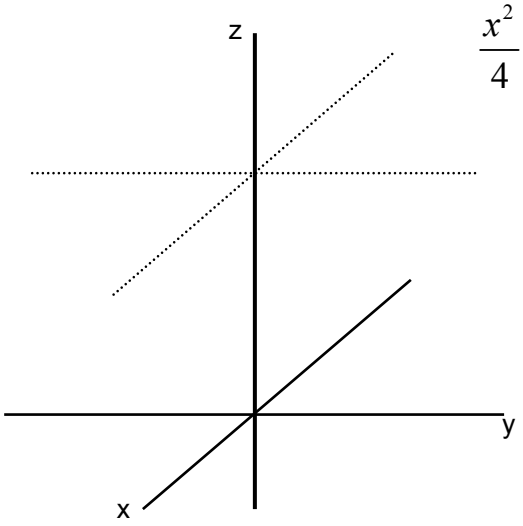
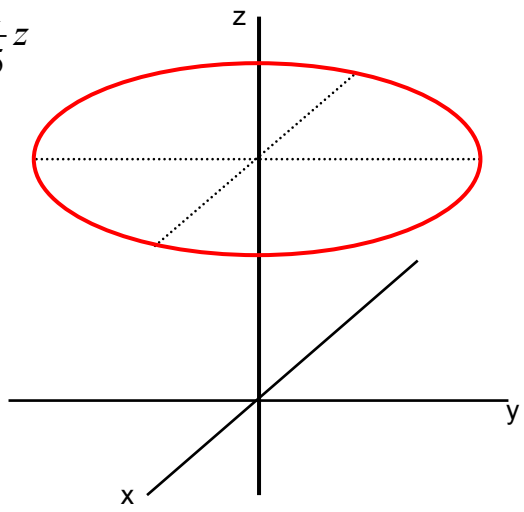
GRAPHING AN ELLIPTIC PARABOLOID

1. Start with a 3D set of axes with the y-axis parallel to the horizontal. At z = 5, very lightly sketch in two lines parallel to the x-axis and the y-axis.



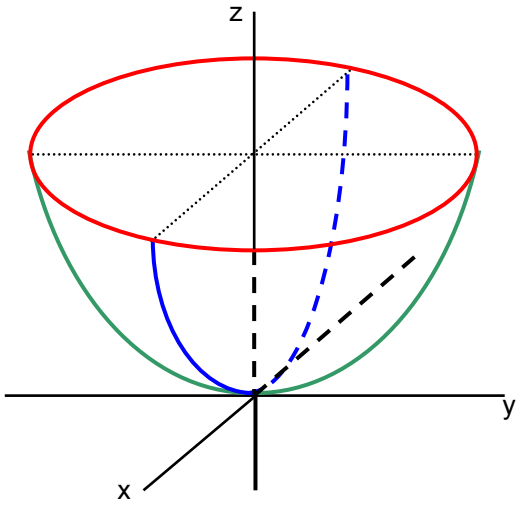
2. Draw an elliptical cross-section on the light axes. Use the equation to determine the endpoints for the ellipse.

$$\frac{x^2}{4}+\frac{y^2}{16}=\frac{1}{5}z$$



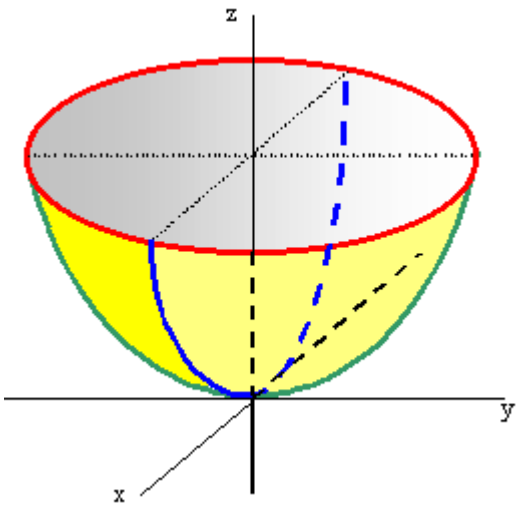
3. Draw the **trace parallel to the y-axis**. It is a parabola.

