# **Rotations Interactive Text Version**

When a two-dimensional shape is rotated about a line, it creates a three-dimensional figure. The shape of the three-dimensional figure depends on both the line of rotation and the original shape.

A right triangle, a circle, and a parallelogram are shown. Each is shown graphed in quadrant 1 of the coordinate plane. When selected, different lines of rotation are shown.

* **right triangle**
  + ***x*-axis:** A right triangle has the vertices [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 0 comma 3 right parenthesis], and [Alt: left parenthesis 2 comma 0 right parenthesis]. It is rotated about the *x*-axis. This rotation creates the three-dimensional figure of a right cone. The vertex of the cone has the coordinates [Alt: left parenthesis 2 comma 0 right parenthesis]. The diameter of the base of the cone is 6 units long and lies on the *y*-axis.



* + ***y* -axis:** A right triangle has the vertices [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 0 comma 3 right parenthesis], and [Alt: left parenthesis 2 comma 0 right parenthesis]. It is rotated about the *y*-axis. This rotation creates the three-dimensional figure of a right cone. The vertex of the cone has the coordinates [Alt: left parenthesis 0 comma 3 right parenthesis]. The diameter of the base of the cone is 4 units long and lies on the *x*-axis.



* + **line 3*x* + 2*y* = 6:** A right triangle has the vertices [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 0 comma 3 right parenthesis], and [Alt: left parenthesis 2 comma 0 right parenthesis]. It is rotated around the line 3*x* + 2*y* = 6. This rotation creates a three-dimensional figure made of two right cones that share a base. The vertex of the first cone has the coordinates [Alt: left parenthesis 0 comma 3 right parenthesis]. The vertex of the second cone has the coordinate [Alt: left parenthesis 2 comma 0 right parenthesis]. The shared base of the cones has a diameter that connects the points [Alt: left parenthesis 0 comma 0 right parenthesis] and [Alt: left parenthesis start fraction 36 over 13 end fraction comma start fraction 24 over 13 end fraction right parenthesis].



* + **line** [Alt: x equals negative 2]**:** A right triangle has the vertices [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 0 comma 3 right parenthesis], and [Alt: left parenthesis 2 comma 0 right parenthesis]. It is rotated around the line [Alt: x equals negative 2]. This rotation creates a three-dimensional figure that is a frustum with a cylindrical section hollowed out of the center. The diameter of the base of the frustum is 8 units long and lies on the *x*-axis. The top of the frustum has a diameter of 4 units. The hollow cylinder centered inside the frustum has a diameter of 4 units.



* + **line *x* = 1:** A right triangle has the vertices [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 0 comma 3 right parenthesis], and [Alt: left parenthesis 2 comma 0 right parenthesis]. It is rotated around the line *x* = 1. This rotation creates a three-dimensional figure that is a cylinder with an upside-down right cone hollowed out of the top. The cylinder is 3 units high. The hollowed-out cone has a base diameter of 2 units and a height of 1.5 units.



* + **line** [Alt: y equals negative 1]**:** A right triangle has the vertices [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 0 comma 3 right parenthesis], and [Alt: left parenthesis 2 comma 0 right parenthesis]. It is rotated around the line [Alt: y equals negative 1]. This rotation creates a three-dimensional figure that is a frustum with a cylindrical section hollowed out in the center. The diameter of the base of the frustum is 8 units long and lies on the *y*-axis. The top of the frustum has a diameter of 2 units. The hollow cylinder centered inside the frustum has a diameter of 2 units.



* **circle**
  + ***x*-axis:** A circle has a radius of 1 unit and a center at [Alt: left parenthesis 1 comma 1 right parenthesis]. It is rotated around the *x*-axis. This rotation creates a three-dimensional figure that looks like a bagel or a torus. The hole in the center of the torus is collapsed so that it is touching itself at a single point on the *x*-axis.



