What is the first derivatives test?

If $f(x)$ is differentiable & let c be a critical point.

And If $f'(c)$ changes from positive to negative

$+ \quad c\# \quad -$

Then $x=c$ is a local maximum

And If $f'(c)$ changes from negative to pos.

$- \quad c\# \quad +$

Then $x=c$ is a local minimum

Use the first derivatives test to identify extrema for $f(x)=x^4-8x^2+1$

$f(x)=x^4-8x^2+1$

$\boxed{1.}$ Find critical numbers

$f'(x)=4x^3-16x$

$0=4x(x^2-4)$

$4x=0 \qquad x^2-4=0$

$x=0 \qquad x^2=4$

$x=\pm 2$

$\boxed{2.}$ Checks signs in between

$- \quad {-2} \quad + \quad 0 \quad - \quad 2 \quad +$

$f'(-3)=- \quad f'(-1)=+ \quad f'(1)=- \quad f'(3)=+$

$\boxed{3.}$ Describe

$x=-2$ & $+2$ are minimums b.c. they are critical #'s and $f'(x)$ changes from neg to positive there

$x=0$ is a max b.c. crit # & $f'(x)$ changes from + to −.

What is the second derivatives test?

If $f(x)$ is differentiable and let c be a critical number

If $f''(x)$ exists and

And If $f''(c)>0$ then local minimum.

And $f''(c)<0$ then local maximum.

Let f be a continuous & differentiable
Given the table of values below,
use the 2nd derivative test to identify extrema,

x	$f(x)$	$f'(x)$
1	1	−10
2	0	−4
3	−8	6
4	0	9

Let f be a continuous & differentiable function
Given the table of values below,
use the 2nd derivative test to identify extrema,

x	$f(x)$	$f'(x)$
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3	−8	6
4	0	9

down like frown

up like a cup

Maximum at $x = 2$ Because $f'(2)=0$ <u>And</u> $f''(2) < 0$

Minimum at $x = 4$ Because $f'(4)=0$ <u>And</u> $f''(4) > 0$.