

1) Using the function given below, find and simplify $\frac{f(x+h)-f(x)}{h}$.

$$f(x) = 3x^2 - 2$$

$$f(x+h) = 3(x+h)^2 - 2 = 3(x^2 + 2xh + h^2) - 2 = 3x^2 + 6xh + 3h^2 - 2$$

$$\begin{aligned} \frac{f(x+h) - f(x)}{h} &= \frac{3x^2 + 6xh + 3h^2 - 2 - (3x^2 - 2)}{h} \\ &= \frac{3x^2 + 6xh + 3h^2 - 2 - 3x^2 + 2}{h} \\ &= \frac{6xh + 3h^2}{h} \\ &= 6x + 3h \end{aligned}$$

2) Given the function below, find $2f(x) + 5$.

$$f(x) = \begin{cases} 3x - 1, & x \leq 0 \\ -2x + 1, & x > 0 \end{cases}$$

Remember that piecewise functions are really two problems in one. This function, $f(x)$ is $f_1(x) = 3x - 1$ whenever $x \leq 0$, and $f_2(x) = -2x + 1$ whenever $x > 0$.

$$2f_1(x) + 5 = 2(3x - 1) + 5 = 6x + 3$$

$$2f_2(x) + 5 = 2(-2x + 1) + 5 = -4x + 7$$

Thus:

$$2f(x) + 5 = \begin{cases} 6x + 3, & x \leq 0 \\ -4x + 7, & x > 0 \end{cases}$$