

Conditions that Destroy Differentiability

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1. Corner
 2. Cusps
 3. Vertical tangent lines
 4. Discontinuities
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1. Answer both parts below for $f(x) := \begin{cases} x^2 + 1 & x < 0 \\ -(x^2) + 4 & x \geq 0 \end{cases}$

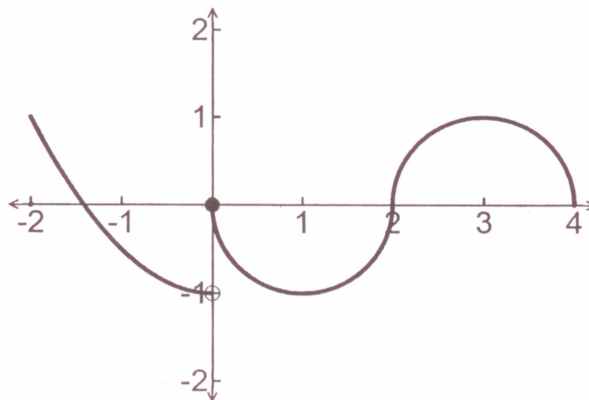
a) Show that $f(x)$ is or is not continuous at $x = 0$.

b) Prove that $f(x)$ is or is not differentiable at $x = 0$.

a) $\lim_{x \rightarrow 0^-} f(x) = 0 + 1 = 1$ Since $\lim_{x \rightarrow 0^-} f(x) \neq \lim_{x \rightarrow 0^+} f(x)$, f is not continuous

$\lim_{x \rightarrow 0^+} f(x) = 0 + 4 = 4$ b) Since f is not continuous, it is not differentiable

**2. The graph shown below has a vertical tangent at $(2, 0)$ and horizontal tangents at $(1, -1)$ and $(3, 1)$. For what values of x , $-2 < x < 4$, is f not differentiable?



f is not differentiable at $x = 0, 2$