Draw the **trace parallel to the x-axis**. It is a parabola viewed from an angle.



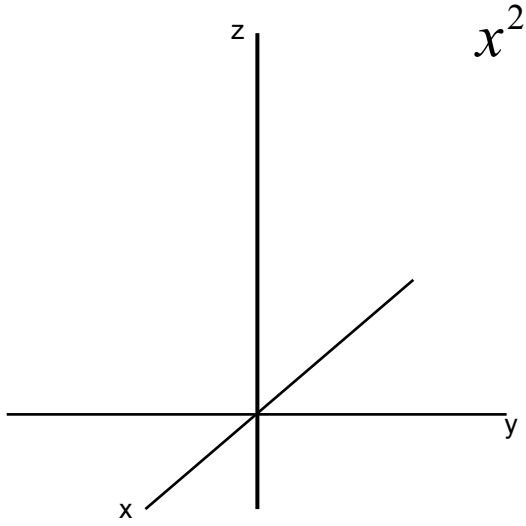
4. Touch up the drawing; add color and shading if you wish.

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=cz$$



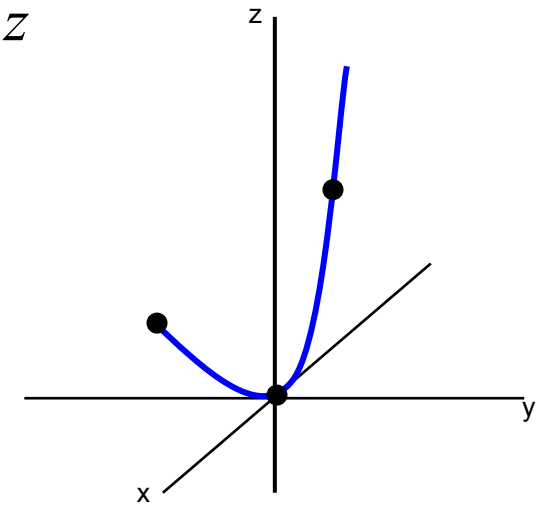
GRAPHING A PARABOLIC CYLINDER

1. Prepare a set of axes with a horizontal y-axis if desired.

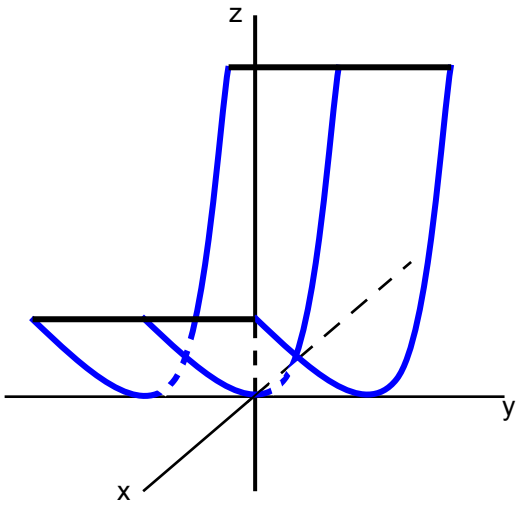


2. Plot the vertex and two points of the xz-trace. Draw a "J" through those points.

$$x^2 = 2z$$

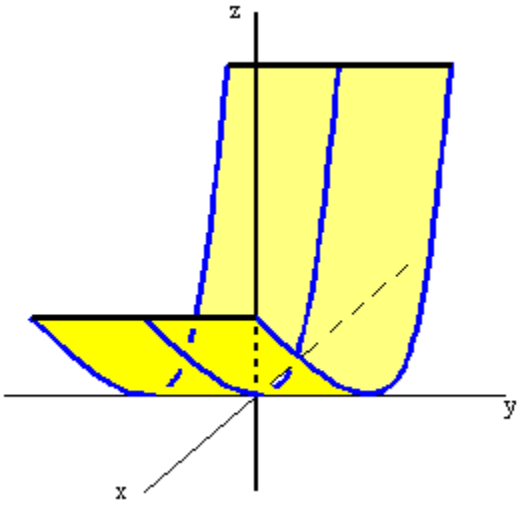


3. Draw two more Js parallel to the first, one on either side. Draw a line segment through each set of endpoints.