* + ***y*-axis:** A circle has a radius of 1 unit and a center at [Alt: left parenthesis 1 comma 1 right parenthesis]. It is rotated around the *y*-axis. This rotation creates a three-dimensional figure that looks like a bagel or a torus. The hole in the center of the torus is collapsed so that it is touching itself at a single point on the *y*-axis.



* + **line *x* = 1:** A circle has a radius of 1 unit and a center at [Alt: left parenthesis 1 comma 1 right parenthesis]. It is rotated around the line *x* =1. This rotation creates the three-dimensional figure of a sphere.



* + **line *y* = 2:** A circle has a radius of 1 unit and a center at [Alt: left parenthesis 1 comma 1 right parenthesis]. It is rotated around the line *y* = 2. This rotation creates a three-dimensional figure that looks like a bagel or a torus. The hole in the center of the torus is collapsed so that it is touching itself at a single point with the coordinates [Alt: left parenthesis 1 comma 2 right parenthesis].



* + **line** [Alt: x equals negative 1]**:** A circle has a radius of 1 unit and a center at [Alt: left parenthesis 1 comma 1 right parenthesis]. It is rotated around the line [Alt: x equals negative 1]. This rotation creates a three-dimensional figure that looks like a bagel or a torus.



* **parallelogram**
  + ***y*-axis:** A parallelogram has vertices at [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 1 comma 3 right parenthesis], [Alt: left parenthesis 4 comma 3 right parenthesis], and [Alt: left parenthesis 3 comma 0 right parenthesis]. It is rotated around the *y*-axis. This rotation creates a three-dimensional figure that is a frustum with a right cone hollowed out of the center. The top base of the frustum has a diameter of 8 units. The diameter of the bottom base of the frustum is 6 units long and lies on the *x*-axis. The base of the hollowed-out cone centered inside the frustum has a diameter of 2 units. The vertex of the cone has the coordinates [Alt: left parenthesis 0 comma 0 right parenthesis].



* + **line** [Alt: x equals negative 1]**:** A parallelogram has vertices at [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 1 comma 3 right parenthesis], [Alt: left parenthesis 4 comma 3 right parenthesis], and [Alt: left parenthesis 3 comma 0 right parenthesis]. It is rotated around the line [Alt: x equals negative 1]. This rotation creates a three-dimensional figure that is a frustum with another frustum hollowed out of the center. The top base of the solid frustum has a diameter of 10 units. The diameter of the bottom base of the solid frustum is 8 units long and lies on the *x*-axis. The top base of the hollow frustum has a diameter of 4 units. The diameter of the bottom base of the hollow frustum is 2 units long and lies on the *x*-axis.



* + **line *x* = 1.5:** A parallelogram has vertices at [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 1 comma 3 right parenthesis], [Alt: left parenthesis 4 comma 3 right parenthesis], and [Alt: left parenthesis 3 comma 0 right parenthesis]. It is rotated around the line *x* = 1.5. This rotation creates a three-dimensional figure that is a frustum. The top base of the frustum has a diameter of 5 units. The diameter of the bottom base of the frustum is 3 units long and lies on the *x*-axis.



* + **line** [Alt: y equals negative 2 x minus 2]**:** A parallelogram has vertices at [Alt: left parenthesis 0 comma 0 right parenthesis], [Alt: left parenthesis 1 comma 3 right parenthesis], [Alt: left parenthesis 4 comma 3 right parenthesis], and [Alt: left parenthesis 3 comma 0 right parenthesis]. It is rotated around the line [Alt: y equals negative 2 x minus 2]*.* This rotation creates a three-dimensional figure that consists of two solid frustums that share a common base. Each solid frustum has another frustum hollowed out of its center. The common base of the solid frustums has a diameter of approximately 11.6 units. The top base of the first solid frustum has a diameter of approximately 6.3 units. The bottom base of the second solid frustum has a diameter of 7.2 units. The 2 hollow frustums share a common base with a diameter of 1.8 units. The top base of the first hollow frustum is 6.3 units. The bottom base of the second hollow frustum is 7.2 units.

