Formulas

Distance between two points:

$$\|AB\| = \|B - A\| = \sqrt{(x_B - x_A)^2 + (y_B - y_A)^2 + (z_B - z_A)^2}$$

Dot product (inner product) of two vectors:

$$\vec{u} \cdot \vec{v} = u_1 v_1 + u_2 v_2 + u_3 v_3 = \|\vec{u}\| \, \|\vec{v}\| \cos\varphi$$

Angle between straight lines:

$$\varphi = \frac{\vec{u} \cdot \vec{v}}{\|\vec{u}\| \, \|\vec{v}\|}$$

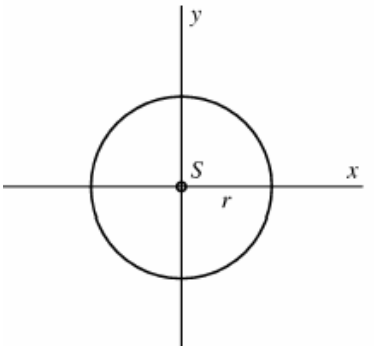
Vector product (cross product) of two vectors:

$$\vec{u} \times \vec{v} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix} = (u_2 v_3 - u_3 v_2, -u_1 v_3 + u_3 v_1, u_1 v_2 - u_2 v_1)$$

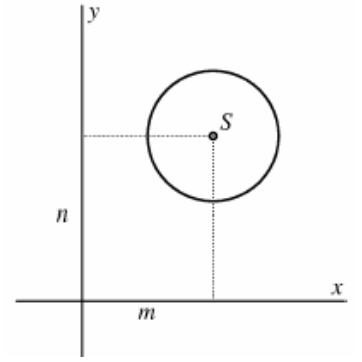
Value of vector product:

$$\| \vec{u} \times \vec{v} \| = \|\vec{u}\| \, \|\vec{v}\| \sin\varphi$$

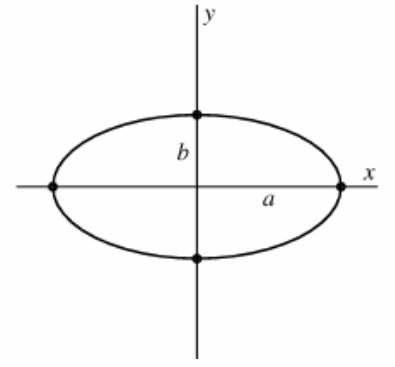
Conic sections



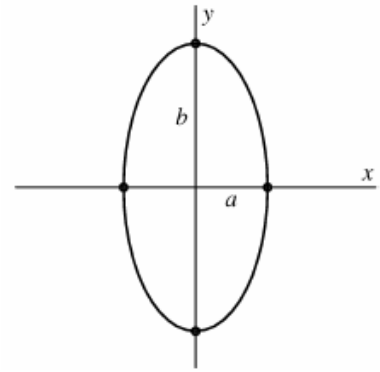
circle $x^2 + y^2 = r^2$



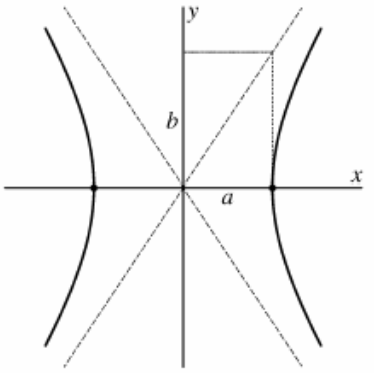
circle $(x-m)^2 + (y-n)^2 = r^2$



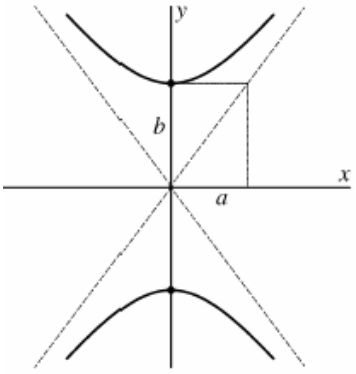
ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$



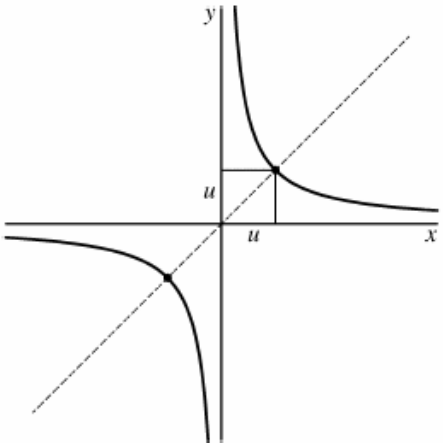
ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$



