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Section 13.6: Cylinders & Quadric Surfaces

Two Big Rules of Graphing Quadric Surfaces

(Note: Different strategies apply to graphing other equations in 3D!)

Quadric surface:

- **Rule #1: If you have no idea how to start, bear in mind that not all traces are created equal.**

Rule #1A: Not all conic sections are created equal.

Rule #1B: Not all axes are created equal.

Some general tips:

1. Always look at the traces of the "outlier" variable, if one exists
2. If it's a toss-up, start with the variable that has the easiest coefficients to work with.

Equation	Which Trace Should I Choose First?	Traces Look Like…
$z = x^2 + \frac{y^2}{4}$		
$\frac{x^2}{4} + \frac{y^2}{9} + z^2 = 1$		
$\frac{y^2}{9} - \frac{z^2}{4} = x$		
$y^2 = \frac{x^2}{4} + z^2$		
$x^2 + y^2 = 1 + z^2$		
$-x^2 - 9y^2 + z^2 = 9$		

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- **Rule #2: Each quadric section in 3D is really a combination of conic sections you've seen before.**

Conic Section	Formula	Recognizable by…
Ellipse	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	
Parabola	$y = ax^2 + b$	
Hyperbola	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	

Example: $z = x^2 - y^2$

Equation	Looks Like it Includes…	Fancy Name	Graphing Strategy
$z = x^2 + \frac{y^2}{4}$			
$\frac{x^2}{4} + \frac{y^2}{9} + z^2 = 1$			
$\frac{y^2}{9} - \frac{z^2}{4} = x$			
$y^2 = \frac{x^2}{4} + z^2$			

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$x^2 + y^2 = 1 + z^2$			
$-x^2 - 9y^2 + z^2 = 9$			