Using the definition of the derivative to calculate the derivative.

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

$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

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

$\lim_{h \to 0} \frac{3(x+h)^2 - (x+h) + 1 - (3x^2 - x + 1)}{h}$

$(x+h)(x+h)$

$x^2 + xh + xh + h^2$

$3(x^2 + 2xh + h^2)$

$\frac{3x^2 + 6xh + 3h^2 \cancel{- x} - h \cancel{+1} \cancel{-3x^2} \cancel{+x} \cancel{-1}}{h}$

$\frac{3h^2}{h} = \frac{3h\cancel{h}}{\cancel{h}}$

$\lim_{h \to 0} \frac{6xh + 3h^2 - h}{h}$

$\lim_{h \to 0} \frac{\cancel{h}(6x + 3h - 1)}{\cancel{h}}$

$\lim_{h \to 0} 6x + \cancel{3h}^0 - 1 = \boxed{6x - 1}$

$f(x) = 1 - \frac{3}{x}$

$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

$f(x+h) \to \lim_{h \to 0} \frac{1 - \frac{3}{x+h} - \left(1 - \frac{3}{x}\right)}{h}$

$\frac{\cancel{1} - \frac{3}{x+h} \cancel{- 1} + \frac{3}{x}}{h}$

LCD $= x(x+h)$

$\frac{-\frac{3x\cancel{(x+h)}}{\cancel{x+h}} + \frac{3\cancel{x}(x+h)}{\cancel{x}}}{\frac{h\,x(x+h)}{1}}$

$\lim_{h \to 0} \frac{-3x + 3(x+h)}{hx(x+h)}$

$\frac{\cancel{-3x} \cancel{+3x} + 3h}{hx(x+h)}$

$\lim_{h \to 0} \frac{3\cancel{h}}{\cancel{h}x(x+h)}$

$\lim_{h \to 0} \frac{3}{x(x+\cancel{h})}$

$\boxed{\frac{3}{x^2}}$

$f(x) = \sqrt{x} + 2$

$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

$f(x+h) \to \frac{\sqrt{x+h} + 2 - (\sqrt{x} + 2)}{h}$

$\lim_{h \to 0} \frac{\sqrt{x+h} \cancel{+2} - \sqrt{x} \cancel{-2}}{h}$

$\lim_{h \to 0} \frac{(\sqrt{x+h} - \sqrt{x})}{h} \cdot \frac{(\sqrt{x+h} + \sqrt{x})}{(\sqrt{x+h} + \sqrt{x})}$

$\sqrt{x} \cdot \sqrt{x}$

x

$\frac{\cancel{x} + h + \cancel{\sqrt{x+h} \cdot \sqrt{x}} - \cancel{\sqrt{x}\sqrt{x+h}} - \cancel{x}}{h(\sqrt{x+h} + \sqrt{x})}$

$\sqrt{2} \cdot \sqrt{2}$

$\sqrt{2 \cdot 2}$

2

$\frac{\cancel{h}^1}{\cancel{h}^1(\sqrt{x+h} + \sqrt{x})}$

$\lim_{h \to 0} \frac{1}{\sqrt{x + h^0} + \sqrt{x}}$

$\frac{1}{\sqrt{x} + \sqrt{x}}$

$\frac{1}{2\sqrt{x}} \cdot \frac{\sqrt{x}}{\sqrt{x}}$

$\frac{\sqrt{x}}{2x}$