

Derivatives Exercise 1

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

$$\begin{aligned} 2) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{-2x-2h - (-2x)}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{-2h}{h} \right) \\ &= \lim_{h \rightarrow 0} (-2) \\ &= -2 \end{aligned}$$

$$\begin{aligned} 3) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{3x+3h-4 - 3x+4}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{3h}{h} \right) \\ &= \lim_{h \rightarrow 0} (3) \\ &= 3 \end{aligned}$$

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$$\begin{aligned} 4) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{-7 + 7}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{0}{h} \right) \\ &= 0 \end{aligned}$$

$$\begin{aligned} 5) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{-4h^2 - 8hx - 4x^2 + 4x^2}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{-4h^2 - 8hx}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{h(-4h - 8x)}{h} \right) \\ &= \lim_{h \rightarrow 0} (-4h - 8x) \\ &= -4(0) - 8x \\ &= -8x \end{aligned}$$

$$\begin{aligned} 6) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{3h^2 + 6hx + 3x^2 - 2x - 2h + 1 - 3x^2 - 2x + 1}{h} \right) \\ &= \lim_{h \rightarrow 0} \left(\frac{3h^2 + 6hx - 2h}{h} \right) \\ &= \lim_{h \rightarrow 0} (3h + 6x - 2) \\ &= 3(0) + 6x - 2 \\ &= 6x - 2 \end{aligned}$$

$$\begin{aligned}
 7) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) & 9) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\
 &= \lim_{h \rightarrow 0} \left(\frac{\frac{2}{x+h} - \frac{2}{x}}{h} \right) & &= \lim_{h \rightarrow 0} \left(\frac{\frac{4}{x+h+1} - \frac{4}{x+1}}{h} \right) \\
 &= \lim_{h \rightarrow 0} \left(\frac{-\frac{2h}{(x+h)(x)}}{h} \right) & &= \lim_{h \rightarrow 0} \left(\frac{-\frac{4h}{(x+1)(x+h+1)}}{h} \right) \\
 &= \lim_{h \rightarrow 0} \left(-\frac{2}{(x+h)(x)} \right) & &= \lim_{h \rightarrow 0} \left(-\frac{4}{(x+1)(x+h+1)} \right) \\
 &= -\frac{2}{(x+0)(x)} & &= -\frac{4}{(x+1)(x+0+1)} \\
 &= -\frac{2}{x^2} & &= -\frac{4}{(x+1)^2}
 \end{aligned}$$

$$\begin{aligned}
 8) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) & 10) f'(x) &= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right) \\
 &= \lim_{h \rightarrow 0} \left(\frac{-\frac{3}{(x+h)^2} + \frac{3}{x^2}}{h} \right) & &= \lim_{h \rightarrow 0} \left(\frac{\sqrt{x+h-3} - \sqrt{x-3}}{h} \right) \\
 &= \lim_{h \rightarrow 0} \left(\frac{\frac{3h(h+2x)}{x^2(x+h)^2}}{h} \right) & &= \lim_{h \rightarrow 0} \left(\frac{1}{\sqrt{h+x-3} + \sqrt{x-3}} \right) \\
 &= \lim_{h \rightarrow 0} \left(\frac{3(h+2x)}{x^2(x+h)^2} \right) & &= \frac{1}{\sqrt{0+x-3} + \sqrt{x-3}} \\
 &= \frac{3(0+2x)}{x^2(x+0)^2} & &= \frac{1}{2\sqrt{x-3}} \\
 &= \frac{6x}{x^4} \\
 &= \frac{6}{x^3}
 \end{aligned}$$