f(x)$	7	40	21	75	-100

1. On the interval $-5 \leq x \leq 1$, must there be a value of x for which $f(x) = 30$? Explain.

2. On the interval $3 \leq x \leq 8$, ***could*** there be a value of x for which $f(x) = 100$? Explain.

3. On the interval $-5 \leq x \leq 14$ what is the minimum number of zeros?

4. For $1 \leq x \leq 14$, what is the fewest possible number of times $f(x) = 20$?

5. For $1 \leq x \leq 8$, what is the fewest possible number of times $f(x) = 7$?

Below is a table of values for a continuous function h.

x	-7	-2	1	4	11
$h(x)$	2	-5	6	-1	10

6. For $-7 \leq x \leq 1$, what is the fewest possible number of times $f(x) = 3$?

7. On the interval $4 \leq x \leq 11$, must there be a value of x for which $f(x) = -2$? Explain.

8. For $-2 \leq x \leq 4$, what is the fewest possible number of times $f(x) = 2$?

9. On the interval $1 \leq x \leq 11$, ***could*** there be a value of x for which $f(x) = -2$? Explain.

10. On the interval $-7 \leq x \leq 11$ what is the minimum number of zeros?

Below is a table of values for a continuous function g.

x	0	2	15	32	50
$g(x)$	-1	10	17	-10	8

11. On the interval $2 \leq x \leq 15$, must there be a value of x for which $g(x) = -3$? Explain.

12. On the interval $15 \leq x \leq 32$, must there be a value of x for which $g(x) = 11$? Explain.

13. What is the minimum number of zeros g must have on the interval $15 \leq x \leq 50$?

14. What is the minimum number of zeros g must have on the interval $0 \leq x \leq 50$?

15. For $15 \leq x \leq 50$, what is the fewest possible number of times $g(x) = 1$?

Use the Intermediate Value Theorem to answer each problem.

16. If $f(x) = 3 - x^2$, will $f(x) = 0$ on the interval $[-2, 1]$? Explain.

17. If $g(x) = \frac{1}{x}$, will $g(x) = -1$ on the interval $[2, 5]$? Explain.

18. **Calculator active.** If $h(x) = \ln(2x + 1)$, will $h(x) = 3$ on the interval $[2, 20]$? Explain.

19. If $f(t) = 3t^2 - 10t + 2$, will $f(x) = 1$ on the interval $[-1, 3]$? Explain.

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Test Prep

20. Let f be a continuous function such that $f(1) = 7$ and $f(7) = 1$. Let g be the function given by $g(x) = f(x) - x$. Explain why there must be a value c for $1 < c < 7$ such that $g(c) = 0$.

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21. The function f is continuous on the closed interval $[1, 3]$ and has values that are given in the table below.

x	1	2	3
$f(x)$	2	k	3

The equation $g(x) = 1$ must have at least two intersections with f in the interval $[1, 3]$ if $k =$

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

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22. Suppose f is continuous on the closed interval $[0,4]$ and suppose $f(0) = 1, f(1) = 2, f(2) = 0, f(3) = -3, f(4) = 3$. Which of the following statements about the zeros of f on $[0,4]$ is always true?

(A) f has exactly one zero on $[0, 4]$.

(B) f has more than one zero on $[0, 4]$.

(C) f has more than two zeros on $[0, 4]$.

(D) f has exactly two zeros on $[0, 4]$.

(E) None of the statements above is true.