

Using Linear Equations to Define Geometric Solids

1. a. Plot the points indicated in the table on the provided grid, and then draw horizontal and vertical line segments to connect the adjacent points.

x	0	0	6	6
y	1	3	3	1

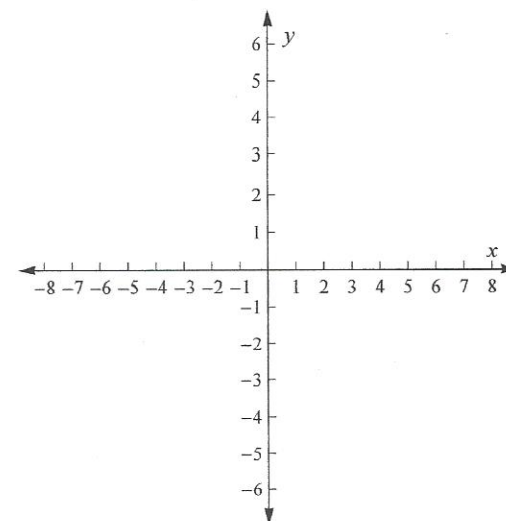
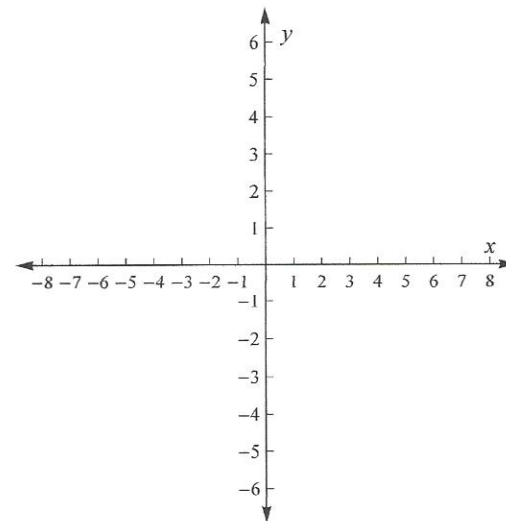
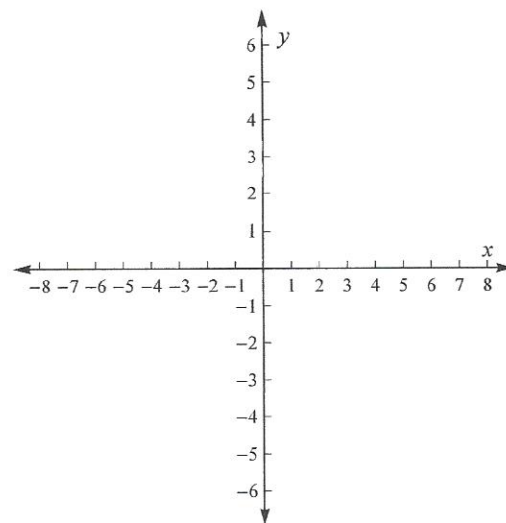
- b. What are the equations for the four lines that bound this region?

- c. What is the perimeter and what is the area of the bounded region?

- d. Draw and describe the geometric solid that is created by revolving the bounded region about the y -axis. What is the shape of the solid's vertical cross-sections? What is the shape of the solid's horizontal cross-sections?

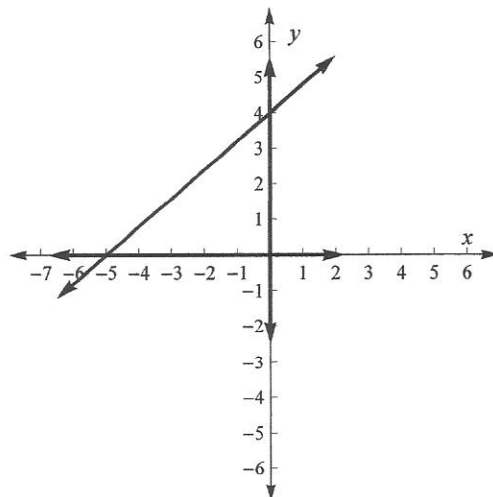
- e. What is the volume of the solid? State the answer in terms of π .

- f. Draw and describe the geometric solid formed by revolving the bounded region about the x -axis. What is the volume of this solid? State the answer in terms of π .