4. Touch up the drawing; add color and shading if you wish.

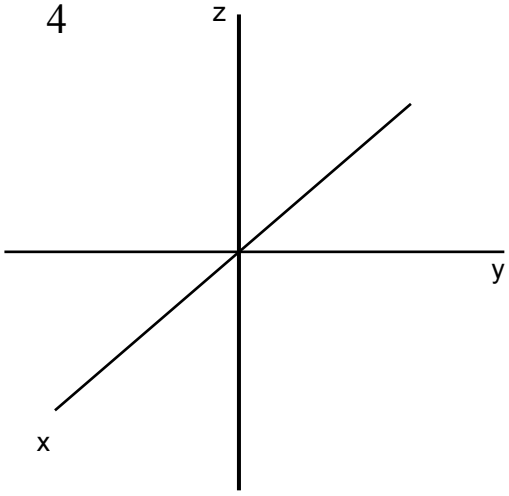
$x^2 = cz$



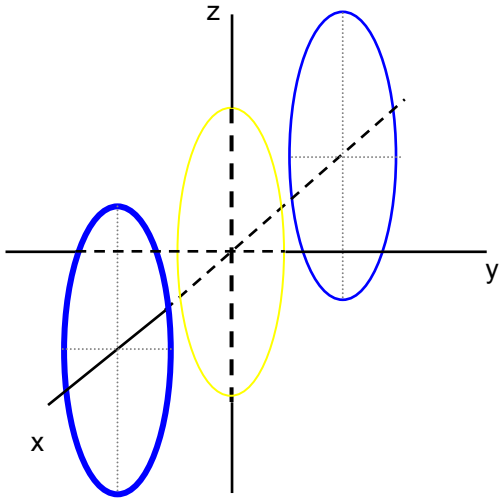
GRAPHING AN ELLIPTIC CYLINDER

1. Prepare a set of axes with a horizontal y-axis if desired.

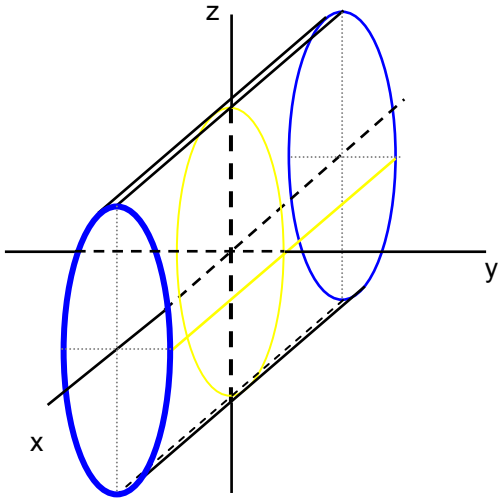
$$y^2 + \frac{z^2}{4} = 1$$



2. Lightly draw an ellipse for the yz-trace, and then make two more ellipses of the same size along the x-axis.

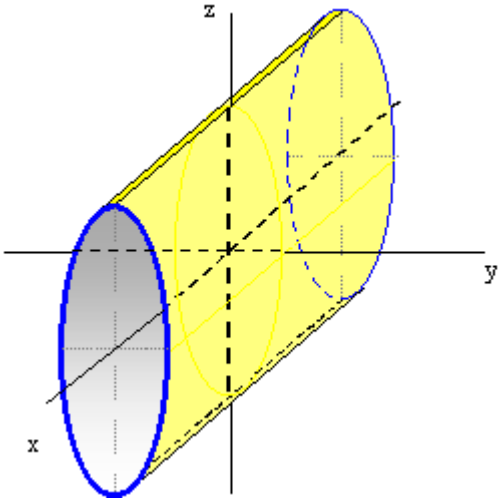


3. Draw straight lines for the edges of the cylinder. A solid line should connect the tops of the ellipses, and a dotted line should connect the bottoms.



