

$$f(x) = 4\sin^2(x+1) + \cos^2(x+1)$$
$$= 4(\sin(x+1))^2 + [\cos(x+1)]^2 \rightarrow [0, 2\pi]$$

$$f'(x) = 8\sin(x+1)\cos(x+1) + 2\cos(x+1)(-\sin(x+1))$$

$$0, \text{ ~~and~~ } = 6\sin(x+1)\cos(x+1)$$

$$0 = \sin(x+1) \mid \cos(x+1)$$

$$\sin(x+1) = 0$$

$$\underline{\cos(x+1) = 0}$$

$$\sin(x) = 0$$

$$x = 0, \pi, 2\pi, 3\pi, \dots$$

$$[0, 2\pi]$$

$$\sin(x+1) = 0$$

$$x+1 = 0, x+1 = \pi, x+1 = 2\pi, x+1 = 3\pi, \dots$$

$$\cancel{x = -1}, x = \pi - 1, x = 2\pi - 1, \cancel{x = 3\pi - 1}, \dots$$

$$\boxed{\begin{array}{l} x = \pi - 1 \\ x = 2\pi - 1 \end{array}}$$

$$\cos(x) = 0$$

$$[0, 2\pi]$$

$$\rightarrow x = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}, \dots$$

$$\cos(x+1) = 0$$

$$x+1 = \frac{\pi}{2}, x+1 = \frac{3\pi}{2}, x+1 = \frac{5\pi}{2}, x+1 = \frac{7\pi}{2}, \dots$$

$$x = \frac{\pi}{2} - 1, x = \frac{3\pi}{2} - 1, x = \frac{5\pi}{2} - 1, x = \frac{7\pi}{2} - 1$$

$$x = \frac{\pi}{2} - 1, x = \frac{3\pi}{2} - 1, x = \frac{5\pi}{2} - 1$$

HW 19 #6

$$\lim_{x \rightarrow \infty} x \sin\left(\frac{\pi}{x}\right)$$

$$x = \frac{1}{1/x}$$

$$\lim_{x \rightarrow \infty} \frac{\sin\left(\frac{\pi}{x}\right)}{1/x}$$

$$\frac{\sin \rightarrow 0}{1/x \rightarrow 0}$$

$$\frac{d}{dx} \sin\left(\frac{\pi}{x}\right) \rightarrow \pi \cos\left(\frac{\pi}{x}\right) \frac{d}{dx} \frac{1}{x} = \pi \cos\left(\frac{\pi}{x}\right) \cdot \frac{-1}{x^2}$$

$$\frac{d}{dx} \frac{1}{x} = \frac{-1}{x^2}$$

$$\lim_{x \rightarrow \infty} \frac{\pi \cos\left(\frac{\pi}{x}\right) \cdot \frac{1}{x^2}}{\frac{1}{x^2}}$$

$$\lim_{x \rightarrow \infty} \pi \cos\left(\frac{\pi}{x}\right)$$

$$\frac{\pi}{x} \rightarrow 0$$

$$\pi \cos(0) = \pi \cdot 1 = \boxed{\pi}$$

MVT  $f(x) = \ln(x^2)$   $[1, \sqrt{e}]$

- cont

$[1, \sqrt{e}]$



- diff

$(1, \sqrt{e})$

MVT holds  $\checkmark$

$$f'(x) = \frac{1}{x^2} \cdot 2x = \frac{2}{x}$$

$x \neq 0$

$$f(x) = \ln(x^2)$$

Rolle's Thm?

$$\begin{array}{cc} [1, \sqrt{e}] \\ \uparrow \quad \uparrow \\ a \quad b \end{array}$$

- cont  $[1, \sqrt{e}]$  ✓

- diff  $(1, \sqrt{e})$  ✓

-  $f(a) = f(b)$  ✗

$$\begin{aligned} f(1) &= \ln(1^2) = \ln(1) = 0 \\ f(\sqrt{e}) &= \ln(\sqrt{e}^2) = \ln(e) = 1 \end{aligned}$$

