# Guided Practice for 2.6: Derivatives of Functions Given Implicitly

## Overview

In this section we take up two problems: (1) finding tangent lines to curves that are not graphs of functions, for example circles or curves that double back on themselves, and (2) finding derivatives of functions for which complete information (such as a formula) is not given. Both of these problems are connect by the same concept, that of an implicit function. The process we develop here, sometimes called *implicit differentiation*, is a powerful application of the Chain Rule that has some similarities to problems you’ve worked before where the functions involved are given only as data or as graphs.

## Learning objectives

### BASIC learning objectives

Each student will be responsible for learning and demonstrating proficiency in the following objectives PRIOR to the class meeting.

* Explain what it means for a curve to be an *implicit function*, as opposed to an explicit function, of x.
* Take the derivative of a function that is, or that involves, an implicit function. (This is done in the Preview Activity).

**Reminder**: [Wolfram|Alpha](http://www.wolframalpha.com) gives you the ability to practice differentiation rules as much as you want. Make up a function to differentiate, take its derivative by hand, then check with W|A.

### ADVANCED learning objectives

The following objectives should be mastered by each student DURING and FOLLOWING the class session through active work and practice:

* Given an equation in x and y, where y is an implicit function of x, calculate the derivative .
* Find the slope and equation of a tangent line to a curve that is specified by an equation that is not the graph of a function.
* Find the points on a curve where the tangent line is horizontal and where the tangent line is vertical.

## Resources

*Reading*: **Read Section 2.7 in Active Calculus**. Please note, here are the main points to focus on during your reading:

* The difference between an *implicit* function and a variable that cannot be explicitly written as the function of another variable
* The example/discussion at subsection 2.7.1 “Implicit Differentiation”, where we get a formula for the tangent line to a circle, is **very** important in this section
* The short note about notation just above Activity 2.7.2 is an important point that’s easy to miss

*Viewing*: Watch the following videos at the MTH 201 YouTube Playlist, which have a combined running time of 15 minutes, 30 seconds:

* [Quick Review: Derivatives of functions given implicitly](http://www.youtube.com/watch?v=YI7uxdvcq4E&list=PL9bIjQJDwfGuXQHuS5Jkmum_CFILoCZX-&index=49) (2:23)
* [Derivatives of implicit functions](http://www.youtube.com/watch?v=wEiiLU2jFng&list=PL9bIjQJDwfGuXQHuS5Jkmum_CFILoCZX-&index=50) (5:06)
* [Finding slope with implicit differentiation](http://www.youtube.com/watch?v=_2aCDXYMz1U&list=PL9bIjQJDwfGuXQHuS5Jkmum_CFILoCZX-&index=51) (8:21)

## Exercises

These exercises can be done during or after your reading and video watching. They are intended to help you make examples of the concepts you are reading and viewing. Work these out on scratch paper, and then you will be asked to submit the results on a web form at the end.

The exercises this time come from the Preview Activity in this section. In Preview Activity 2.7 you are asked to differentiate a function that combines an implicitly defined function f (whose formula is not known) with an explicit function (whose formula is known). Here is part (a) of that Preview Activity so you will have a sense of what you are supposed to do:

[x^2 + f(x)] = [x^2] + [f(x)] = 2x + f’(x) ]

The rest of the exercises are found on the submission form linked below.

## Turn-in instructions

Go to the web form located at the following link and type in your answers: http://gvsu.edu/s/0QR

Responses are due at 11:59pm Eastern time the day before the class. If you do not have access to the internet where you live, please let me know in advance and we will make alternative arrangements.