

## Questions from Homework

Find the derivative of each function.

**Remember!**

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

1.  $f(x) = 8x^2 - 10$

2.  $f(x) = 2x^2 + 14x - 7$

3.  $f(x) = x^3$

4.  $f(x) = \frac{x+4}{2x+3}$

**Remember!**

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

① Find  $f(x+h)$ 

② Fill in formula

2.  $f(x) = 2x^2 + 14x - 7$

$$\begin{aligned} \textcircled{1} f(x+h) &= 2(x+h)^2 + 14(x+h) - 7 \\ &= 2(x+2xh+h^2) + 14x + 14h - 7 \\ &= 2x^2 + 4xh + 2h^2 + 14x + 14h - 7 \end{aligned}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{2x^2 + 4xh + 2h^2 + 14x + 14h - 7 - (2x^2 + 14x - 7)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\cancel{2x^2} + 4xh + \cancel{2h^2} + \cancel{14x} + 14h - \cancel{7} - \cancel{2x^2} - \cancel{14x} + \cancel{7}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{4xh + 2h^2 + 14h}{h} \quad \leftarrow \text{Common factor}$$

$$= \lim_{h \rightarrow 0} \frac{\cancel{h}(4x + 2h + 14)}{\cancel{h}} = 4x + 14$$

$$f'(x) = 4x + 14$$

**Remember!**

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$\textcircled{3} f(x) = x^3$$

$$\begin{aligned} f(x+h) &= (x+h)^3 = (x+h)(x+h)(x+h) \\ &= (x+2xh+h^2)(x+h) \\ &= x^3 + \underline{x^2h} + \underline{2xh^2} + \underline{xh^2} + h^3 \\ &= \boxed{x^3 + 3x^2h + 3xh^2 + h^3} \end{aligned}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{\cancel{x^3} + 3x^2h + 3xh^2 + h^3 - \cancel{x^3}}{h}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{3x^2h + 3xh^2 + h^3}{h} \quad \leftarrow \text{factor out an } h$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{\cancel{h}(3x^2 + 3xh + h^2)}{\cancel{h}} = 3x^2$$

$$\boxed{f'(x) = 3x^2}$$

**Remember!**

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$f(x) = \frac{x+4}{2x+3}$$

$$f(x+h) = \frac{(x+h)+4}{2(x+h)+3}$$

$$= \frac{x+h+4}{2x+2h+3}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{\frac{x+h+4}{2x+2h+3} - \frac{x+4}{2x+3}}{h} \quad \begin{array}{l} * \text{ Multiply each} \\ \text{term by} \\ (2x+3)(2x+2h+3) \end{array}$$

$$= \lim_{h \rightarrow 0} \frac{(2x+3)(x+h+4) - (x+4)(2x+2h+3)}{h(2x+3)(2x+2h+3)}$$

$$= \lim_{h \rightarrow 0} \frac{2x^2 + 2xh + 8x + 3x + 3h + 12 - (2x^2 + 2xh + 3x + 8x + 8h + 12)}{h(2x+3)(2x+2h+3)}$$

$$= \lim_{h \rightarrow 0} \frac{\cancel{2x^2} + \cancel{2xh} + \cancel{8x} + \cancel{3x} + 3h + \cancel{12} - \cancel{2x^2} - \cancel{2xh} - \cancel{3x} - \cancel{8x} - 8h - \cancel{12}}{h(2x+3)(2x+2h+3)}$$

$$= \lim_{h \rightarrow 0} \frac{-5h}{h(2x+3)(2x+2h+3)} = \frac{-5}{(2x+3)^2}$$

↑  
Slope of the  
tangent

Try this one!

Remember!

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

Differentiate the following function using the *Limit Definition of the Derivative*

$$f(x) = \sqrt{x+3} \quad f(x+h) = \sqrt{(x+h)+3} = \sqrt{x+h+3}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{(\sqrt{x+h+3} - \sqrt{x+3}) (\sqrt{x+h+3} + \sqrt{x+3})}{h (\sqrt{x+h+3} + \sqrt{x+3})}$$

$$= \lim_{h \rightarrow 0} \frac{x+h+3 - (x+3)}{h (\sqrt{x+h+3} + \sqrt{x+3})}$$

# Homework