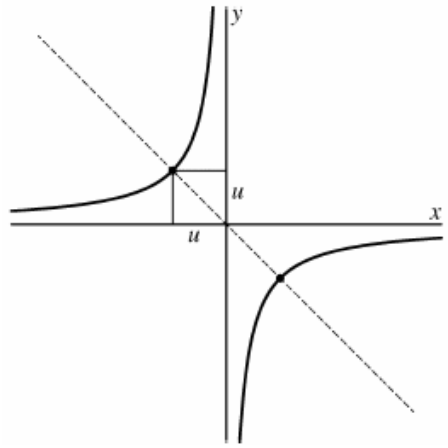
hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$



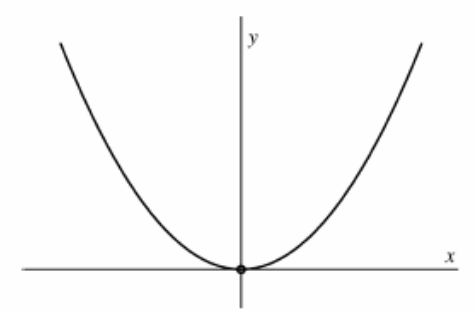
hyperbola $-\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$



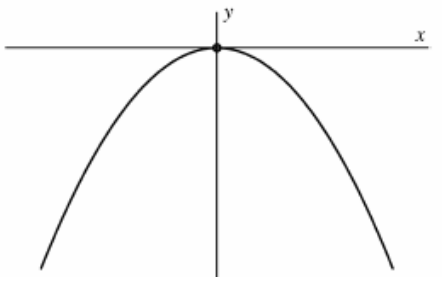
equiaxed hyperbola $y=\frac{k}{x},\ \left(u=\sqrt{k}\right)$



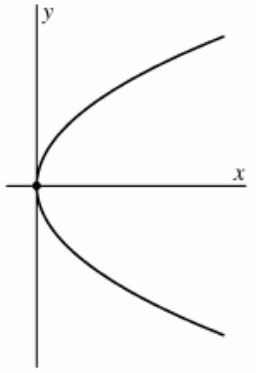
equiaxed hyperbola $y=-\frac{k}{x},\ \left(u=\sqrt{k}\right)$



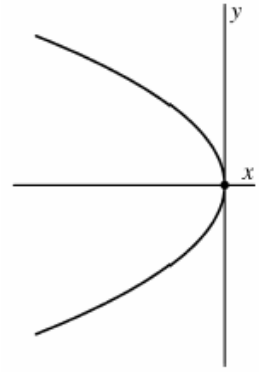
parabola $x^2=2py$



parabola $x^2=-2py$

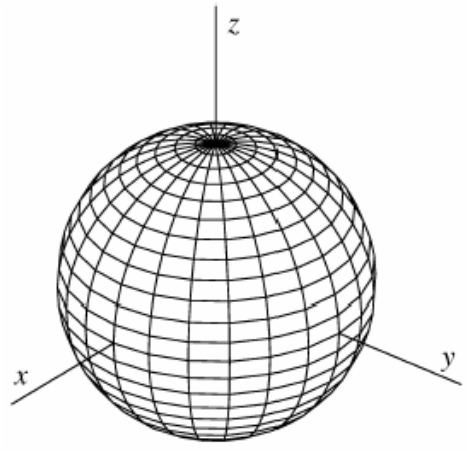


parabola $y^2=2px$

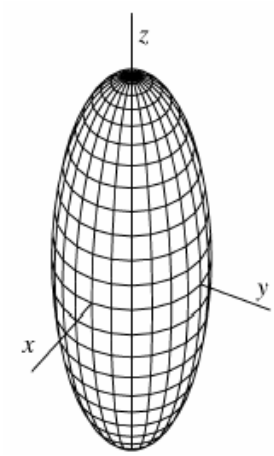


parabola $y^2=-2px$

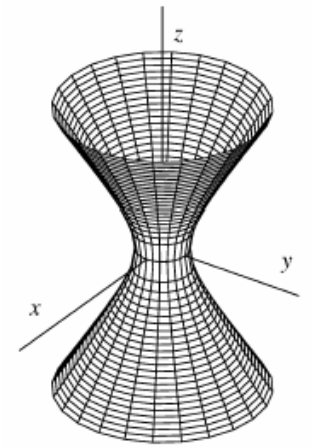
Quadrics



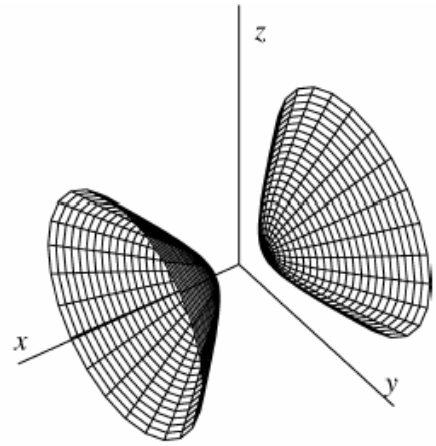
sphere $x^2 + y^2 + z^2 = r^2$



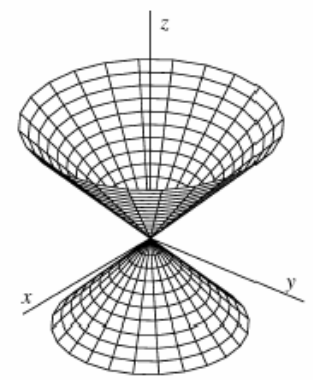
ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$



