

Find the limit, if exists. You must show work!!

$$1. \lim_{x \rightarrow 0} \frac{\sin x}{3x} = \frac{1}{3} \left[\lim_{x \rightarrow 0} \frac{\sin x}{x} \right] = \frac{1}{3} \cdot 1 = \frac{1}{3}$$

$$2. \lim_{x \rightarrow 3} \sqrt{x-3} = dne \text{ since the limit does not exist coming from the left.}$$

$$3. \lim_{x \rightarrow 1^-} \frac{|x-1|}{x-1} = \lim_{x \rightarrow 1^-} \frac{-(x-1)}{x-1} = \lim_{x \rightarrow 1^-} (-1) = -1 \quad \text{recall: } |x-1| = \begin{cases} -(x-1) & \text{if } x < 1 \\ x-1 & \text{if } x \geq 1 \end{cases}$$

$$4. \lim_{x \rightarrow 3} \frac{\sqrt{x-3}-5}{x-4} = \frac{\sqrt{0-3}-5}{3-4} = \frac{\sqrt{0}-5}{-1} = \frac{-5}{-1} = 5$$

Note: use direct substitution – why?

$$5. \lim_{x \rightarrow \frac{\pi}{6}} \tan(2x) = \frac{\sin\left(2 \cdot \frac{\pi}{6}\right)}{\cos\left(2 \cdot \frac{\pi}{6}\right)} = \frac{\sin\left(\frac{\pi}{3}\right)}{\cos\left(\frac{\pi}{3}\right)} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3}$$

Note: use direct substitution – why?

Find the derivative of each function.

$$6. f(x) = 3x^3 - 2x - \pi \quad f'(x) = 9x^2 - 2$$

$$7. y = \sqrt{x} + \sqrt[3]{x^2} = x^{1/2} + x^{2/3} \quad y' = \frac{1}{2}x^{1/2-1} + \frac{2}{3}x^{2/3-1} = \frac{1}{2}x^{-1/2} + \frac{2}{3}x^{-1/3} = \frac{1}{2\sqrt{x}} + \frac{2}{3\sqrt[3]{x}}$$

$$8. h(x) = 3\cos x \quad h'(x) = -3\sin x$$

$$9. k(x) = \cot x \quad k'(x) = -\csc^2 x$$

$$10. f(x) = ax^{n-1} \quad f'(x) = (n-1)ax^{n-1-1} = a(n-1)x^{n-2}$$