

**Exercise 31**

Find  $f'(a)$ .

$$f(x) = 3x^2 - 4x + 1$$

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**Solution**

Determine the derivative of  $f(x)$ .

$$\begin{aligned} f'(x) &= \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} \\ &= \lim_{h \rightarrow 0} \frac{[3(x+h)^2 - 4(x+h) + 1] - [3x^2 - 4x + 1]}{h} \\ &= \lim_{h \rightarrow 0} \frac{[3(x^2 + 2xh + h^2) - 4x - 4h + 1] - 3x^2 + 4x - 1}{h} \\ &= \lim_{h \rightarrow 0} \frac{(3x^2 + 6xh + 3h^2 - 4x - 4h + 1) - 3x^2 + 4x - 1}{h} \\ &= \lim_{h \rightarrow 0} \frac{6xh + 3h^2 - 4h}{h} \\ &= \lim_{h \rightarrow 0} (6x + 3h - 4) \\ &= 6x - 4 \end{aligned}$$

Plug in  $x = a$  to this formula to get  $f'(a)$ .

$$f'(a) = 6a - 4$$