1. Find the number \( b \) such that the line \( y = b \) divides the finite region bounded by the curves \( y = x^2 \) and \( y = 4 \) into two regions with equal areas.  
(\emph{Hint}: Set up two integrals with respect to \( y \), not with respect to \( x \).)

2. We will examine the mathematical object “Gabriel’s horn” or “Torricelli’s Trumpet.”  
\textit{NB}: Torricelli was the first mathematician to study this object, and was a student of Galileo in the 17th century.

(a) Let \( b \) be an arbitrary real number at least 1. Find the volume of the solid obtained by rotating the region enclosed by \( x = 1 \), \( x = b \), \( y = 0 \), and \( y = 1/x \) about the \( x \)-axis. Sketch pictures of the region and the solid.

(b) Take the limit of your answer from (a) as \( b \) goes to \( \infty \). What have you found?

(c) By (b), you can fill this object with a finite amount of paint, but…  
\textit{Fact}: The surface area of this solid is infinite.\(^1\)  
\textit{Discuss}: Is this a paradox?

3. Set up but do not evaluate an integral to find the volume of the solid whose base is the ellipse \( x^2/4 + y^2 = 1 \) and whose cross-sections perpendicular to the base and the \( x \)-axis are semicircles. Try to draw it!

4. Set up but do not evaluate an integral to find the volume of the solid whose base is a disk with radius \( r \) and whose parallel cross-sections perpendicular to the base are squares. Try to draw it!

5. Set up but do not evaluate an integral to find the volume of the solid obtained by rotating the region enclosed by the curves \( y = x^2 \) and \( x = y^2 \) about the line \( y = 1 \). Sketch a picture of the region and a representative disk or annulus (washer).

6. Set up but do not evaluate an integral to find the volume of the solid obtained by rotating the region enclosed by the curves \( y = x^3 \), \( y = 0 \), and \( x = 1 \) about the line \( x = 2 \). Sketch a picture of the region and a representative disk or annulus (washer).

7. Set up but do not evaluate an integral to find the volume of the solid obtained by rotating the region enclosed by the curves \( y = \sin x \), \( x = \pi/2 \), and \( y = 0 \) about the \( x \)-axis. Sketch a picture of the region and a representative disk or annulus (washer).

8. Set up but do not evaluate an integral to find the volume of the solid obtained by rotating the region enclosed by the curves \( 2x = y^2 \), \( x = 0 \), and \( y = 4 \) about the \( y \)-axis. Sketch a picture of the region and a representative disk or annulus (washer).

9. Set up but do not evaluate an integral to find the volume of the solid obtained by rotating the region enclosed by the curves \( y = 4x - 3 \), \( y = 1 \), \( x = 1 \), and \( x = 4 \) about the \( x \)-axis. Sketch a picture of the region and a representative disk or annulus (washer).

\(^1\)This can be shown using material in Calculus 2.