

1. Find $\frac{dy}{dx}$

a. $3x^2y + 5y^3 = 9$

$$3x^2 \frac{dy}{dx} + 6xy + 15y^2 \frac{dy}{dx} = 0 \rightarrow \frac{dy}{dx} (3x^2 + 15y^2) = -6xy$$

$$\frac{dy}{dx} = \frac{-6xy}{3x^2 + 15y^2} = \boxed{\frac{-2xy}{x^2 + 5y^2}}$$

b. $y^4 - y^3 = x^2 + 5x$

$$4y^3 \frac{dy}{dx} - 3y^2 \frac{dy}{dx} = 2x + 5$$

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

$$\frac{dy}{dx} = \frac{2x + 5}{4y^3 - 3y^2}$$

c. $y^2 = 3 \sin(y) - x^4$

$$2y \frac{dy}{dx} = 3 \cos(y) \frac{dy}{dx} - 4x^3 \rightarrow 4x^3 = 3 \cos(y) \frac{dy}{dx} - 2y \frac{dy}{dx}$$

$$\frac{dy}{dx} = \frac{4x^3}{3 \cos(y) - 2y}$$

d. $x^2 y^4 + y^3 x = 2xy - x$

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

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

$$\frac{dy}{dx} = \frac{2y - 1 - 2xy^4 - y^3}{4x^2 y^3 + 3xy^2 - 2x}$$