

MORE Continuity with VARIABLES

Find values of  $a$  and  $b$  s.t.  
 $f(x)$  is continuous on  $(-\infty, \infty)$

$$f(x) = \begin{cases} x+1, & x < 2 \\ ax+bx^2, & 2 \leq x < 5 \\ ax-b, & x \geq 5 \end{cases}$$

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

$$\lim_{x \rightarrow 2^+} ax+bx^2 = 4a+2b$$

$$\left. \begin{array}{l} \lim_{x \rightarrow 2^-} x+1 \\ \lim_{x \rightarrow 2^+} ax+bx^2 \end{array} \right\} f(2) = 4a+2b$$

$$\therefore 4a+2b=3$$

$$\lim_{x \rightarrow 5^-} ax+bx^2 = 25a+5b$$

$$\lim_{x \rightarrow 5^+} ax-b = 5a-b$$

$$\left. \begin{array}{l} \lim_{x \rightarrow 5^-} ax+bx^2 \\ \lim_{x \rightarrow 5^+} ax-b \end{array} \right\} f(5) = 5a-b$$

$$\therefore 25a+5b = 5a-b$$

$$\boxed{20a+6b=0}$$

Solve the System

$$\begin{array}{r} 4a+2b=3 \quad \times 3 \quad -12a-6b=-9 \\ 20a+6b=0 \quad \times 1 \quad 20a+6b=0 \\ \hline 8a = -9 \\ a = -\frac{9}{8} \end{array}$$

$$\therefore 4a+2b=3$$

$$4\left(-\frac{9}{8}\right)+2b=3$$

$$-\frac{9}{2}+2b=3$$

$$2b=3+\frac{9}{2}$$

$$2b=\frac{15}{2}$$

$$b=\frac{15}{4}$$

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$$\#2. f(x) = \begin{cases} 3x+2 & , x < 1 \\ 2ax^2+bx-4 & , 1 \leq x < 3 \\ ax^2+b & , x \geq 3 \end{cases}$$

$$\lim_{x \rightarrow 1^+} 3x+2 = \lim_{x \rightarrow 1^+} 2ax^2+bx-4 = f(1) = 5$$

$$\therefore 2a+b-4=5$$

$$\boxed{2a+b=9}$$

$$\lim_{x \rightarrow 3^-} 2ax^2+bx-4 = \lim_{x \rightarrow 3^+} ax^2+b$$

$$= 18a+3b-4 = 9a+b$$

$$\therefore 18a+3b-4=9a+b$$

$$9a+2b=4$$

$$\begin{array}{r} \therefore 9a+2b=4 \\ 2a+b=9 \xrightarrow{\times 2} 4a+2b=18 \\ \hline 5a = -14 \\ a = -14/5 \end{array}$$

$$\therefore 2\left(-\frac{14}{5}\right)+b=9$$

$$-\frac{28}{5}+b=9$$

$$b=9+\frac{28}{5}$$

$$b=\frac{45}{5}+\frac{28}{5}$$

$$\boxed{b=\frac{73}{5}}$$

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$$\begin{array}{l}
 \lim_{x \rightarrow 5} \frac{x^2 - 6x + 5}{x - 5} \\
 = \lim_{x \rightarrow 5} \frac{(x-5)(x-1)}{(x-5)} \\
 = \lim_{x \rightarrow 5} x - 1 \\
 = 4
 \end{array}
 \left\{
 \begin{array}{l}
 \lim_{x \rightarrow 5} \frac{x}{x-5} \\
 \lim_{x \rightarrow 5^+} \frac{+}{+} = +\infty \\
 \lim_{x \rightarrow 5^-} \frac{-}{-} = -\infty
 \end{array}
 \right.$$

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