

GRADIENTS TO LEVEL CURVES AND SURFACES

For each function below, find parametric equations for the gradient vector at the point below on the indicated level curve or surface.

1. $z = x^2 + y^2$, level curve $z = 1$, $P = \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right)$.

2. $z = x^2 - y^2$, level curve $z = 1$, $P = (1, 0)$.

3. $z = -x^2 - y^2$, level curve $z = -1$, $P = \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right)$.

4. $z = x^2 + y^2 - 1$, level surface $x^2 + y^2 - z = 1$, $P = (1, 1, 1)$.

5. $z = x^2 - y^2 + 1$, level surface $x^2 - y^2 - z = -1$, $P = (1, 1, 1)$.