

**Answer on Question #75967 – Math – Calculus
Question**

Obtain the curl of the following vector field:

$$A = e_r + r \cos \theta e_\theta + r e_\varphi$$

Solution

Obtain the curl of the vector field

$$\begin{aligned} \text{curl } \vec{A} &= \vec{\nabla} \times \vec{A} = \left(e_r \frac{\partial}{\partial r} + \frac{e_\theta}{r} \frac{\partial}{\partial \theta} + \frac{e_\varphi}{r \sin \theta} \frac{\partial}{\partial \varphi} \right) \times (A_r e_r + A_\theta e_\theta + A_\varphi e_\varphi) = \\ &= \frac{e_r}{r \sin \theta} \left[\frac{\partial}{\partial \theta} (A_\varphi \sin \theta) - \frac{\partial A_\theta}{\partial \varphi} \right] + \frac{e_\theta}{r \sin \theta} \left[\frac{\partial A_r}{\partial \varphi} - \sin \theta \frac{\partial}{\partial r} (r A_\varphi) \right] + \\ &+ \frac{e_\varphi}{r} \left[\frac{\partial}{\partial r} (r A_\theta) - \frac{\partial A_r}{\partial \theta} \right] = \frac{e_r}{r \sin \theta} [r \cos \theta - 0] + \frac{e_\theta}{r \sin \theta} [0 - \sin \theta (2r)] + \\ &+ \frac{e_\varphi}{r} [2r \cos \theta - 0] = \cot \theta e_r - 2e_\theta + 2 \cos \theta e_\varphi. \end{aligned}$$

Answer: $\text{curl } \vec{A} = \vec{\nabla} \times \vec{A} = \cot \theta e_r - 2e_\theta + 2 \cos \theta e_\varphi.$