1. Find the volume, $\mathcal{V}$, of a ball of radius R in four dimensions. Hint #1: In general, in n dimensions (for any positive integer n), we of course trivially have that $\mathcal{V} = \int_{\mathcal{B}} \mathrm{dV}$, if $\mathcal{B}$ is the ball-shaped region whose volume we are seeking and dV is the n-dimensional volume element. Hint #2: For any fixed n, then, we obtain $\mathcal{V}$ by first explicitly writing dV in a choice of coordinates, then secondly knowing the bounds of $\mathcal{B}$ in our choice of coordinates, and then thirdly by actually performing the n-dimensional integration of dV over $\mathcal{B}$. Hint #3: First do the $n = 2$ case (where volume is also called "area" and a ball is also called a "disk"), then do the $n = 3$ case. (The $n = 1$ case works as well, but is less instructive.) Can you find the answer for all n?

2. Find explicit analytical expressions for the inverse hyperbolic trigonometric functions $\cosh^{-1}(x)$, $\sinh^{-1}(x)$, and $\tanh^{-1}(x)$. That is, invert $y = \cosh(x) := \frac{1}{2}(e^x + e^{-x})$ to solve for y, and then do likewise for $y = \sinh(x) := \frac{1}{2}(e^x - e^{-x})$ and $y = \tanh(x) := \sinh(x)/\cosh(x)$ (or use the previous two answers). Caution: pay attention to domains of definition.