Quadric surfaces

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
\[ z = \frac{x^2}{a^2} + \frac{y^2}{b^2} \]

Hyperbolic paraboloid
\[ z = \frac{x^2}{a^2} - \frac{y^2}{b^2} \]

Elliptic cylinder
\[ \frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 0 \]

Parabolic cylinder
\[ z = \frac{x^2}{a^2} + \frac{y^2}{b^2} \]

Hyperbolic paraboloid
\[ z = \frac{x^2}{a^2} - \frac{y^2}{b^2} \]

1. Determine the type of a surface. You may use the above equations or consider cross-sections.
   a) \( \frac{x^2+y^2}{4} - z^2 = 0 \); b) \( x^2 + z^2 + y = 1 \); c) \( z = \frac{x^2+(z+1)^2}{2} \); d) \( x^2 - 2y^2 + 3z^2 = -1 \).

2. A cone is defined by the equation \( x^2 + y^2 - 3z^2 = 0 \). Find the opening angle \( \theta \) of it.

   \[ \theta \]

   \[ \frac{\pi}{3} \text{ answer} \]

Partial derivatives

3. a) Let \( u(x, y) = \ln(e^x + e^y) \). Compute \( \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} \).
b) Let $u(x, y, z) = (x - y)(y - z)(z - x)$. Compute $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$.

4. Let $u(x, y, z) = x^y$. Find all first-order partial derivatives of $u$. 

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