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 Dept: Mechatronics
 Course: ENG 283

Assignment 1

Using L'Hopital's Rule:

$$\lim_{x \rightarrow 0} \left[\frac{\sin x - \cos x}{x^3} \right]$$

$$\frac{\sin 0 - \cos 0}{0^3} = \frac{0 - 1}{0} = \text{Undefined}$$

~~$$f' = \frac{\cos x + \sin x}{3x^2} = \frac{1 + 0}{3(0)^2} = \text{Undefined}$$~~

$$f' = \frac{-\sin x + \cos x}{6x} = \frac{-0 + 1}{6(0)} = \text{Undefined}$$

$$f'' = \frac{-\cos x - \sin x}{6} = \frac{-1 - 0}{6} = \underline{\underline{-\frac{1}{6}}}$$

1d ~~1d~~
$$\lim_{x \rightarrow 4} \left[\frac{x^2 - 8x + 16}{x^2 - 5x + 4} \right]$$

$$= \frac{4^2 - 8(4) + 16}{4^2 - 5(4) + 4} = \frac{16 - 32 + 16}{16 - 20 + 4} = \frac{0}{0} = \text{Undefined}$$

$$f' = \frac{2x - 8}{2x - 5} = \frac{2(4) - 8}{2(4) - 5} = \frac{8 - 8}{8 - 5} = \text{Undefined}$$

$$f'' = \frac{2}{2} = 1$$

1e
$$\lim_{x \rightarrow \pi/2} \left[\frac{[x^2 - \pi/4] \sin(\cos x)}{x - \pi/2} \right] = \frac{[\frac{\pi^2}{4} - \pi/4] \sin(\cos \pi/2)}{\pi/2 - \pi/2} = \text{Undefined}$$

~~1e~~ ~~1e~~ $\pi/4 = 45$

~~1e~~ ~~1e~~ f' of $\sin(\cos x)$

Let $\cos x = u$

~~1e~~ ~~1e~~ $\sin u = \cos u$

$\Rightarrow \cos(\cos u)$

f of sin u
by chain rule $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$

$$\frac{dy}{dx} = \cos u \cdot \frac{du}{dx} = -\cos x$$

$$= \cos u = \cos x$$

$$\cos(\cos x) = -\cos x$$

$$= \lim_{x \rightarrow \pi/2} \left[\frac{2x \cdot \cos(\cos x) \cdot -\cos x}{1} \right]$$

$$2\left(\frac{\pi}{2}\right) \cdot \cos(\cos \frac{\pi}{2}) \cdot -\cos(\frac{\pi}{2})$$

$$\pi \cdot 0.9999 \cdot -0.9996 \approx \pi \cdot 1 \cdot -1$$

$$= -\pi$$

$$\lim_{x \rightarrow 2+\sqrt{3}} \cos \left[\sin^{-1} \left(\frac{x-2}{x-\sqrt{3}} \right) \right]$$

$$\cos \left[\sin^{-1} \left(\frac{2+\sqrt{3}-2}{2+\sqrt{3}-\sqrt{3}} \right) \right] = \cos \left[\sin^{-1} \left(\frac{\sqrt{3}}{2} \right) \right]$$

$$= \cos 60 = \underline{0.5}$$

$$\textcircled{1} \lim_{x \rightarrow \pi} \ln \left[\exp \left(\frac{3x^2 + 2x - 1}{x+1} \right) \right]$$

$$\ln \left[\exp \left(\frac{3(\pi)^2 + 2(\pi) - 1}{\pi + 1} \right) \right]$$

$$\ln \left[\exp \left(\frac{3\pi^2 + 2\pi - 1}{\pi + 1} \right) \right]$$

$$\ln \left[\exp \left(\frac{3\pi^2 + 6\pi - 4}{\pi + 2} \right) \right]$$

Long division for $3x^2 + 6x - 4$

$$3x^2 + 6x - 4$$

$$3x(x+2) - 2(x+2)$$

$$= (x+2)(3x-2)$$

$$\lim_{x \rightarrow \pi/2} \ln \left[\frac{\exp(x+2)(3x-2)}{4} \right] = \frac{x+2}{2}$$

$$= \lim_{x \rightarrow \pi/2} \ln \left[\frac{\exp(x+2)(3x-2)}{4} \times \frac{x}{x+2} \right]$$

$$= \lim_{x \rightarrow \pi/2} \ln \left[\exp \frac{(3x-2)}{2} \right] = \underline{3.7124}$$

$\pi/2$
or