## Answer on Question \#74854-Math - Calculus

## Question

Express the vector field vector $F=x z i+\left(x^{2}+y^{2}\right) j+\frac{x}{z} k$ in cylindrical polar coordinates.

## Solution

Any vector field can be written as

$$
F=F_{x} i+F_{y} j+F_{z} k=F_{\rho} e_{\rho}+F_{\varphi} e_{\varphi}+F_{z} e_{z}
$$

for our condition

$$
F_{x}=x z, F_{y}=x^{2}+y^{2}, F_{z}=\frac{x}{z} .
$$

Use the next conversion between cartesian and cylindrical coordinates:

$$
x=\rho \cos \varphi, y=\rho \sin \varphi, z=z
$$

Let's substitute in the condition:

$$
\begin{gathered}
F_{\rho}=x z=\rho \cos \varphi \cdot z=\rho z \cos \varphi, \\
F_{\varphi}=x^{2}+y^{2}=\left(\rho^{2} \cos ^{2} \varphi+\rho^{2} \sin ^{2} \varphi\right)=\rho^{2}, \\
F_{z}=\frac{x}{z}=\frac{\rho \cos \varphi}{z} .
\end{gathered}
$$

Then

$$
F=\rho z \cos \varphi e_{\rho}+\rho^{2} e_{\varphi}+\frac{\rho \cos \varphi}{z} e_{z}
$$

Answer: $F=\rho z \cos \varphi e_{\rho}+\rho^{2} e_{\varphi}+\frac{\rho \cos \varphi}{z} e_{z}$.

