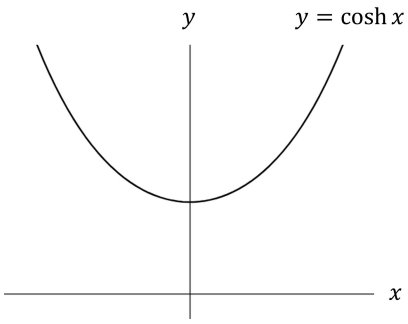
1. (28 pts) The region $\mathcal{R}$ is bounded by the curve $y = \cosh x$ and the x-axis on the interval $0 \leq x \leq \ln 2$.



   (a) Set up but do not evaluate integrals to find the requested quantities.
      i. The volume of a solid with $\mathcal{R}$ as the base and cross-sections perpendicular to the x-axis that are semi-circular regions with diameters in the base.
      ii. The volume generated by rotating $\mathcal{R}$ about the line $x = 1$.

   (b) Rotate the curve $y = \cosh x$ on the given interval about the line $x = 1$. Evaluate an integral to find the resulting surface area. You may leave your answer in terms of hyperbolic functions.
   $\big($*Hint:* $\cosh^2 x - \sinh^2 x = 1\big)$

2. (24 pts) The following two problems are not related.

   (a) Find the solution of the equation $\dfrac{dy}{dx} = x\sqrt{1-y^2}$ with initial condition $y(0) = \frac{1}{2}$. Express your answer in the form $y = f(x)$.

   (b) A trapezoidal region has vertices at $(0,0), (0,3), (k,3)$, and $(k,1)$, where k is a positive constant. If the x-coordinate of the centroid of the region is $\bar{x} = 7$, find the value of k.

3. (14 pts) Consider the sequence $a_n = \dfrac{1+\ln(n)}{n}$ for $n = 3, 4, 5, \ldots$. Be sure to justify your answers to the following questions.

   (a) Is the sequence monotonic?

   (b) Is the sequence bounded?

   (c) Does the sequence converge? If so, what does it converge to?

4. (18 pts) Let the nth partial sum of a series $\displaystyle\sum_{n=1}^{\infty} a_n$ equal $s_n = 5 - \dfrac{5}{\sqrt{n+1}}$. Be sure to justify your answers to the following questions.

   (a) Find the values of a_1 and a_2, the first two terms of the series. Write each term as the sum or difference of two fractions.

   (b) Does $\displaystyle\sum_{n=1}^{\infty} a_n$ converge or diverge? If it converges, find its sum.

   (c) Does a_n converge or diverge? If it converges, what does it converge to?

(d) Does $\sum_{n=1}^{\infty} s_n$ converge or diverge? If it converges, find its sum.

5. (16 pts) Let b be a constant. Consider the geometric series given by $b - \frac{b^2}{4} + \frac{b^3}{16} - \cdots$.

   (a) Write the series in the form $\sum_{n=1}^{\infty} ar^{n-1}$.

   (b) Find all values of b for which the series will converge.

   (c) If the sum of the series is $8/5$, what is the value of b?