ex Is $f(x) = \begin{cases} x^2 & x<0 \\ x & x \geq 0 \end{cases}$

Differentiable at $x=0$ $\quad f(0)=0$

Der. from left $\quad \lim_{x \to 0^-} \frac{x^2 - 0}{x-0} = \lim_{x \to 0^-} x = 0$

from right $\quad \lim_{x \to 0^+} \frac{x-0}{x-0} = \lim_{x \to 0^+} 1 = 1 \neq 0$

Since these are different then no

f' DNE exist at $x=0$

Ex2 Is $f(x) = \begin{cases} 5-2x & x \geq 1 \\ 4-x^2 & x < 1 \end{cases}$

cont^s and Diff

at $x=1$

<u>Cont^s</u>

① $\lim_{x \to 1^-} 4-x^2 = 3$ so $\lim_{x \to 1} f = 3$

$\lim_{x \to 1^+} 5-2x = 3$

② $f(1) = 5-2(1) = 3 = \lim_{x \to 1} f$

so yes cont^s at $x=1$

<u>Diff</u>ble

$$\lim_{x \to 1^-} \frac{4-x^2-3}{x-1} = \lim_{x \to 1^-} \frac{1-x^2}{x-1} = -\lim_{x \to 1} \frac{\cancel{(x-1)}(x+1)}{\cancel{(x-1)}}$$

$$= -2$$

$$\lim_{x \to 1^+} \frac{5-2x-3}{x-1} = \lim_{x \to 1^+} \frac{2-2x}{x-1}$$

$$= \lim_{x \to 1} \frac{-2\cancel{(x-1)}}{\cancel{x-1}} = -2$$

$\therefore$ same

$f'(1) = -2$