4. Touch up the drawing; add color and shading if you wish.

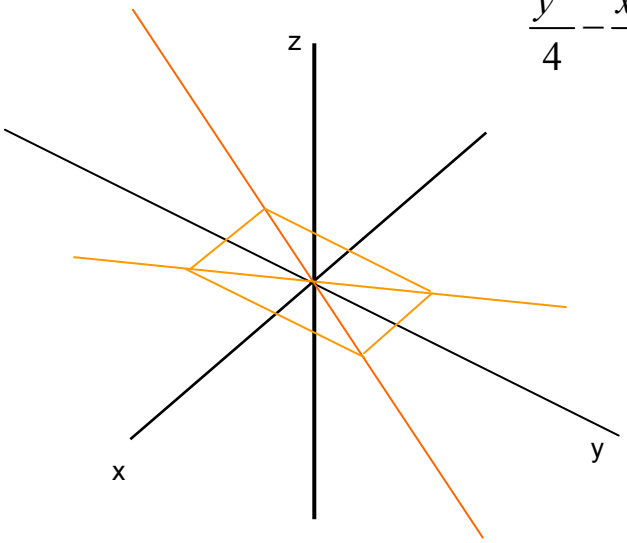
$$\frac{y^2}{a^2} + \frac{z^2}{b^2} = 1$$



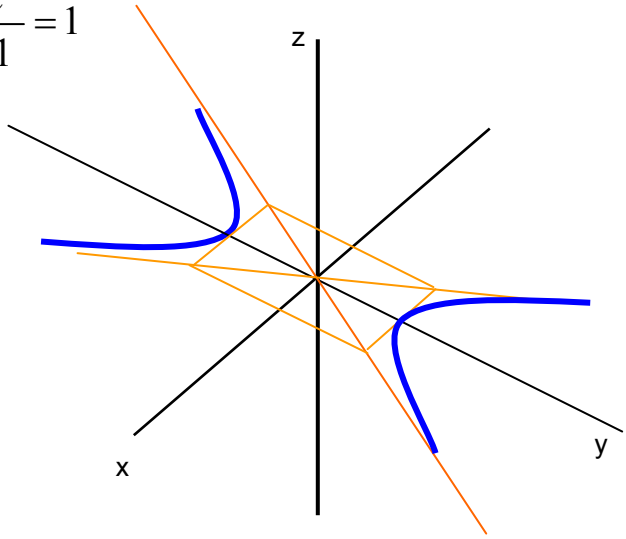
GRAPHING A HYPERBOLIC CYLINDER

1. Begin with a set of axes with the y-axis at an angle. Draw two parallel lines a units from the x axis and two parallel lines b units from the y-axis to form a rectangle. Then draw and extend the diagonals of the rectangle you have formed.

