

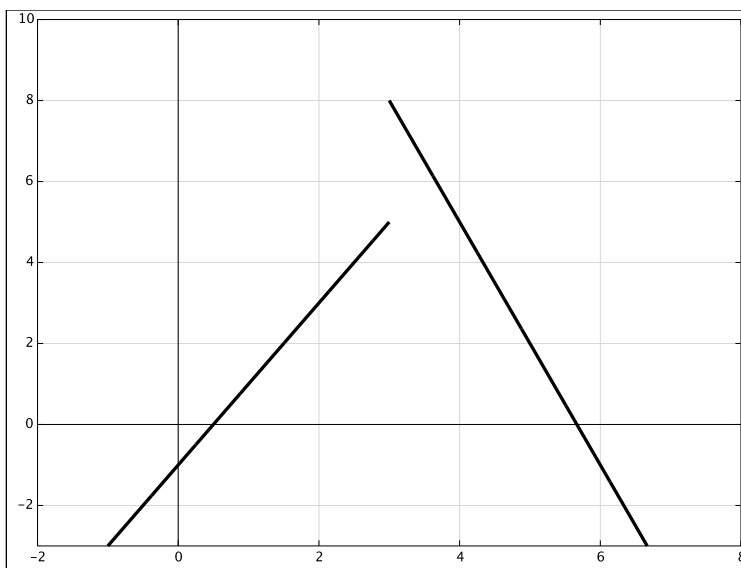
# Math 151, Quiz # 3, September 17, 2013

**1.** Evaluate  $\sinh(\ln(5))$ . Is the function  $f(x) = \sinh(x) \cosh(x)$  an odd function or an even function? Explain.

**Solution:** Recall that  $\sinh(x) = \frac{e^x - e^{-x}}{2}$ . So  $\sinh(\ln(5)) = \frac{e^{\ln(5)} - e^{-\ln(5)}}{2} = \frac{5 - 1/5}{2} = \frac{24/5}{2} = \frac{12}{5}$ .

From the definition above we can see that  $\sinh(x)$  is an odd function:  $\sinh(-x) = -\sinh(x)$ . This is similar to the  $\sin$  function. Also, just as  $\cos$  is an even function,  $\cosh$  is an even function. We can confirm this from the definition:  $\cosh(x) = \frac{e^x + e^{-x}}{2}$ . So  $\cosh(-x) = \cosh(x)$ . The product of an odd function and an even function is odd. We can confirm this directly since  $\sinh(-x) \cosh(-x) = [-\sinh(x)][\cosh(x)] = -[\sinh(x) \cosh(x)]$ .

**2.** In the plot below the function  $f(x)$ , a piecewise function composed of two lines, is plotted. Evaluate the following limits or state that the limit does not exist: **Answers are in bold below.**



$\lim_{x \rightarrow 3^-} f(x) = 5$ . As we approach 3 from the left we follow the line on the left which is approaching the value 5.

$\lim_{x \rightarrow 3^+} f(x) = 8$ . As we approach 3 from the right we follow the line on the right towards 3 which is approaching the value 8.

$\lim_{x \rightarrow 3} f(x)$ . This limit does not exist. As we approached 3 from the left the limit was 5 and from the right we got 8. As these values do not match we have a discontinuity, so the limit does not exist.