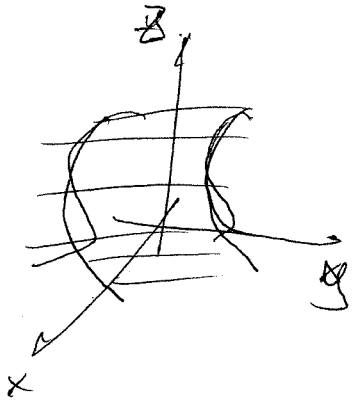
Cylinder is a surface that consists of all lines (called rulings) that are parallel to a given line and pass through a given plane curve

$z = x^2$



parabolic cylinder.

$x^2 + y^2 = 1$.

A quadric surface is the graph of a second-degree equation in x, y, z

$$Ax^2 + By^2 + Cz^2 + Dxy + Eyz + Fxz + Gx + Hy + Iz + J = 0.$$

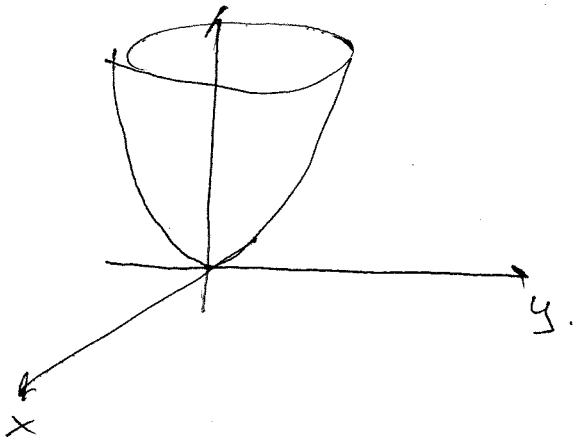
By translation and rotation it can be reduced to one of the two standard forms

$$Ax^2 + By^2 + Cz^2 + J = 0 \quad \text{or} \quad Ax^2 + By^2 + Iz = 0$$

Ex $x^2 + \frac{y^2}{9} + \frac{z^2}{4} = 1$

$z = 0$. $x^2 + \frac{y^2}{9} = 1$ circle. ellipsoid.

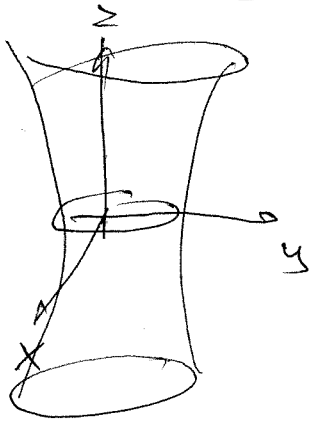
Ex. $z = 4x^2 + y^2$



elliptic paraboloid.

Ex $z = y^2 - x^2$ hyperbolic paraboloid.

Ex $\frac{x^2}{4} + y^2 - \frac{z^2}{4} = 1$ hyperboloid of one sheet.



Ellipsoid.

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

Cone

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

Elliptic Paraboloid

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

Hyperboloid of One Sheet (Connected Hyperboloid)

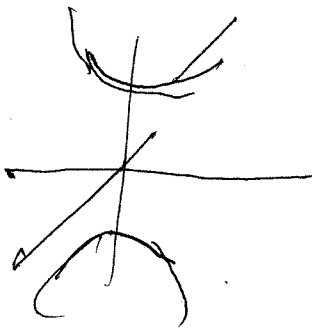
$$\frac{x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=1.$$

Hyperbolic Paraboloid

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

Hyperboloid of 2 Sheets

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



Ex. Classify the quadric surface

$$x^2+2z^2-6x-y+10=0.$$

$$y-1=(x-3)^2+2z^2 \quad \rightarrow \text{elliptic paraboloid.}$$

$y-1$: linear — shifted hy 1

$(x-3)^2$: quad — shifted hy 3

$2z^2$: quad — stretched hy 2.