

Lesson 18: The First Derivative Test

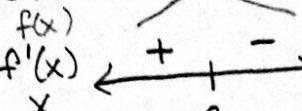
If $f'(x) > 0$, then $f(x)$ is increasing.

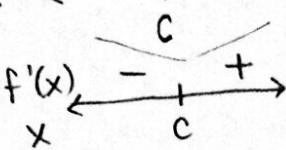
If $f'(x) < 0$, then $f(x)$ is decreasing.

First Derivative Test

① Find the CV's of $f(x)$ ($f'(c) = 0$ or DNE, and $f(c)$ is defined)

② Find where $f'(x)$ is > 0 and < 0 .

③ If  , then $f(c)$ is a relative max.

If  , then $f(c)$ is a relative min.

Otherwise, $f(c)$ is not a relative extrema.

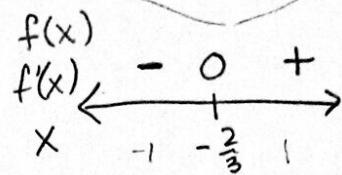
Ex 1

$$y = 3x^2 + 4x$$

$$y' = 6x + 4 \stackrel{\text{set}}{=} 0$$

$$\text{CV: } x = -\frac{4}{6} = -\frac{2}{3}$$

rel min at $(-\frac{2}{3}, -\frac{4}{3})$



rel min at

$$\left(-\frac{2}{3}, 3\left(-\frac{2}{3}\right)^2 + 4\left(-\frac{2}{3}\right)\right) \\ = \left(-\frac{2}{3}, -\frac{4}{3}\right)$$

Ex 2

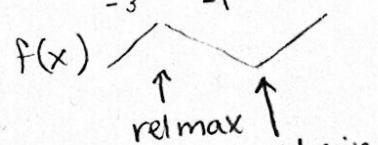
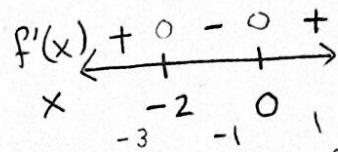
$$f(x) = 3x^3 + 9x^2 - 4$$

$$f'(x) = 9x^2 + 18x \stackrel{\text{set}}{=} 0$$

$$9x(x+2) = 0$$

$$x = 0, -2$$

rel max at $(-2, 8)$; rel min at $(0, -4)$



Ex 3

$f'(x) = x(x+2)^2(x-3)^3$. Find relative extrema of $f(x)$.

$$\text{CV's: } x = 0, x = -2, x = 3$$

rel max at $x = 0$; rel min at $x = 3$

