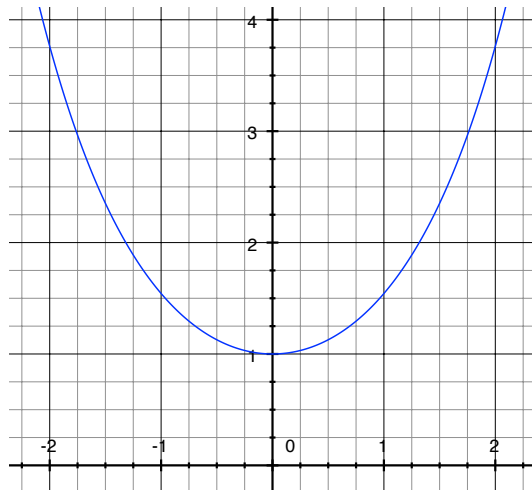


MAT132, Paper Homework 4
due in recitation on 10/10, 10/11, or 10/12

1. In this problem, we consider the following curve, known as a *catenoid*.



It is the shape that a rope makes when it is hanging down from two points. Mathematically, the catenoid is the graph of the function $f(x) = \cosh x$. In case you don't know,

$$\cosh x = \frac{e^x + e^{-x}}{2} \quad \text{and} \quad \sinh x = \frac{e^x - e^{-x}}{2}$$

are the *hyperbolic cosine* and *hyperbolic sine* functions (pronounced *cosh* and *sinh*).

- (a) Let ℓ be the arc length of the catenoid from the point $(0, 1)$ to the point $(a, \cosh a)$. Write down an integral that represents ℓ .
- (b) Evaluate the integral.
- (c) Prove the identity $\cosh^2 x - \sinh^2 x = 1$, and use it to show that $\ell = \sinh a$.