

Exercise 1

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

$$f'(x) = 2(3x^2) - 2x + 3(1) = 6x^2 - 2x + 3$$

$$f(x) = \frac{5x - 3}{2x + 4}$$

$$f'(x) = \frac{(5x - 3)'(2x + 4) - (5x - 3)(2x + 4)'}{(2x + 4)^2}$$

$$= \frac{(5)(2x + 4) - (5x - 3)(2)}{(2x + 4)^2}$$

$$= \frac{10x + 20 - 10x + 6}{(2x + 4)^2} = \frac{26}{(2x + 4)^2}$$

$$f(x) = \frac{x^2 - 3x + 3}{x - 1}$$

$$f'(x) = \frac{(x^2 - 3x + 3)'(x - 1) - (x^2 - 3x + 3)(x - 1)'}{(x - 1)^2}$$

$$= \frac{(2x - 3)(x - 1) - (x^2 - 3x + 3)(1)}{(x - 1)^2}$$

$$= \frac{2x^2 - 2x - 3x + 3 - x^2 + 3x - 3}{(x - 1)^2} = \frac{x^2 - 2x}{(x - 1)^2}$$

$$f(x) = \frac{x^3}{x^2 + 1}$$

$$f'(x) = \frac{(x^3)'(x^2 + 1) - (x^3)(x^2 + 1)'}{(x^2 + 1)^2}$$

$$= \frac{3x^2(x^2 + 1) - x^3(2x)}{(x^2 + 1)^2}$$

$$= \frac{3x^4 + 3x^2 - 2x^4}{(x^2 + 1)^2} = \frac{x^4 + 3x^2}{(x^2 + 1)^2}$$

Exercise 2

$$f(x) = (\sqrt{x-1} + 2)^2$$

$$\begin{aligned} f'(x) &= 2(\sqrt{x-1} + 2)'(\sqrt{x-1} + 2) \\ &= 2\left(\frac{1}{2\sqrt{x-1}}\right)(\sqrt{x-1} + 2) = \frac{\sqrt{x-1} + 2}{\sqrt{x-1}} \end{aligned}$$

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

$$\begin{aligned} f'(x) &= \frac{(\sqrt{x})'(x-1) - (\sqrt{x})(x-1)'}{(x-1)^2} \\ &= \frac{\left(\frac{1}{2\sqrt{x}}\right)(x-1) - (\sqrt{x})(1)}{(x-1)^2} = \frac{\frac{x-1}{2\sqrt{x}} - \sqrt{x}}{(x-1)^2} \\ &= \frac{\frac{x-1-2x}{2\sqrt{x}}}{(x-1)^2} = \frac{-x-1}{2\sqrt{x}(x-1)^2} \end{aligned}$$

$$f(x) = x\sqrt{x^2-1}$$

$$\begin{aligned} f'(x) &= (x)'(\sqrt{x^2-1}) + (x)(\sqrt{x^2-1})' \\ &= (1)(\sqrt{x^2-1}) + (x)\left(\frac{2x}{2\sqrt{x^2-1}}\right) \\ &= \sqrt{x^2-1} + \frac{x^2}{\sqrt{x^2-1}} = \frac{x^2-1+x^2}{\sqrt{x^2-1}} = \frac{2x^2-1}{\sqrt{x^2-1}} \end{aligned}$$

$$f(x) = (x+1)\sqrt{x}$$

$$\begin{aligned} f'(x) &= (x+1)'(\sqrt{x}) + (x+1)(\sqrt{x})' \\ &= (1)(\sqrt{x}) + (x+1)\left(\frac{1}{2\sqrt{x}}\right) \\ &= (\sqrt{x}) + \frac{x+1}{2\sqrt{x}} = \frac{2x+x+1}{2\sqrt{x}} = \frac{3x+1}{2\sqrt{x}} \end{aligned}$$