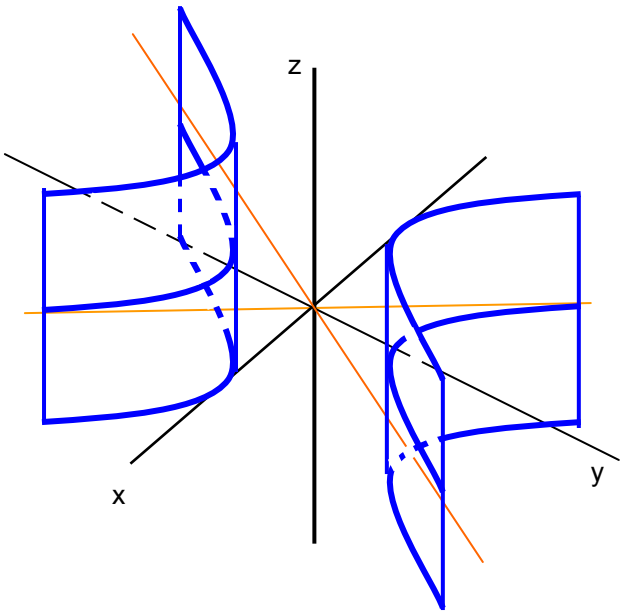
$$\frac{y^2}{4} - \frac{x^2}{1} = 1$$



2. Draw two arcs that brush against the edge of the rectangle and then move asymptotically close to the diagonals.

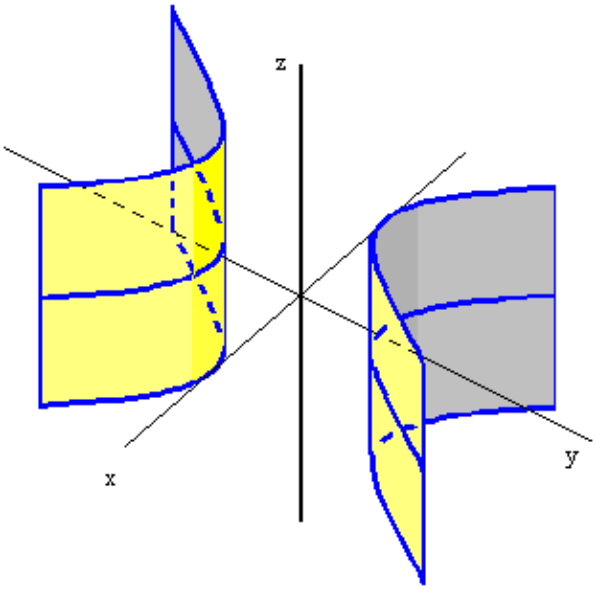


3. Draw exact copies of these arcs about three units above and three units below the first ones. Draw vertical line segments to connect the edges.



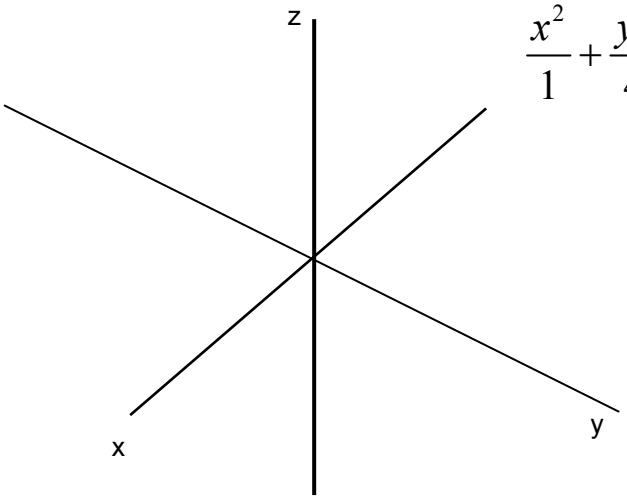
4. Touch up the drawing; add color and shading if you wish.

