IMPLICIT DIFFERENTIATION

1. If $x^2 + y^2 = 5$, find $\frac{dy}{dx}$.

2. If $x^2 - xy + y^3 = 1$,
   a) Find $\frac{dy}{dx}$
   b) Find y' when $x = 1$. Explain.

3. The graphs of $x^2 + y^2 - 12x - 6y + 25 = 0$ and $x^2 + y^2 + 2x + y - 10 = 0$ are tangent to each other at
   A) (2,1), but not (0,0) B) (0,0), but not (2,1)
   C) both (2,1) and (0,0) D) neither (2,1) nor (0,0).

4. Find the slope of the tangent to $(x + y)^2 = (2x - y)^3$ at (0,-1).

5. If $y = (3 + 6x + \sqrt{x^2 + 9})^{1/5}$, find $y'(4)$. (Hint: It's EASIEST to raise both sides to the 5th power, then differentiate implicitly.)

6. 2ND AND 3RD DERIVATIVES If $x^2 - y^2 = 1$, find a) $\frac{dy}{dx}$, b) $\frac{d^2y}{dx^2}$, c) $\frac{d^3y}{dx^3}$.

7. MATCH each (implicit) function on the left with "its" y' on the right. (Note: "a" stands for a constant in each problem.)

I) $y^4 = x^2 + 5$	A) $\frac{-x^2}{y^2}$
II) $x^2 = a^2 + y^2$	B) $\frac{-y}{2y + x}$
III) $x = -y - xy$	C) $\frac{-x}{y}$
IV) $y^2 + xy = 3$	D) $\frac{x}{2y^3}$
V) $x^2 = a^2 - y^2$	E) $\frac{x}{y}$
VI) $x^3 + y^3 - a^3 = 0$	F) $\frac{1 - y}{1 + x}$
VII) $x - y = xy$	G) $\frac{1 + y}{-1 - x}$

*8. Find the slope of $y^5 + y^3 = x^3$ as it passes through the origin.

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(9) Given the curve $y^3 + 3x^2y + 13 = 0$.

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

b) Write an equation for the line tangent to the curve at the point (2,-1).

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(10) Given the curve $x^2 - xy + y^2 = 9$.

a) Write a general expression for the slope of the curve.

b) Find the coordinates of the points on the curve where the tangents are vertical.

c) At the point (0,3), find the rate of change in the slope of the curve with respect to x.

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(11) Consider the curve given by $xy^2 - x^3y = 6$.

(a) Show that $\frac{dy}{dx} = \frac{3x^2y - y^2}{2xy - x^3}$.

(b) Find all points on the curve whose x-coordinate is 1, and write an equation for the tangent line at each of these points.

(c) Find the x-coordinate of each point on the curve where the tangent line is vertical.

(12) Given the curve $x + xy + 2y^2 = 6$.

(a) Find an expression for the slope of the curve at any point (x, y) on the curve.

(b) Write an equation for the line tangent to the curve at the point (2, 1).

(c) Find the coordinates of all other points on this curve with slope equal to the slope at (2, 1).