Rolle's thm fails

$$f(x) = x^4 e^{-x}$$

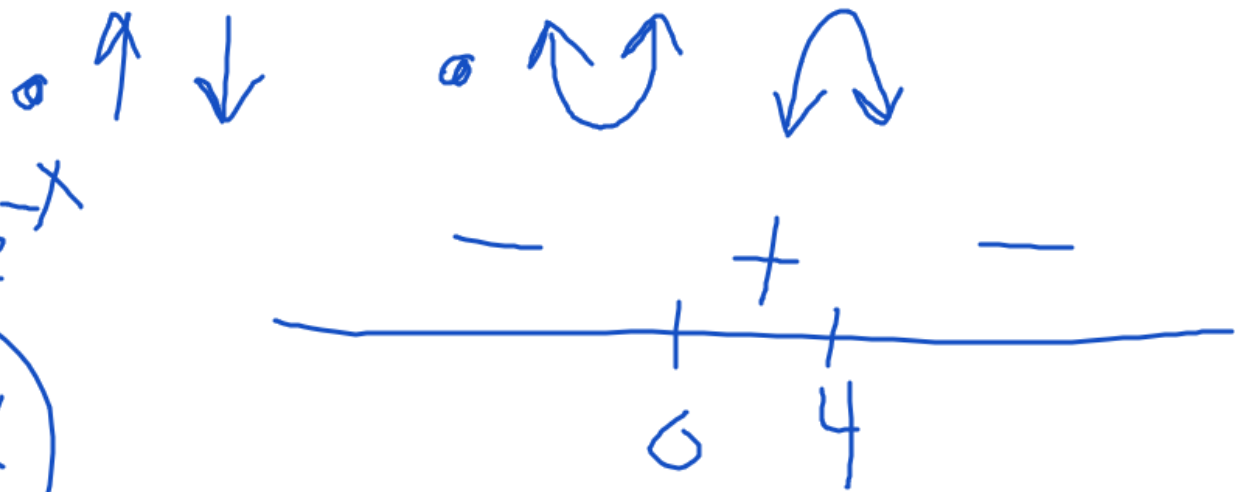
$$f'(x) = 4x^3 e^{-x} - x^4 e^{-x}$$

$$0, \text{ und } = x^3 (4-x)$$

$$\leftarrow e^x \rightarrow$$

$$0 = x^3 (4-x)$$

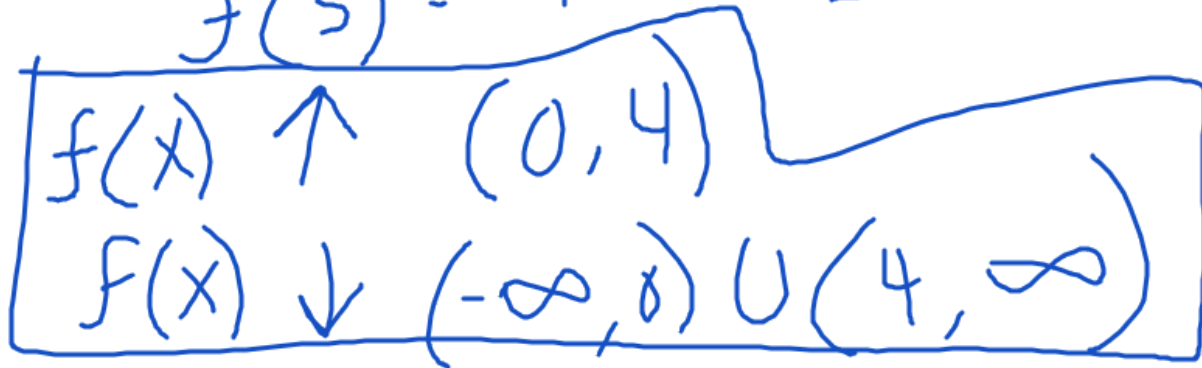
→  $x=0, x=4$   
critical points



$$f'(-1) = - \cdot + = -$$

$$f'(1) = + \cdot + = +$$

$$f'(5) = + \cdot - = -$$





$$f'(x) = 4x^3 e^{-x} - x^4 e^{-x}$$

$$f''(x) = 12x^2 e^{-x} - 8x^3 e^{-x} + x^4 e^{-x}$$

$$0, \text{ und } = \frac{x^2 (12 - 8x + x^2)}{e^x}$$

$$0 = x^2 (x^2 - 8x + 12)$$

$$0 = x^2 (x-2)(x-6)$$

possible infl. points

$$x=0, x=2, x=6$$