

10 17-17:56

$f(x) = x^5 - 5x^4 + 5x^3 + 1$
 $I = (0, 6)$
 $f'(x) = 5x^4 - 20x^3 + 15x^2$
 $f'(x) = 0$
 $5x^4 - 20x^3 + 15x^2 = 0$
 $x^2(x^2 - 4x + 3) = 0$
 $5x^2(x-3)(x-1) = 0$
 $x=0, x=1, x=3$
 $f'(1/2) > 0$
 $f'(2) < 0$
 $f'(5) > 0$
 $f(0) = 1$
 $f(1) = 2$
 $f(3) = 1$
 $f(6) = 1$
 $f(0) = 1$
 $f(1) = 2$
 $f(3) = 1$
 $f(6) = 1$

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$f(x) = x(x-1)^2$
 $f'(x) = (x-1)(-x-1) + 2x(x-1)$
 $f'(x) = -x^2 - 1 + 2x^2 - 2x = x^2 - 2x - 1$
 $f'(x) = 0 \Leftrightarrow x = 1 \vee x = -1$
 $f''(x) = 2x - 2$
 $f''(1) = 0$
 $f''(-1) = -4 < 0$
 $f(1) = 0$
 $f(-1) = -2$
 $f(x) \rightarrow \infty$ as $x \rightarrow \infty$
 $f(x) \rightarrow -\infty$ as $x \rightarrow -\infty$
 $f(x) = ax + b$
 $a = \lim_{x \rightarrow \infty} \frac{f(x)}{x} = \lim_{x \rightarrow \infty} \frac{x^2 - 2x - 1}{x} = \lim_{x \rightarrow \infty} (x - 2 - \frac{1}{x}) = \infty$
 $b = \lim_{x \rightarrow \infty} (f(x) - ax) = \lim_{x \rightarrow \infty} (x^2 - 2x - 1 - (x^2 - 2x)) = -1$
 \Rightarrow NE ASS

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$f(x) = \frac{x^3 - 2x^2 + 2x}{x^2 + 1}$
 $f'(x) = \frac{(3x^2 - 4x + 2)(x^2 + 1) - (x^3 - 2x^2 + 2x)(2x)}{(x^2 + 1)^2}$
 $f'(x) = \frac{3x^4 + 3x^2 - 4x^3 - 4x + 2x^2 + 2 - 2x^4 + 4x^3 - 4x^2 - 4x}{(x^2 + 1)^2}$
 $f'(x) = \frac{x^4 - 4x^2 - 4x + 2}{(x^2 + 1)^2}$
 $f'(x) = 0 \Leftrightarrow x^4 - 4x^2 - 4x + 2 = 0$
 $x = 2, x = -2$
 $f(2) = \frac{8 - 8 + 4}{5} = \frac{4}{5}$
 $f(-2) = \frac{-8 - 8 - 4 + 2}{5} = -\frac{18}{5}$
 $f(x) \rightarrow \frac{x^3}{x^2} = x$ as $x \rightarrow \infty$
 $f(x) \rightarrow \frac{-2x^2}{x^2} = -2$ as $x \rightarrow -\infty$

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$f(x) = \frac{x^2 - 2x}{x^2 + 1}$
 $f'(x) = \frac{(2x - 2)(x^2 + 1) - (x^2 - 2x)(2x)}{(x^2 + 1)^2}$
 $f'(x) = \frac{2x^3 + 2x - 2x^2 - 2 - 2x^3 + 4x^2}{(x^2 + 1)^2}$
 $f'(x) = \frac{2x^2 - 2x - 2}{(x^2 + 1)^2}$
 $f'(x) = 0 \Leftrightarrow x^2 - x - 1 = 0$
 $x = \frac{1 \pm \sqrt{5}}{2}$
 $f''(x) = \frac{4x - 2}{(x^2 + 1)^3}$
 $f''(\frac{1 + \sqrt{5}}{2}) > 0$
 $f''(\frac{1 - \sqrt{5}}{2}) < 0$
 $f(\frac{1 + \sqrt{5}}{2}) = \frac{1 - \sqrt{5}}{2}$
 $f(\frac{1 - \sqrt{5}}{2}) = \frac{1 + \sqrt{5}}{2}$
 $f(x) \rightarrow \frac{x^2}{x^2} = 1$ as $x \rightarrow \infty$
 $f(x) \rightarrow \frac{-2x}{x^2} = 0$ as $x \rightarrow -\infty$

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$f(x) = 1 - \frac{2}{1+x^2}$
 $f'(x) = \frac{4x}{(1+x^2)^2}$
 $f'(x) = 0 \Leftrightarrow x = 0$
 $f''(x) = \frac{4(1+x^2)^2 - 8x^2(1+x^2)}{(1+x^2)^4}$
 $f''(x) = \frac{4(1+x^2) - 8x^2}{(1+x^2)^3}$
 $f''(0) = \frac{4}{1} = 4 > 0$
 $f(0) = 1 - \frac{2}{1} = -1$
 $f(x) \rightarrow 1$ as $x \rightarrow \infty$
 $f(x) \rightarrow 1$ as $x \rightarrow -\infty$

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$$a = \lim_{x \rightarrow \infty} \frac{x + \arctan x}{x} = \lim_{x \rightarrow \infty} 1 + \frac{\arctan x}{x}$$

$$= 1$$

$$b = \lim_{x \rightarrow \infty} (x + \arctan x - x) = 0$$

$$f = x$$

$$a = \lim_{x \rightarrow \infty} \frac{x + \arctan x}{x} = \lim_{x \rightarrow \infty} \frac{1 + \frac{\arctan x}{x}}{1} = 1$$

$$b = \lim_{x \rightarrow \infty} (x + \arctan x - x) =$$

$$= \lim_{x \rightarrow \infty} (\arctan x) = 2\pi$$

$$f = x$$

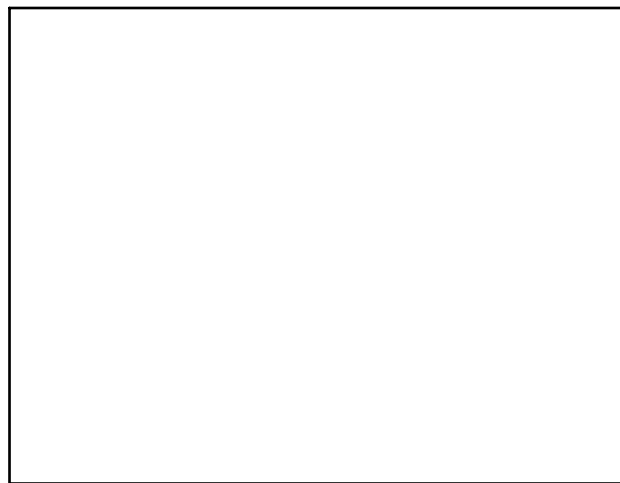
$$f = x + 2\pi$$

$$\lim_{x \rightarrow \infty} x + \arctan x = \infty$$

$$\lim_{x \rightarrow \infty} x + \arctan x = \infty$$

$\arctan 0 = 0$
 $\arctan 0 = \frac{\pi}{2}$

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