$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$



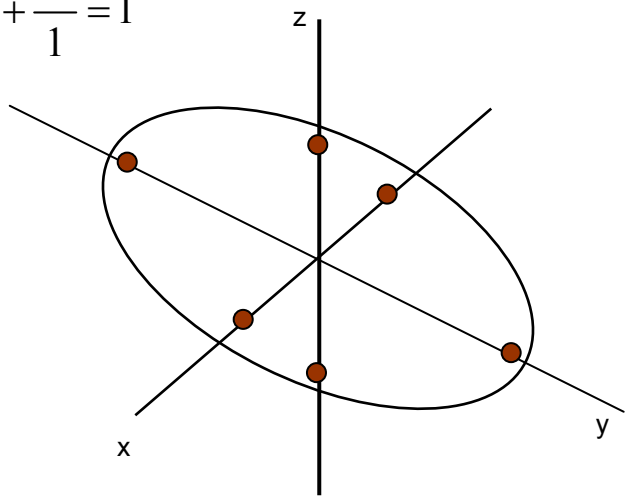
GRAPHING AN ELLIPSOID

1. Construct a set of axes with the y-axis at an angle. Mark off the endpoints of the axes of the ellipsoid.

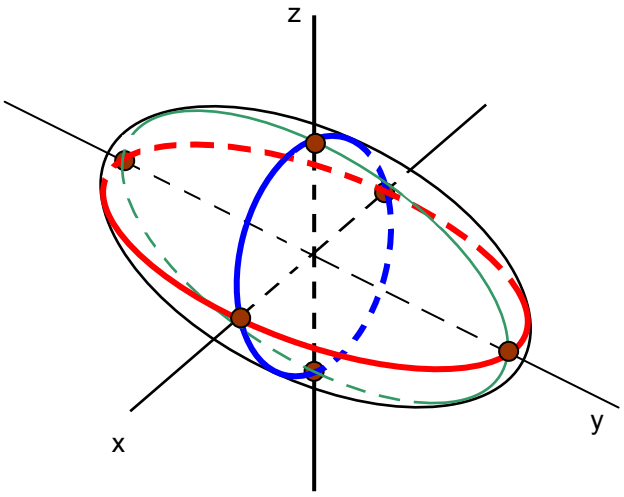


2. Draw an ellipse so that it passes slightly around these points.

$$\frac{x^2}{1}+\frac{y^2}{4}+\frac{z^2}{1}=1$$

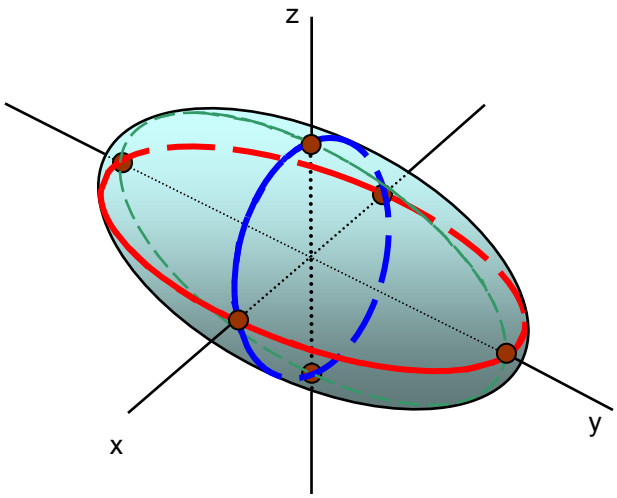


3. Draw the xy-trace – an ellipse. Draw the xz-trace – an ellipse. If you wish, you may also draw the yz-trace – an ellipse, but it might make the picture somewhat cluttered.



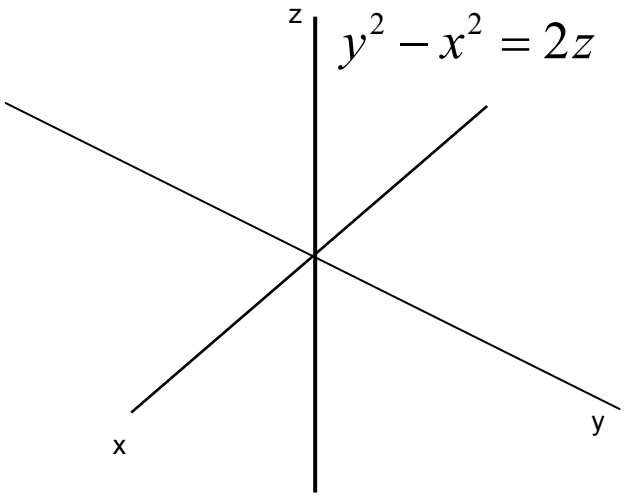
4. Touch up the drawing; add color and shading if you wish.

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$$

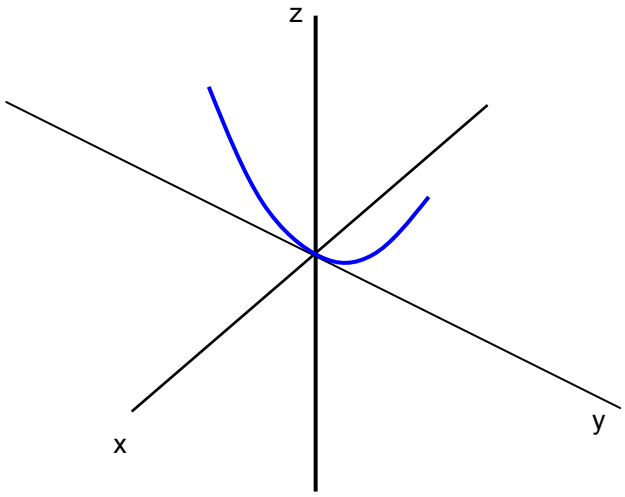


GRAPHING A PARABOLIC HYPERBOLOID

1. Construct a set of axes with the y-axis at an angle.



2. Plot a few points on the upright parabola – the yz-trace. This will serve as the backbone of the saddle.



3. Draw the xz-trace – an inverted parabola. Draw copies of this parabola at each end of the backbone. Connect the front and back edges with arcs to smooth out the drawing.

4. Touch up the drawing; add color and shading if you wish.

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = cz^2$$