

## 2.5 Implicit Differentiation

Implicit Form

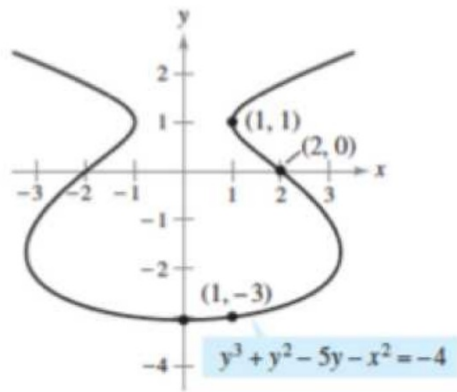
$$xy = 1$$

Explicit Form

$$y = \frac{1}{x} = x^{-1}$$

ex: If  $x^2 - y^2 = 16$  find  $\frac{dy}{dx}$ .

Implicit differentiation is necessary to derive equations that can only be expressed implicitly.



ex: Find  $\frac{dy}{dx}$ .

a)  $x^2 - 2y^3 + 4y = 2$

ex: Find  $\frac{dy}{dx}$ .

b)  $x^2y - 2\cos 3x = 3$

ex: Find  $\frac{dy}{dx}$ .

e)  $y = \sin(xy)$

ex: If  $x^2 + y^2 = 1$  find  $\frac{d^2y}{dx^2}$ .

ex:  $x^2 - xy + y^2 = 7$

a) Find  $\frac{dy}{dx}$ .

b) Find the slope at the point  $(-1, 2)$ .

c) Write an equation of the tangent line to the graph at the point  $(-1, 2)$ .

d) Write an equation of the normal line to the graph at the point  $(-1, 2)$ .

ex:  $4x^2 + y^2 - 8x + 4y + 4 = 0$

a) Find the points, if any, at which the equation has a horizontal tangent line.

b) Find the points, if any, at which the equation has a vertical tangent line.



## Logarithmic Differentiation

When given a complicated equation it is often convenient to use logarithms as aids in differentiating nonlogarithmic functions. This process is called logarithmic differentiation.

Candidates for Logarithmic Differentiation:

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

- $y = x^{x-1}$

ex: Differentiate.

a)  $y = \frac{(x-2)^2}{\sqrt{x^2+1}}$

ex: Differentiate.

b)  $y = x^{x-1}$