

Product Rule

$$2x(12-x^2)$$

$$2x \cdot 2x + (12+x^2)2$$

$$4x^2 + 24 + 2x^2$$

$$\frac{dy}{dx} = 6x^2 + 24$$

$$y = (6x^2 - x)(10 - 20x)$$

$$(6x^3 - x) - 20 + (10 - 20x)(18x^2 - 1)$$

$$-120x^3 + 20x + 180x^2 - 360x^3 - 10 + 20x$$

$$-480x^3 + 180x^2 + 40x - 10$$

$$y = (x^3 + 7x - 1)(5x + 2)$$

$$(x^3 + 7x - 1)5 + (3x^2 + 7)(5x + 2)$$

$$5x^3 + 35x - 5 + 15x^3 + 35x + 6x^2 + 14$$

$$20x^3 + 6x^2 + 70x + 9$$

$$y = x^{-2}(4 + 3x^{-3})$$

$$= x^{-2}(-9x^{-6}) + (4 + 3x^{-3}) - 2x^{-3}$$

$$= -9x^{-6} - 8x^{-3} - 6x^{-6}$$

$$= -15x^{-6} - 8x^{-3}$$

Note: $\frac{-15}{x^6} - \frac{8}{x^3} \left(\frac{x^3}{x^3}\right) = \frac{-15}{x^6} - \frac{8x^3}{x^6}$

$$= \frac{-15 - 8x^3}{x^6}$$

$$\frac{dV}{dx} = u \cdot \frac{dV}{dx} + V \frac{du}{dx}$$

Chain Rule

$$Y = 2U^2 - 4U, \quad U = 6X^{-5}$$

$$\frac{dY}{dX} = \frac{dY}{dU} \cdot \frac{dU}{dX}$$

$$\frac{dY}{dU} = 4U - 4 \quad \text{sub } 4(6X^{-5}) - 4 = 24X^{-5} - 4$$

$$\frac{dU}{dX} = 3X^{-5}$$

$$\frac{dY}{dX} = (24X^{-5} - 4)3X^{-5} = 72 - 12X^{-5}$$

$$Y = U - U^2 \quad U = 25X^2$$

$$\frac{dY}{dU} = 1 - 3U^2 \quad \text{sub } 1 - 3(25X^2)^2$$

$$\frac{dY}{dX} = (1 - 3 \cdot 0625X^4) \cdot 5X$$

$$\frac{dU}{dX} = 5X$$

$$\frac{dY}{dX} = (1 - 1.875X^4) \cdot 5X = 5X - 9.375X^5$$

$$Y = U^{2.5} \quad U = 2X^2 - 4$$

$$\frac{dY}{dU} = 2.5X^{2.5} \quad \frac{dU}{dX} = 4X \quad \frac{dY}{dX} = 4X \cdot 2.5X^{2.5} = X^{2.5}$$

$$Y = 4U^2 - 4 \quad X = 3X^2 - 2X$$

$$\frac{dY}{dU} = 8U \quad \text{sub } 8(3X^2 - 2X) = 24X^2 - 16X$$

$$\frac{dU}{dX} = 6X - 2$$

$$\begin{aligned} \frac{dY}{dX} &= (24X^2 - 16X)(6X - 2) \\ &= 144X^3 - 96X^2 - 96X^2 + 32X \\ &= 144X^3 - 192X^2 + 32X \end{aligned}$$