2. The region, R , is bounded by three lines.

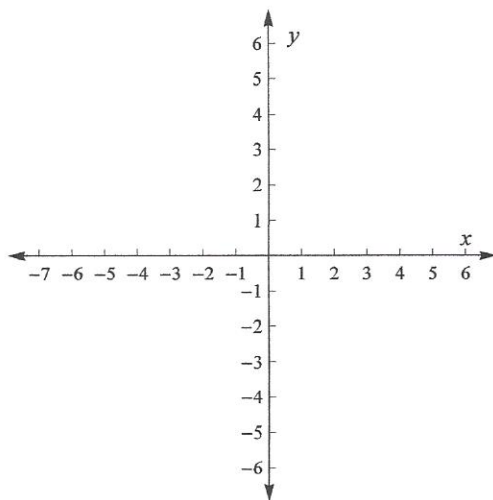
a. What are the equations of the lines that define the bounded region?



b. What is the perimeter of R ?

c. What is the area of R ?

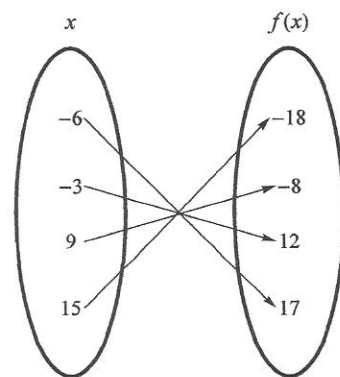
d. Draw and describe the geometric solid formed by revolving region R about the y -axis. What is the volume of this solid? State the answer in terms of π .



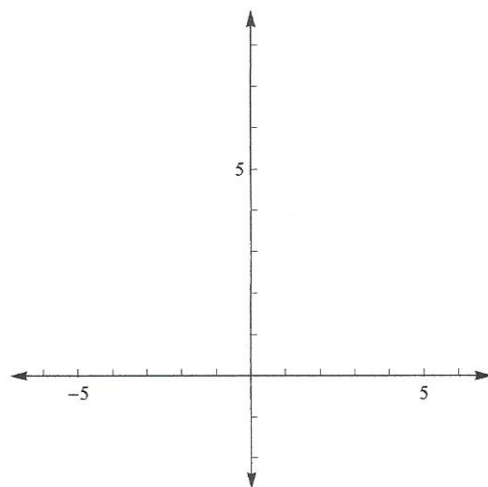
e. Will the volume of the cone formed when the region R is revolved about the x -axis, instead of the y -axis, be greater, less, or the same? Explain the reasoning that leads to your answer.

3. Given the following

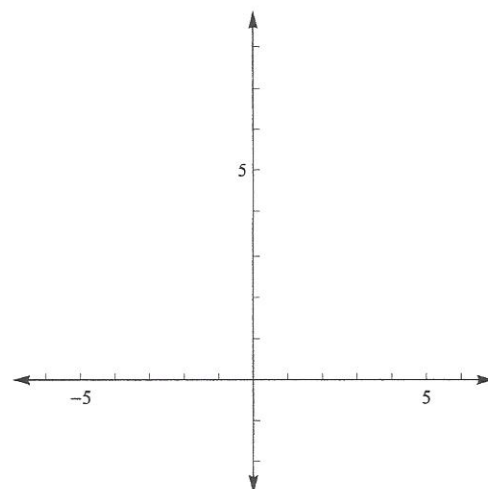
- a linear function $f(x)$
- a linear function $g(x)$ for which $g(4) = 0$ and $g(7) = 0$
- a vertical line that contains the point $(3, 7)$



- a. What are the equations of $f(x)$, $g(x)$, and the vertical line?
- b. Graph and shade the region bounded by $f(x)$, $g(x)$, the vertical line, and the y -axis. Describe the region and list the coordinates of the vertices.



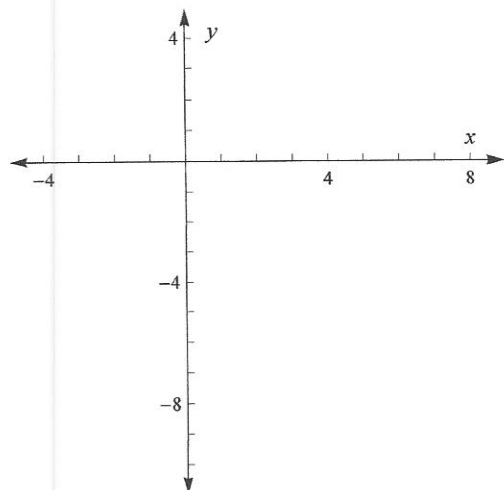
- c. What is the perimeter and what is the area of the bounded region?
- d. On the grid provided for part (b), sketch the solid that results from revolving the region about the y -axis. Describe the solid. What is the volume of this solid? State the answer in terms of π .



