

1. Use the *Product Rule* to find the derivative of each of these:

(iv)  $y = (2x - 1)(x^2 - 2)$     (v)  $y = (1 - x)(2 - x^2)$     (vi)  $y = (x^3 - 1)(2x + 1)$

**Product rule**

$$y = uv \Rightarrow \frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$u = 2x - 1$$

$$\frac{du}{dx} = 2$$

$$v = x^2 - 2$$

$$\frac{dv}{dx} = 2x$$

$$y = (2x - 1)(x^2 - 2)$$

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

$$= 4x^2 - 2x + 2x^2 - 4$$

$$= 6x^2 - 2x - 4$$

20. If  $f(x) = \sqrt{\frac{4x}{x+3}}$ , find the value of  $f'(1)$ .

*Chain Rule*

outside  $\rightarrow \sqrt{u}$   
inside  $\rightarrow$  quotient

*Quotient Rule*

**Quotient rule**

$$y = \frac{u}{v} \Rightarrow \frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

$$u = 4x$$

$$\frac{du}{dx} = 4$$

$$v = x + 3$$

$$\frac{dv}{dx} = 1$$

$$x = 1$$

$$f(x) = \left( \frac{4x}{x+3} \right)^{\frac{1}{2}}$$

$$f'(x) = \underbrace{\frac{1}{2} \left( \frac{4x}{x+3} \right)^{-\frac{1}{2}}}_{\text{diff outside}} \cdot \underbrace{\frac{(x+3)(4) - (4x)(1)}{(x+3)^2}}_{\text{diff. inside}} \cdot \text{Quotient}$$

$$= \frac{1}{2} \left( \frac{4x}{x+3} \right)^{-\frac{1}{2}} \left( \frac{4x + 12 - 4x}{(x+3)^2} \right)$$

$$= \frac{1}{2} \left( \frac{4x}{x+3} \right)^{-\frac{1}{2}} \left( \frac{12}{(x+3)^2} \right)$$

$$= \frac{6}{(x+3)^2} \left( \frac{4x}{x+3} \right)^{-\frac{1}{2}}$$

$$f'(1) = \frac{6}{(1+3)^2} \left( \frac{4(1)}{1+3} \right)^{-\frac{1}{2}} = \frac{3}{8} \checkmark$$