

**Instructions**

You should submit a carefully written report addressing the problems given below. You are encouraged to discuss ideas with others for this project. If you do work with others, you must still write your report independently.

Use the writing conventions given in *Some notes on writing in mathematics*. You should include enough detail so that a reader can follow your reasoning and reconstruct your work. You should not show every algebraic or arithmetic step. All graphs should be done carefully on graph paper or using appropriate technology.

The project is due in class on Friday December 5.

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*Hyperbolic functions* are defined in terms of the exponential function. Many relations among hyperbolic functions are similar to corresponding relation among trigonometric functions. You can find information on hyperbolic functions in Section 3.11 of our text.

For your report, start by stating the definitions of  $\cosh x$  and  $\sinh x$  and then write an exposition that includes the following elements.

1. Use the definitions of  $\cosh x$  and  $\sinh x$  to prove the identity  $\cosh^2 x - \sinh^2 x = 1$ .
2. Use the definition of  $\cosh x$  to determine the derivative of  $\cosh x$ . Include relevant plots to illustrate this derivative.
3. Using the fact that  $\frac{d}{dx}[\sinh x] = \cosh x$  to determine the derivative of  $\sinh^{-1} x$ . Find an expression that gives the derivative of  $\sinh^{-1} x$  in terms of algebraic operations (as opposed to transcendental operations such as trigonometric, exponential, and logarithmic functions).