- e. Draw and describe the geometric solid formed by revolving the bounded region about the vertical line $x = 3$. What is the volume of this solid? State the answer in terms of π .

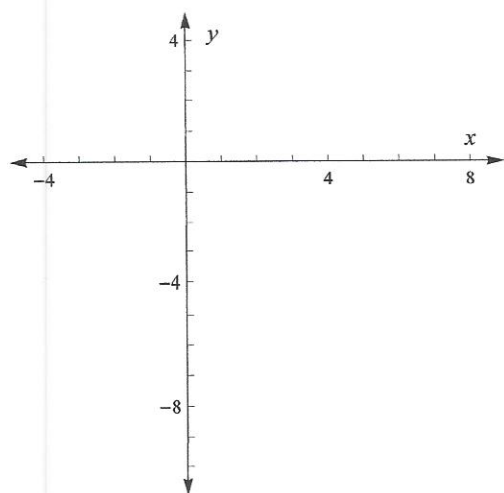
4. A region is bounded by the lines $y = -\frac{5}{4}x$, $y = \frac{3}{4}(x-4) - 5$, and $x = 0$.

a. Graph each linear equation and shade the region bounded by these three lines.



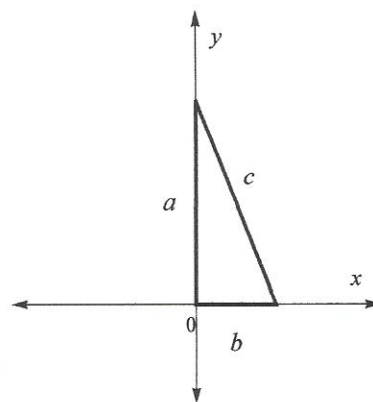
b. Describe the region, determine the vertices, and calculate the area of the region.

c. Draw and describe the geometric solid that is created by revolving the bounded region about the y-axis. What is the volume of the solid? State the answer in terms of π .

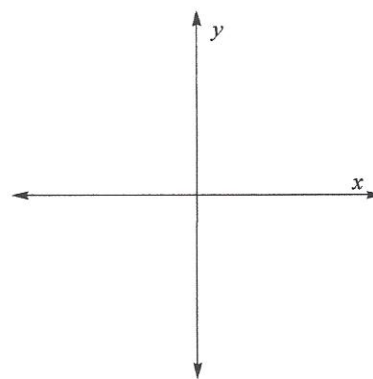


5. A triangular region has sides of lengths a , b , and c , as shown on the graph.

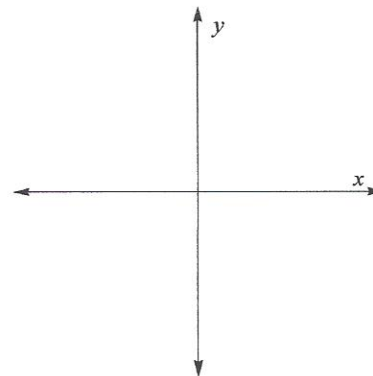
a. What is the area of the region?



b. Draw and describe the geometric solid that is created by revolving the region about the y -axis. What is the volume of this solid? State the answer in terms of π .

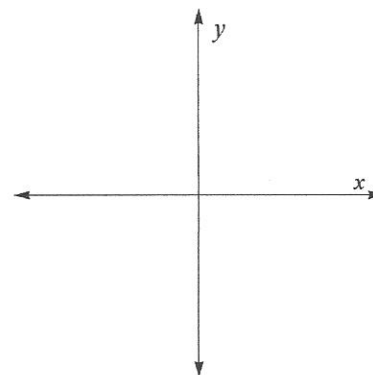


c. Draw and describe the geometric solid that is created by revolving the region about the x -axis. What is the volume of this solid? State the answer in terms of π .



