

## Lesson 3.1: Implicit Differentiation

All the derivatives you have done to this point have been \_\_\_\_\_. These are equations that are explicitly written in terms of  $x$ .

In this lesson, you will be working with \_\_\_\_\_ where the relationship between  $x$  and  $y$  is only \_\_\_\_\_.

For example,  $x^2 + y^2 = 1$ ,  $xy + y^2 = 3$ , and  $xy = 1$  are all implicit equations.

It is possible to differentiate implicit equations using \_\_\_\_\_.

### Procedure

Warm-Up Examples: Differentiate

1.  $y = x$

2.  $y = x^2$

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

4.  $y = (f(x))^2$

Examples:

1. Given  $x^2 - 2y^3 + 3x = 6$ , find  $y'$ .

2. Find the slope of the tangent line to and normal to the graph of  $x^2 + 4y^2 = 25$  at (3,2).

3. Given  $x^3 - 2xy + y^3 = 5x$ , find  $\frac{dy}{dx}$  and evaluate at the point (1,2).

4. Given  $x^2 + y^2 = 3$ , find  $\frac{d^2x}{dy^2}$  (or  $x''$ ) with respect to  $y$ .

5. Given  $\cot(y) = x - y$  find  $\frac{dy}{dx}$ .