Section 12.6 Cylinders and Quadric Surfaces

**EX.9**

(a) \(x^2 + y^2 - z^2 = 1\)

(b) It is just a rotation of graph with 90 degree.

(c) It is just a shift of graph with 1 unit space along y-axis.

**EX.15**

\(-x^2 + 4y^2 - z^2 = 4\)

**EX.19**

\(y = z^2 - x^2\)
EX.21

This equation is for ellipsoid and has shorter expansion on z-axis comparing to y-axis. Hence it is VII but not IV.

EX.23

It is Hyperboloid and the only Hyperboloid is graph II.

EX.25

It is VI because restrict to any z the graph is parabola.

EX.27

It is cylinder since restrict to any hyperplane $y = c$ it is circle. Hence it is VIII.

EX.35

It can be rewritten as $(x - 2)^2 - (y + 1)^2 + (z - 1)^2 = 0$. The graph is like $x^2 + z^2 = y^2$ by shift from $(0, 0, 0)$ to $(2, -1, 1)$. See the graph below.
EX.43

It is $y = x^2 + z^2$. Or one can take $(x \cos \theta, y, x \sin \theta)$. This mean when we restrict $y$ variable, it will be a circle.

EX.45

A point that is equidistance from the point $(-1, 0, 0)$ to the plane $x = 1$ satisfy the following equation

$$(x + 1)^2 + y^2 + z^2 = (x - 1)^2.$$ 

This is equivalence to $4x + y^2 + z^2 = 0$. And this is paraboloid. Graph as below