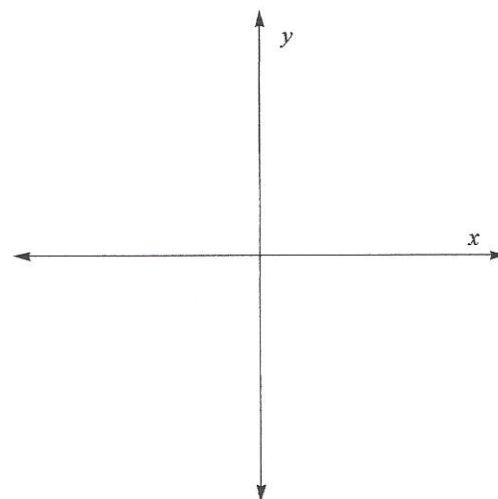
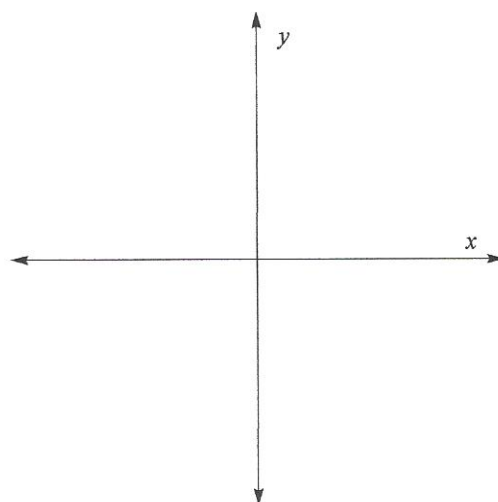
d. If the volumes of the solids from part (b) and part (c) are the same, what is the relationship between a and b ? Show the analysis that leads to your conclusion.

e. If the region is revolved about the line $x = b$, describe how to determine the volume of the solid that is created. What is that volume?

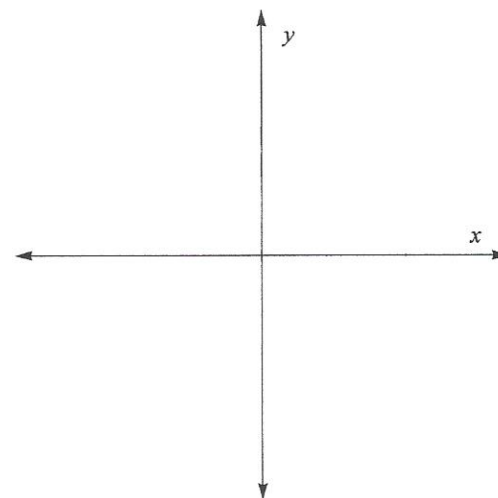


6. A region is bounded by the lines
 $y = a$, $y = a + 3$, $x = b$, $x = b + 5$, where $a > 0$ and $b > 0$.

- Sketch a graph and shade the region bounded by these lines on the axes provided.
- List the vertices of the shape.
- Identify the figure formed by the shaded region and determine the area of the shaded region.
- Draw and describe the geometric solid that is created by revolving the region about the y -axis. Show that the volume of this solid is $(30\pi b + 75\pi)$ cubic units.



- Draw and describe the geometric solid formed by revolving the region about the x -axis. What is the volume of this solid? State the answer in terms of π .



7. Use the Mathematica demonstration to visualize the region with vertices $(0, 1)$, $(1, 2)$, $(2, 2)$ and $(4, 0)$. Create a sketch of the region.

a. What is the perimeter and what is the area of the bounded region?

b. What is the system of equations that creates the bounded region?

