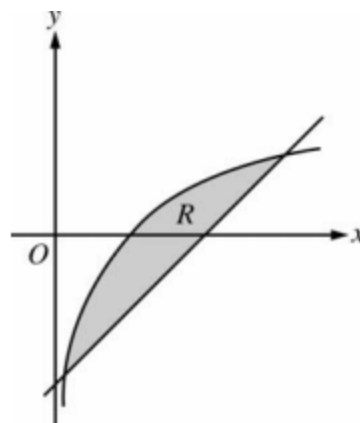


## AP Calculus Free Response Questions – Area and Volume

### 2006 #1

Let  $R$  be the shaded region bounded by the graph of  $y = \ln x$  and the line  $y = x - 2$ , as shown above.

- Find the area of  $R$ .
- Find the volume of the solid generated when  $R$  is rotated about the horizontal line  $y = -3$ .
- Write, but do not evaluate, an integral expression that can be used to find the volume of the solid generated when  $R$  is rotated about the  $y$ -axis.

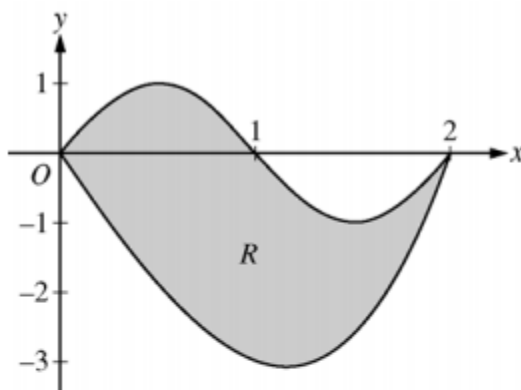


### 2007 #1

Let  $R$  be the region in the first and second quadrants bounded above by the graph of  $y = \frac{20}{1+x^2}$  and below by the horizontal line  $y = 2$ .

- Find the area of  $R$ .
- Find the volume of the solid generated when  $R$  is rotated about the  $x$ -axis.
- The region  $R$  is the base of a solid. For this solid, the cross sections perpendicular to the  $x$ -axis are semicircles. Find the volume of this solid.

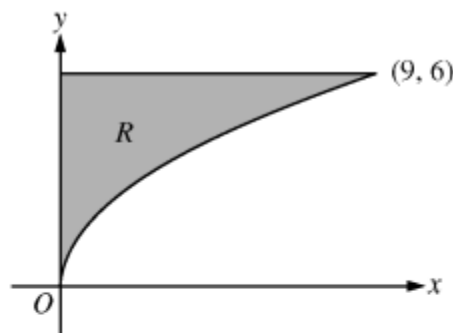
### 2008 #1



Let  $R$  be the region bounded by the graphs of  $y = \sin(\pi x)$  and  $y = x^3 - 4x$ , as shown in the figure above.

- Find the area of  $R$ .
- The horizontal line  $y = -2$  splits the region  $R$  into two parts. Write, but do not evaluate, an integral expression for the area of the part of  $R$  that is below this horizontal line.
- The region  $R$  is the base of a solid. For this solid, each cross section perpendicular to the  $x$ -axis is a square. Find the volume of this solid.
- The region  $R$  models the surface of a small pond. At all points in  $R$  at a distance  $x$  from the  $y$ -axis, the depth of the water is given by  $h(x) = 3 - x$ . Find the volume of water in the pond.

2010 #1

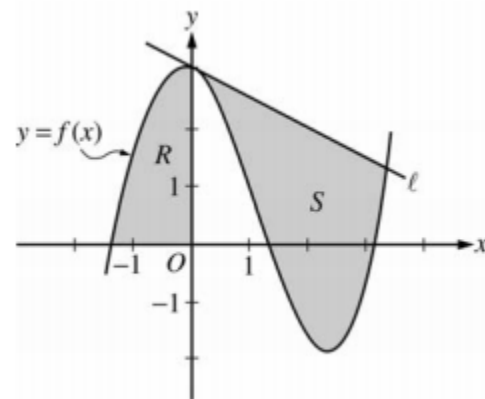


Let  $R$  be the region in the first quadrant bounded by the graph of  $y = 2\sqrt{x}$ , the horizontal line  $y = 6$ , and the  $y$ -axis, as shown in the figure above.

- Find the area of  $R$ .
- Write, but do not evaluate, an integral expression that gives the volume of the solid generated when  $R$  is rotated about the horizontal line  $y = 7$ .
- Region  $R$  is the base of a solid. For each  $y$ , where  $0 \leq y \leq 6$ , the cross section of the solid taken perpendicular to the  $y$ -axis is a rectangle whose height is 3 times the length of its base in region  $R$ . Write, but do not evaluate, an integral expression that gives the volume of the solid.

2006B #1

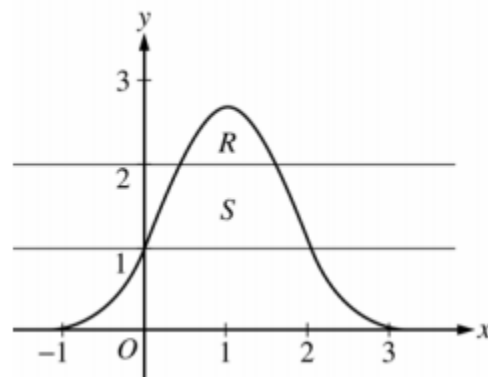
Let  $f$  be the function given by  $f(x) = \frac{x^3}{4} - \frac{x^2}{3} - \frac{x}{2} + 3\cos x$ . Let  $R$  be the shaded region in the second quadrant bounded by the graph of  $f$ , and let  $S$  be the shaded region bounded by the graph of  $f$  and line  $\ell$ , the line tangent to the graph of  $f$  at  $x = 0$ , as shown above.



- Find the area of  $R$ .
- Find the volume of the solid generated when  $R$  is rotated about the horizontal line  $y = -2$ .
- Write, but do not evaluate, an integral expression that can be used to find the area of  $S$ .

2007 B #1

Let  $R$  be the region bounded by the graph of  $y = e^{2x-x^2}$  and the horizontal line  $y = 2$ , and let  $S$  be the region bounded by the graph of  $y = e^{2x-x^2}$  and the horizontal lines  $y = 1$  and  $y = 2$ , as shown above.



- Find the area of  $R$ .
- Find the area of  $S$ .
- Write, but do not evaluate, an integral expression that gives the volume of the solid generated when  $R$  is rotated about the horizontal line  $y = 1$ .