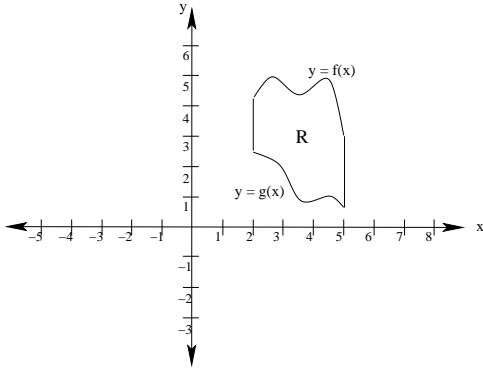


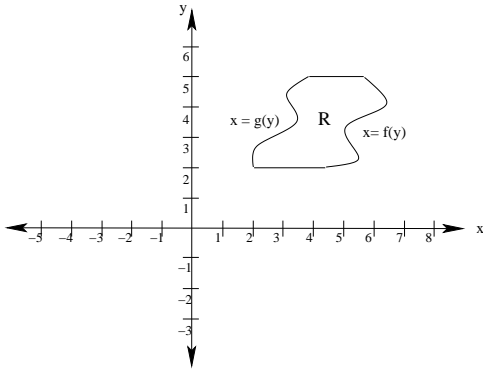
1. Let  $R$  be the region bounded by the graphs of  $y = f(x)$ ,  $y = g(x)$ ,  $x = 2$ , and  $x = 5$  (see graph below).



Set up an integral (you do **not** need to evaluate it) that can be used to find each of the following:

- The area of  $R$
- The volume of the solid generated if  $R$  is revolved about the  $x$ -axis.
- The volume of the solid generated if  $R$  is revolved about the  $y$ -axis.
- The volume of the solid generated if  $R$  is revolved about  $x = 9$ .
- The volume of the solid generated if  $R$  is revolved about  $x = -4$ .
- The volume of the solid generated if  $R$  is revolved about  $y = 8$ .
- The volume of the solid generated if  $R$  is revolved about  $y = -2$ .

2. Let  $R$  be the region bounded by the graphs of  $x = f(y)$ ,  $x = g(y)$ ,  $y = 2$ , and  $y = 5$  (see graph below).

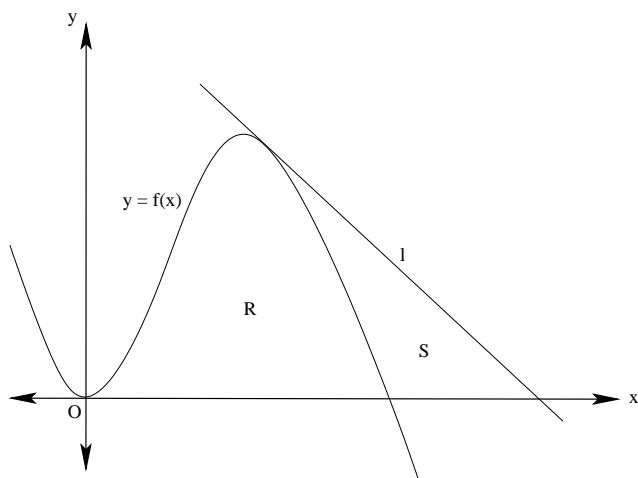


Set up an integral (you do **not** need to evaluate it) that can be used to find each of the following:

- (a) The area of  $R$
  
- (b) The volume of the solid generated if  $R$  is revolved about the  $x$ -axis.
  
- (c) The volume of the solid generated if  $R$  is revolved about the  $y$ -axis.
  
- (d) The volume of the solid generated if  $R$  is revolved about  $x = 9$ .
  
- (e) The volume of the solid generated if  $R$  is revolved about  $x = -4$ .
  
- (f) The volume of the solid generated if  $R$  is revolved about  $y = 8$ .
  
- (g) The volume of the solid generated if  $R$  is revolved about  $y = -2$ .

3. A doughnut-shaped solid is called a **torus**. Use the washer method to calculate the volume of the torus obtained by rotating the region inside the circle with equation  $(x - a)^2 + y^2 = b^2$  around the  $y$ -axis (assume that  $a > b$ ). Hint: Evaluate the integral by interpreting it as the area of a circle.

4. Let  $R$  be the region bounded by the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ . Show that the solid obtained by rotating  $R$  about the  $y$ -axis (called an **ellipsoid**) has volume  $\frac{4}{3}\pi a^2 b$ .



5. (From the 200? AP Calculus AB exam.) Let  $f$  be the function given by  $f(x) = 4x^2 - x^3$ , and let  $\ell$  be the line  $y = 18 - 3x$ , where  $\ell$  is tangent to the graph of  $f$ . Let  $R$  be the region bounded by the graph of  $f$  and the  $x$ -axis, and let  $S$  be the region bounded by the graph of  $f$ , the line  $\ell$ , and the  $x$ -axis, as shown above. Find the volume of the solid generated when  $R$  is revolved about the  $x$ -axis.

6. (From the 200? AP Calculus AB exam.) Let  $R$  be the region enclosed by the graph of  $y = \sqrt{x-1}$ , the vertical line  $x = 10$ , and the  $x$ -axis.

(a) Find the area of  $R$ .

(b) Find the volume of the solid generated when  $R$  is revolved about the horizontal line  $y = 3$ .

(c) Find the volume of the solid generated when  $R$  is revolved about the vertical line  $x = 10$ .