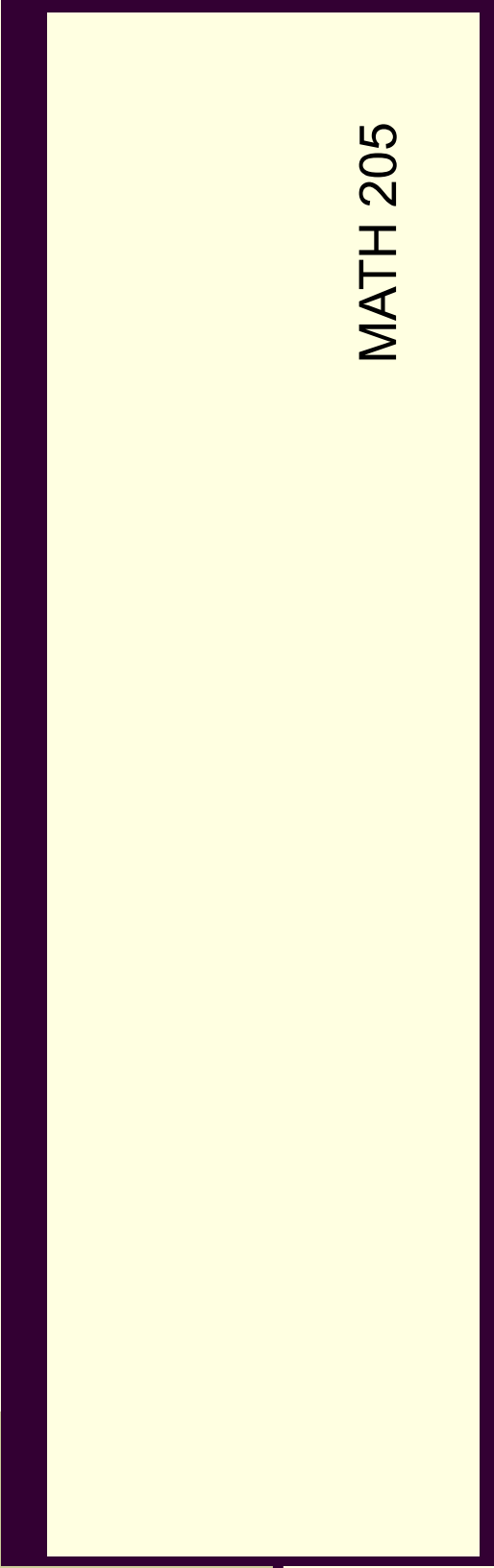# 3.8 Implicit Differentiation

MATH 205

Determine the following:

1. y' if $7x + 14y = 33$

2. y' if $x^2 + y^2 = 25$

What about these?

3. $\dfrac{dy}{dx}$ if $y^2 - 4xy + 7x^2 = 10$

4. $\dfrac{dy}{dx}$ if $x^3 + y^3 - 9xy = 0$

So, what now…

- Though it may happen that the isolation of y is algebraically prohibitive (or impossible), we can still take the derivative of the equation by using the implicit relationship of x and y.

- To do this, we will take the derivative of each term, with respect to x, and isolate $\dfrac{dy}{dx}$.

- y will be treated as function of x and the chain rule then applies, i.e. $y = y(x)$

  - For example: the derivative of y^2 with respect to x yields $2y\dfrac{dy}{dx}$

Now With Implicit Differentiation

5. y' if $7x + 14y = 33$

6. y' if $x^2 + y^2 = 25$

Now With Implicit Differentiation

7. $\dfrac{dy}{dx}$ if $y^2 - 4xy + 7x^2 = 10$

8. $\dfrac{dy}{dx}$ if $x^3 + y^3 - 9xy = 0$

Normal lines

- Definition: Normal Line

  A normal line is the line perpendicular to the tangent line at the point of tangency.

9. Find the equations of the normal and tangent lines to Folium of Descartes $x^3 + y^3 - 9xy = 0$ at the point (2, 4).

Power Rule for Rational Exponents

- Power Rule extended to Rational Exponents:

  Assume p and q are integers with $q \neq 0$.

  Then $\dfrac{d}{dx} x^{\frac{p}{q}} = \dfrac{p}{q} x^{\frac{p}{q}-1}$ provided $x > 0$ when q is even

Determine Each of the Following:

10.

$$\frac{d}{dx}\left(4x^3 - 9x^2 + 7\right)^{\frac{7}{5}}$$

11.

$$\frac{d}{dx}\left[\left(\sqrt[5]{4x^3 - 8e^{2x} + 7x}\right)\sec(6x^4)^{\frac{3}{}}\right]$$

Higher Order Derivatives

12. Find $\dfrac{d^2y}{dx^2}$ if $4x^2 - 8y^2 = 10$

Higher Order Derivatives

13. Find $\dfrac{d^2 y}{dx^2}$ if $3x^5 = \cos(3y)$.