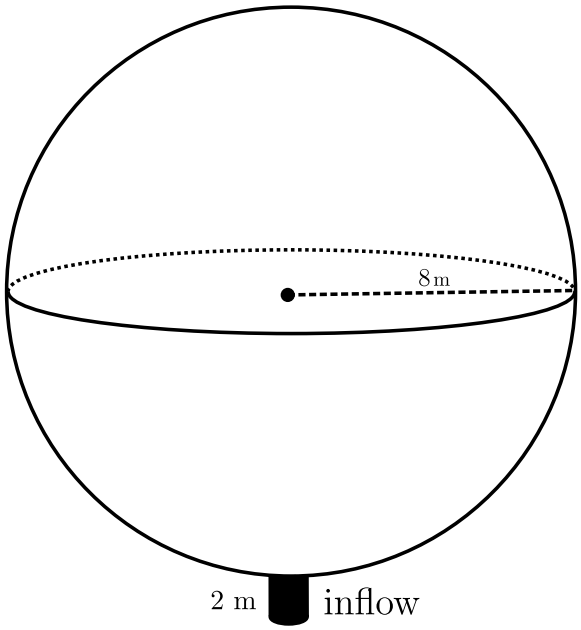
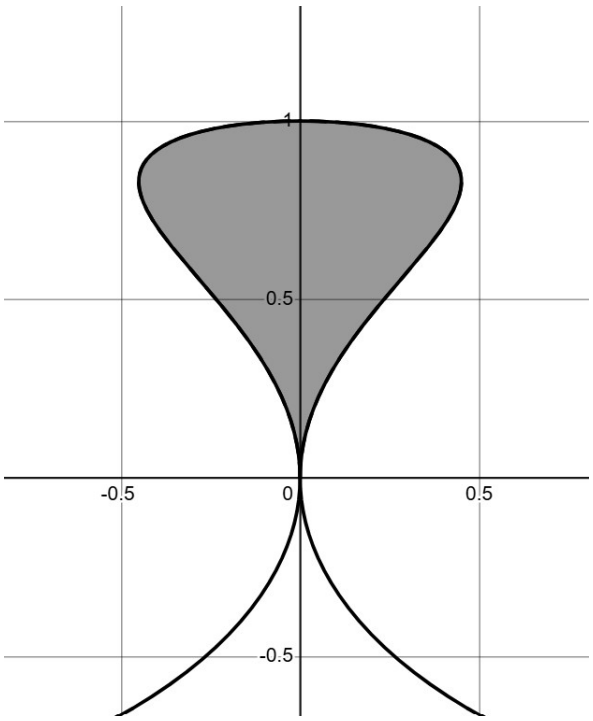
1. **Filling a spherical tank.** A spherical tank with an inner radius of 8 m has its lowest point 2 m above the ground. It is filled by a pipe that feeds the tank at its lowest point. Ignoring the volume of the inflow pipe, how much work is required to fill the tank if it is initially empty?

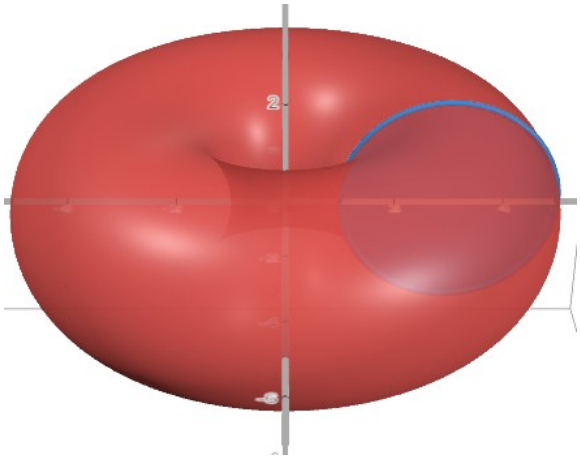


2. **Implicitly defined regions.** Determine the area of the shaded region bounded by the curve $x^2 = y^4(1 - y^3)$.



3. **Hemispherical bowl.** A hemispherical bowl of radius 8 inches is filled to a depth of h inches, where $0 \leq h \leq 8$. Find the volume of water in the bowl as a function of h. (Check the special cases of $h = 0$ and $h = 8$.)

4. **Volume of a doughnut.** A doughnut shaped solid is formed by revolving a circle of radius 2 centered at the point (3,0) about the y-axis. Find the volume of this doughnut.



5. **Fermat's volume ratio.** Let R be the region bounded by the curve $y = \sqrt{x+a}$ with $a > 0$, the y-axis, and the x-axis. Let S be the solid generated by revolving R about the y-axis. Let T be the inscribed cone that has the same circular base as S and height $\sqrt{a}$. Show that

$$\frac{\text{volume}(S)}{\text{volume}(T)} = \frac{8}{5}.$$

Start by drawing the corresponding graph.