**Note:** The best way to start a volume problem is to draw pictures.

| **Volume Formulae** | **Explanation** |
|---|---|
| $$Volume = \int_a^b A(x)\,dx$$ | General rule for finding volume of a solid with respect to $x$. $A(x)$ is the area of the cross section (at position x). |
| $$Volume = \int_c^d A(y)\,dy$$ | General rule for finding volume of a solid with respect to $y$. $A(y)$ is the area of the cross section (at position y). |

| **How to Find** $A(x)$ | **Explanation** |
|---|---|
| $$A(x) = \pi(R^2 - r^2)$$ | If the cross sections are disks or washers. $R =$ outer radius $r =$ inner radius |
| $$A(x) = 2\pi r \cdot h$$ | If the cross sections are cylinders. $r =$ radius of cylinder $h =$ height |

1. Let $R$ be the region bounded by the graphs of $f(x) = 2 - 2x^2$ and $g(x) = 0$.
   (a) Sketch the region bounded by $f(x)$ and $g(x)$ on the same coordinate plane, and label the region $S$. Find the intersection points.

(b) Set up an integral to find the volume of the solid formed by revolving the region $S$ about the $x$-axis. **Do not evaluate the integral.**

(c) Set up an integral to find the volume of the solid formed by revolving the region $S$ about the line $y = 5$. **Do not evaluate the integral.**

(d) Set up an integral to find the volume of the solid formed by revolving the region $S$ about the line $x = -2$. **Do not evaluate the integral.** (Hint: Cylinders)

2. Let $S$ be the region bounded by the graphs of $f(x) = 2x^2$ and $g(x) = 2\sqrt{x}$. Solve the following problems.

   (a) Sketch the region, and label it $S$. Find its intersection points

   (b) Set up an integral to find the volume of the solid formed by revolving the region $S$ about the $y$-axis. **Do not evaluate the integral.**

   (c) Set up an integral to find the volume of the solid formed by revolving the region $S$ about the line $x = -1$. **Do not evaluate the integral.**

3. Sketch the region $S$ bounded by the curves $y = 4 - x^2$ and $y = x^2 - 4$. Find the volume of the solid obtained by rotating $R$ about the line $x = 2$.