3.10 (Day 1) Implicit Differentiation

Objective: 1. Find the derivative implicitly.

Explicit form:
y is written as a function of x

Ex. $y = x^2$ $y = \sqrt{x}$ $y = \frac{1}{x}$
$y = \ln x$ $y = \sin x$ ....

Implicit form
If y is also thought of as an independent variable $f(x, y)$
This is implicit form.

Ex. $x^2 + y^2 = 4$ $y - 3 = 5(x - 7)$
$\frac{(x-2)^2}{3} + \frac{(y+4)^2}{9} = 2$ $xy = 3$
$x^2 + 2xy + 5y^2 = 8$

Find $\frac{dy}{dx}$

1. $y = (x+3)^4$
$\frac{dy}{dx} = 4(x+3)^3 \cdot \frac{dx}{dx}$

2. $y = \sin x$
$\frac{dy}{dx} = \cos(x) \cdot \frac{dx}{dx}$

Find $\frac{dy}{dt}$

3. $y = (x^2+4)^4$
$\frac{dy}{dt} = 4(x^2+4)^3 \left(2x \cdot \frac{dx}{dt}\right)$

4. $y = \sin x$
$\frac{dy}{dt} = \cos x \cdot \frac{dx}{dt}$

Find $\frac{dy}{dx}$

5. $x^2 + y^2 - x = 4$
$2x \frac{dx}{dx} + 2y \frac{dy}{dx} - \frac{dx}{dx} = 0$
$2x + 2y \frac{dy}{dx} - 1 = 0$
$2y \frac{dy}{dx} = 1 - 2x$
$\frac{dy}{dx} = \frac{1-2x}{2y}$

6. $y^3 + y^2 - 5y - x^2 = -4$
$3y^2 y' + 2yy' - 5y' - 2x = 0$
$y'(3y^2 + 2y - 5) = 2x$
$y' = \frac{2x}{3y^2+2y-5}$

7. Find the slope of $x^2 + y^2 = 25$
At $(-3, 4)$
$x^2 + y^2 = 25$
$2x + 2yy' = 0$
$-6 + 8y' = 0$
$y' = \frac{6}{8}$
$y' = \frac{3}{4}$

8. Find the slope of $3(x^2+y^2)^2 = 100xy$
At the $(3, 1)$
$3(x^2+y^2)^2 = 100xy$
$6(x^2+y^2)^1(2x+2yy') = 100y + 100xy'$
$6(10)(2+2y') = 100 + 300y'$
$60(2+2y') = 100 + 300y'$
$360 + 120y' = 100 + 300y'$
$260 = 180y'$
$\frac{26}{18} = y'$
$\frac{13}{9} = y'$

9. $x^2 + xy + y^2 = 5$
$2x + xy' + y + 2yy' = 0$
$y'(x+2y) = -y - 2x$
$y' = \frac{-y-2x}{x+2y}$

10. $x^2 - 3xy + y = 12$
$2x - 3y - 3xy' + y' = 0$
$y'(1-3x) = 3y - 2x$
$y' = \frac{3y-2x}{1-3x}$

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