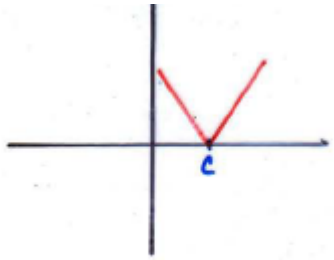
## Differentiability

**w-up:** Graph $y = x^{2/3}$

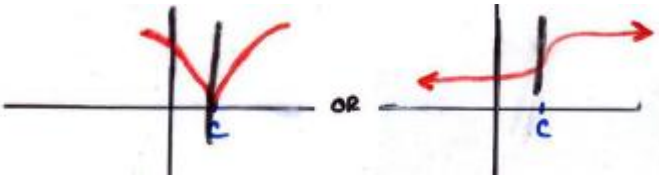
### When derivatives CANNOT be found

1) Tangent lines have different slopes from the left and right at that *x*-value




Not differentiable at x = c

2) Tangent line vertical at that *x*-value (undefined slope)

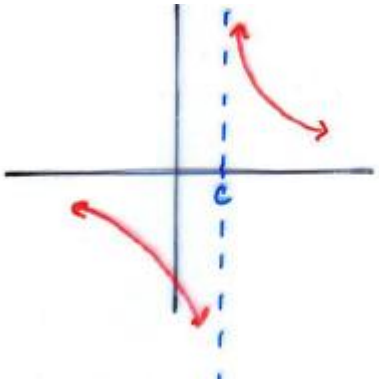



Not differentiable at x = c

Called a "cusp"

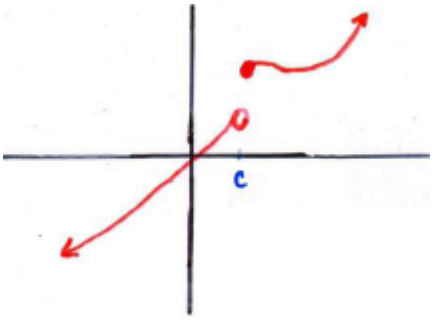
So…… Continuity does not necessarily mean Differentiability

3) Function undefined at that *x*-value




Not differentiable at x = c

4) Function is discontinuous at that *x*-value




Not differentiable at x = c

Write an example of function which models each of the four methods where derivatives cannot be found.

## Derivatives of Piece-wise Functions

Determine intervals of differentiability for each function.

A) $$f(x)=\begin{cases}2x-2, & x<2\\ \frac{1}{2}x^2, & x\geq 2\end{cases}$$

B) $$f(x)=\begin{cases}3x^2-2, & x<0\\ 2x-2, & x\geq 0\end{cases}$$

For a piece-wise function to be differentiable everywhere, the graph must first be continuous at the *x*-value for the split domain(limit from left = limit from right.) Secondly, the derivative must also be the same at this *x*-value(slope from the left = slope from the right.)