

## Concavity and Curve Sketching (4.4)

### Expected Skills.

At the end of this section, students should be able to:

- explain the difference between concave up and concave down,
- use the second derivative of a function to determine:
  - on what interval(s) a curve is concave up, respectively concave down,
  - where the inflection points are,
  - the nature of a local extremum,
- qualitatively sketch the graph of a function using the information provided by the first and second derivatives,
- given the algebraic expression of a function as well as its graph (e.g. using a graphing software), qualitatively verify that the curve corresponds to the given function.

**Pre-Class Activity** (ch4-applications-5-concavity-1-pc). The goal of this pre-class activity is to have the students *see* the difference between concave up and concave down. We also want to convey the message that looking at the second derivative gives us new information compared to looking only at the first derivative.

**Worksheet** (ch4-applications-5-concavity-2-ws). In the class activity we start with the definition of the concavity. We can base ourselves on the pre-class activity. We then ask the students to think about the second derivative test.

In the second exercise we first ask students to basically identify an inflection point (without telling them it is called an inflection point). We then introduce the notion of inflection point. Then, we have the students identify inflection points of various functions. Finally, we have the students look at “what happens” to the second derivative when the function has an inflection point; in particular, we underline that just looking for  $f''(x) = 0$  or  $f''(x)$  does not exist is not enough.

In the third exercise we have the students identify the steps for curves sketching and then have them sketch various functions.