

Calc 1: MVT & Rolle's Theorem

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DIRECTIONS

Problems 1-9: Find the value of c guaranteed by the Mean Value Theorem or Rolle's Theorem. Show your work: verify hypotheses, set $f'(c)$ equal to the average rate of change, solve for c . Problem 10: Explain why MVT does not apply.

1 Find c in $[0,1]$ (MVT):

$$f(x) = e^x$$

Answer: _____

2 Find c in $[-2,2]$ (Rolle's):

$$f(x) = x^4 - 4x^2$$

Answer: _____

3 Find c in $[0, 2\sqrt{3}]$ (Rolle's):

$$f(x) = x^3 - 12x$$

Answer: _____

4 Find c in $[2,4]$ (MVT):

$$f(x) = \frac{x-2}{x}$$

Answer: _____

5 Find c in $[-3,3]$ (Rolle's):

$$f(x) = x^3 - 9x$$

Answer: _____

6 Find c in $[0,3]$ (Rolle's):

$$f(x) = 5x^2 - 15x$$

Answer: _____

7 Find c in $[-2,4]$ (MVT):

$$f(x) = x^3 + 1$$

Answer: _____

8 Find c in $[-2,2]$ (Rolle's):

$$f(x) = x^3 - 4x$$

Answer: _____

9 Find c in $[1,3]$ (MVT):

$$f(x) = \frac{x-1}{x}$$

Answer: _____

10 Explain (MVT on $[-3,1]$):

Why does $f(x) = \sqrt{x^2 - 4}$ not hold true for the Mean Value Theorem on $[-3, 1]$?

Answer: _____

Answer Key & Solutions

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TEACHER NOTES

#2: $f'(x)=4x^3-8x=0 \rightarrow x(x^2-2)=0$; $c=0, \pm\sqrt{2}$. #4: MVT slope= $[f(4)-f(2)]/2=1/4$; $f'(x)=2/x^2$; $c=2\sqrt{2}$. #8: $f'(x)=3x^2-4=0$; $c=\pm\sqrt{4/3}$. #10: $\sqrt{x^2-4}$ undefined for $|x|<2$; interval contains $(-2,2)$.

1 Find c in $[0,1]$ (MVT):

$$f(x) = e^x$$

$$= c = \ln(e - 1)$$

2 Find c in $[-2,2]$ (Rolle's):

$$f(x) = x^4 - 4x^2$$

$$= c = 0; \quad c = \pm\sqrt{2}$$

3 Find c in $[0, 2\sqrt{3}]$ (Rolle's):

$$f(x) = x^3 - 12x$$

$$= c = 2$$

4 Find c in $[2,4]$ (MVT):

$$f(x) = \frac{x-2}{x}$$

$$= c = 2\sqrt{2}$$

5 Find c in $[-3,3]$ (Rolle's):

$$f(x) = x^3 - 9x$$

$$= c = \pm\sqrt{3}$$

6 Find c in $[0,3]$ (Rolle's):

$$f(x) = 5x^2 - 15x$$

$$= c = \frac{3}{2}$$

7 Find c in $[-2,4]$ (MVT):

$$f(x) = x^3 + 1$$

$$= c = 2$$

8 Find c in $[-2,2]$ (Rolle's):

$$f(x) = x^3 - 4x$$

$$= c = \pm\frac{2}{\sqrt{3}}$$

9 Find c in $[1,3]$ (MVT):

$$f(x) = \frac{x-1}{x}$$

$$= c = \sqrt{3}$$

10 Explain (MVT on $[-3,1]$):

Why does $f(x) = \sqrt{x^2 - 4}$ not hold true for the Mean Value Theorem on $[-3, 1]$?

Answer:

$f(x)$ is not defined on the open interval $(-2, 2)$, so the continuity hypothesis of MVT is not satisfied.