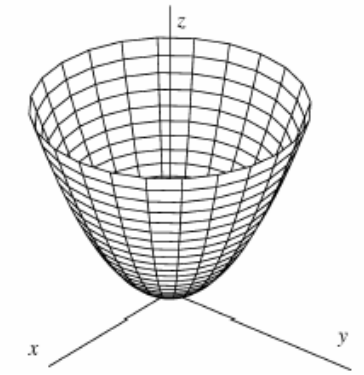
hyperboloid of one sheet $\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$



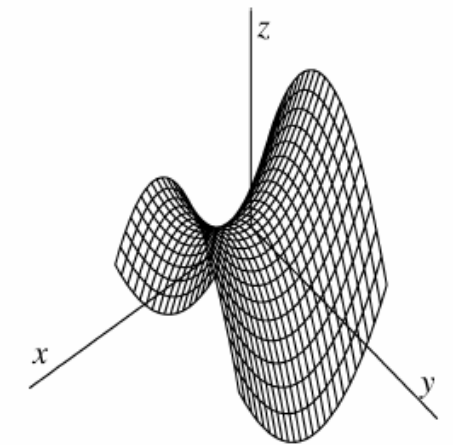
hyperboloid of two sheets $\frac{x^2}{a^2} - \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$



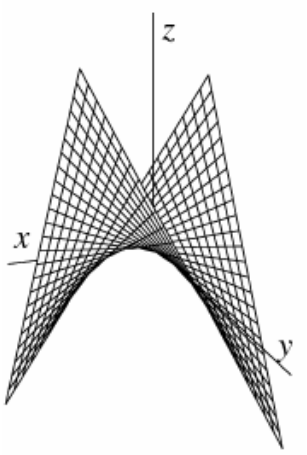
cone $\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 0$



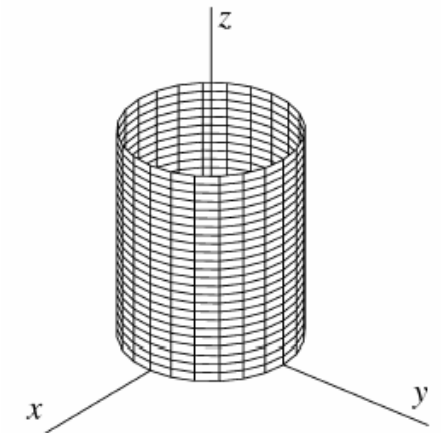
elliptic paraboloid $\frac{x^2}{a^2} + \frac{y^2}{b^2} = z$



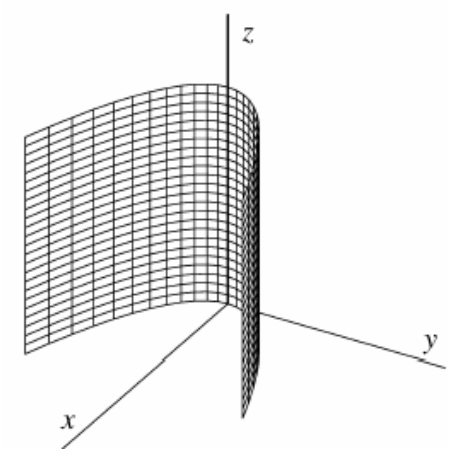
hyperbolic paraboloid $\frac{x^2}{a^2} - \frac{y^2}{b^2} = z$



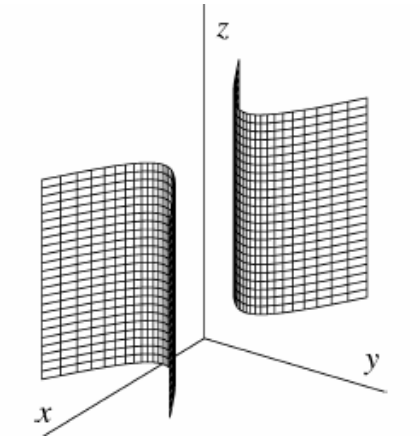
hyperbolic paraboloid (rotated) $z = axy$



elliptic cylinder $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$



$\frac{x^2}{a^2} = y$



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