

Name: Solution I.D. # _____ Section # _____ Serial # _____1. Use the definition find $f'(x)$ if $f(x) = \sqrt{5x+1}$

$$\begin{aligned}
 f'(x) &= \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \rightarrow 0} \frac{\sqrt{5(x+h)+1} - \sqrt{5x+1}}{h} \\
 &= \lim_{h \rightarrow 0} \frac{\sqrt{5x+5h+1} - \sqrt{5x+1}}{h} = \lim_{h \rightarrow 0} \frac{\sqrt{5x+5h+1} - \sqrt{5x+1}}{h} \cdot \frac{\sqrt{5x+5h+1} + \sqrt{5x+1}}{\sqrt{5x+5h+1} + \sqrt{5x+1}} \\
 &= \lim_{h \rightarrow 0} \frac{5x+5h+1 - 5x-1}{h(\sqrt{5x+5h+1} + \sqrt{5x+1})} = \lim_{h \rightarrow 0} \frac{5h}{h(\sqrt{5x+5h+1} + \sqrt{5x+1})} = \frac{5}{\sqrt{5x+1} + \sqrt{5x+1}} = \frac{5}{2\sqrt{5x+1}}
 \end{aligned}$$

2. Find $\frac{dy}{dx}$ for each of the following:

i) $y = x(1+x^3)^3$

$$\begin{aligned}
 \frac{dy}{dx} &= x[3(1+x^3)^2(3x^2)] + (1+x^3)^3 \\
 &= 9x^3(1+x^3)^2 + (1+x^3)^3 \\
 &= (1+x^3)^2[9x^3 + 1+x^3] \\
 &= (1+x^3)^2[10x^3 + 1]
 \end{aligned}$$

ii) $y = \frac{\sqrt{\pi}}{3}$

$$\frac{dy}{dx} = 0$$

3. Find y''' at $x = -1$ if $y = x - x^4$

$$y' = 1 + 4x^{-5}$$

$$y'' = -20x^{-6}$$

$$y''' = 120x^{-7} = \frac{120}{x^7}$$

$$y''' \Big|_{x=-1} = -120$$