

Find the derivative of $f(x) = 5x^2 + x$ using the definition of derivative

$$(1) f'(x) = \lim_{h \rightarrow 0} \left(\frac{(5(x+h)^2 + (x+h)) - (5x^2 + x)}{h} \right)$$

$$(2) f'(x) = \lim_{h \rightarrow 0} \left(\frac{(5x^2 + 10xh + 5h^2 + (x+h)) - (5x^2 + x)}{h} \right)$$

$$(3) f'(x) = \lim_{h \rightarrow 0} \left(\frac{10xh + 5h^2 + h}{h} \right)$$

$$(4) f'(x) = \lim_{h \rightarrow 0} \left(\frac{h(10x + 5h + 1)}{h} \right)$$

$$(5) f'(x) = \lim_{h \rightarrow 0} (10x + 5h + 1)$$

$$(6) f'(x) = 10 \lim_{h \rightarrow 0} x + 5 \lim_{h \rightarrow 0} h + \lim_{h \rightarrow 0} 1 \quad \text{evaluate the limits}$$

$$(7) f'(x) = 10x + 5(0) + 1 = 10x + 1$$

Step one is the definition of derivative

Step two – five is algebra simplification

Step six is using addition and scalar rule of limits

Step seven is evaluating the limits and simplifying