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Quiz 2: Extrema

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Let $f(x) = 2x^3 - 9x^2 + 12x + 1$, on the domain $[0, 3]$.

1. What is $f'(x)$?
2. What are the critical points of f?
3. Does f have a maximum value on $[0, 3]$; if so, what is it?
4. Does f have a minimum value on $[0, 3]$; if so, what is it?
5. List all local minima and local maxima of f in $(0, 3)$.

(1) $f'(x) = 6x^2 - 18x + 12 = 6(x^2 - 3x + 2) = 6(x-1)(x-2)$

(2) $f'(x)$ is defined for all x.

$f'(x) = 0$ for $x = 1$ and $x = 2$.

The critical points are at $x = 1$ and $x = 2$.

(3)–(5) $f(0) = 1$

$f(1) = 2 - 9 + 12 + 1 = 6$

$f(2) = 2 \cdot 8 - 9 \cdot 4 + 12 \cdot 2 + 1 = 16 - 36 + 24 + 1 = 5$

$f(3) = 2 \cdot 27 - 9 \cdot 9 + 12 \cdot 3 + 1 = 54 - 81 + 36 + 1 = 10$

(3) Maximum value of f on $[0,3]$ is 10

(4) Minimum value of f on $[0,3]$ is 1

(5) $f(x)$ has a local minimum value of 5 at $x = 2$

$f(x)$ has a local maximum value of 6 at $x = 1$.

Alternate method to identify local minimum & maximum:

$f'(x) > 0$ for $x < 1$

$f'(x) < 0$ for $1 < x < 2$ $\Rightarrow$ f has a local maximum at $x = 1$

$f'(x) > 0$ for $x > 2$ $\Rightarrow$ f has a local minimum at $x = 2$.