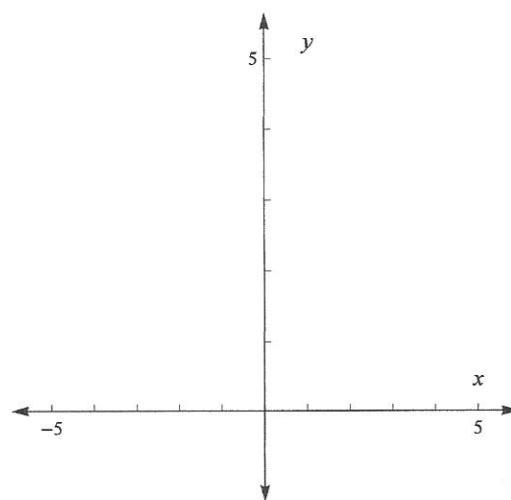
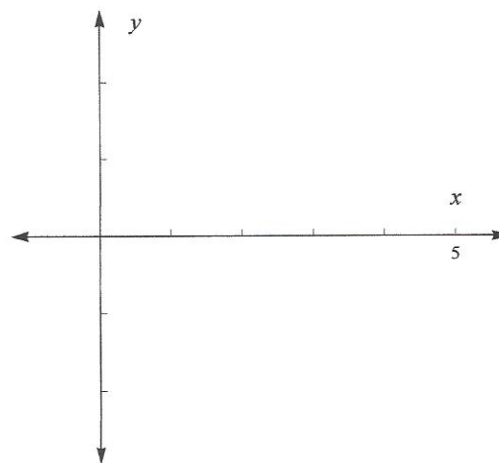
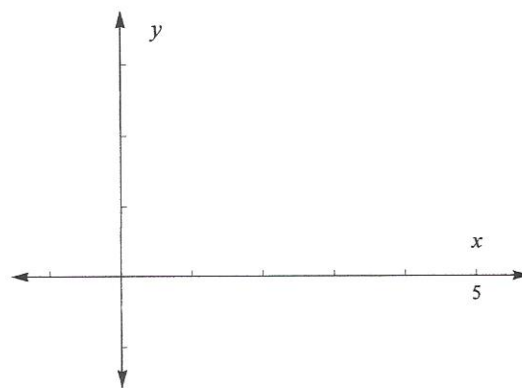
c. Use the Mathematica demonstration to revolve the figure about the x -axis. Draw a sketch of the figure created by the revolution on the grid.

d. Explain a method that you could use to calculate the volume of the solid from part (c).

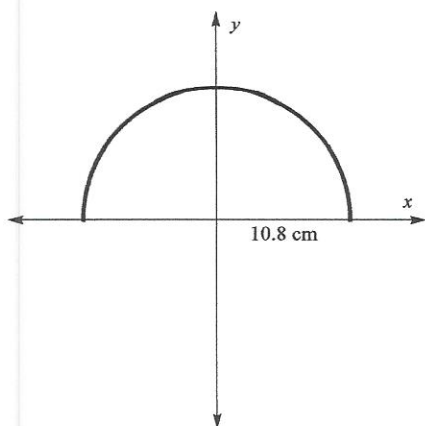
e. Use the Mathematica demonstration to revolve the figure about the y -axis. Draw a sketch of the figure created by the revolution on the grid provided.

f. Explain a method that you could use to calculate the volume of the solid from part (e).

g. What is the volume of either the figure revolved about the x -axis or the figure revolved about the y -axis? State the answer in terms of π .

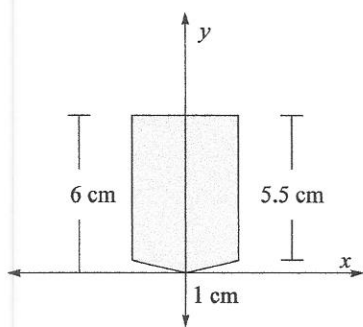


8. Custom Bowling Balls, Inc. has designed a mold to make a new series of bowling balls out of resin. The mold has a radius of 10.8 cm as illustrated in the 2-dimensional drawing.

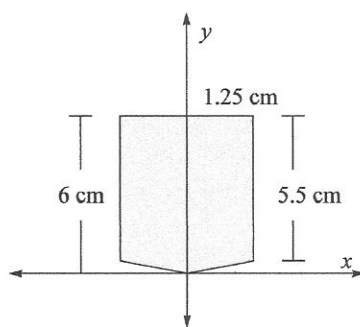


- To view the three-dimensional mold, revolve the figure about the x -axis. What three-dimensional figure does this revolution create?
- What is the circumference of the great circle of the bowling ball? Record the answer correct to three decimal places.
- How much resin is needed to fill the mold? Record the answer correct to three decimal places.

After the bowling ball has been removed from the mold, Custom Bowling Balls Inc. will custom fit a customer's grip. After measuring the customer's fingers and thumb, two drill bits are selected for drilling the holes. The two-dimensional cross-sections for each drill bit used for one customer are shown.



Drill bit for finger holes



Drill bit for thumb hole

- To model the hole created by drilling, revolve each of these figures about the y -axis. Describe the shapes of the holes that are created. Based on this model, what is the volume of the portion of the ball that will be removed by each bit?