

# quiz 3

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# Name

(0a) Please type your name at the top of your worksheet as a comment.

(0b) The policy for the quiz is as follows: Do your quiz independently. Do not engage in consultation with others. (Exception: You are encouraged to ask me questions in the public chat, the private chat, or in a breakout.) During the quiz, you may use your class notes, code you wrote previously, Sage and CoCalc, and resources posted on our Blackboard site. You are not permitted to engage with any other resources of any kind anywhere. Please confirm your compliance with the academic honesty policy for this quiz and your understanding of the consequences. You can do this by typing I confirm. I understand..

(1) Define  $f_1(x) = e^x$ ,  $f_2(x) = e^{-x}$ , and  $f(x) = (e^x + e^{-x})/2$ .

(1a) Graph the three functions on the same set of axes, choosing scaling that shows the key features of the graphs.

(1b) Explain which graph is the graph of  $f_1(x)$ , which is the graph of  $f_2(x)$ , and which is the graph of  $f(x)$  in a complete sentence.

(2) The function  $f(x) = (e^x + e^{-x})/2$  is called the hyperbolic cosine function and can be written in the equivalent form  $g(x) = \cosh(x)$ .

(2a) Use Sage to provide evidence that these two functions  $f(x)$  and  $g(x)$  are the same, perhaps by graphing them both on the same set of axes.

(2b) What is an approximate value for  $\cosh(3)$ , accurate to three decimal digits? Does this answer look right based on your graph? Explain, rescaling your graph as needed.

(3a) Is it true that  $\cosh(-x) = \cosh(x)$  for all  $x$ ?

(3b) Explain your answer to (3a) in a complete sentence.

(4a) What is the limit of  $\cosh(x)$  as  $x$  approaches infinity?

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(4b) Is your answer in (4a) the same as if you use the definition of  $\cosh(x)$  in terms of exponentials, as given in (2)? Briefly explain.

(5a) Use Sage to find the derivative of  $\cosh(x)$ .

(5b) Is your answer to (5a) consistent with the definition  $\sinh(x) = (e^x - e^{-x})/2$ ? Briefly explain.