

## Answer on Question #68204 – Math – Calculus

### Question

Given that

$$\varphi = \ln|r|$$

such that  $r = xi + yj + zk$

find  $\nabla\varphi$

### Solution

$$|r| = \sqrt{x^2 + y^2 + z^2}, \quad \varphi = \ln\sqrt{x^2 + y^2 + z^2}.$$

$$\begin{aligned} \nabla\varphi &= \varphi_x \mathbf{i} + \varphi_y \mathbf{j} + \varphi_z \mathbf{k} = \frac{2x}{\sqrt{x^2 + y^2 + z^2}} \mathbf{i} + \frac{2y}{\sqrt{x^2 + y^2 + z^2}} \mathbf{j} + \frac{2z}{\sqrt{x^2 + y^2 + z^2}} \mathbf{k} = \\ &= \frac{2}{\sqrt{x^2 + y^2 + z^2}} (x\mathbf{i} + y\mathbf{j} + z\mathbf{k}). \end{aligned}$$