## Question \#74600

Is Cramer 's Rule applicable for solving the linear system below? If yes, apply it. Otherwise, alter the last equation in the system so that the solution can be obtained by applying the rule.
$\left\{\begin{array}{c}x+y+z=\pi \\ -\pi x+\pi y+\sqrt{ } 2 z=0 \\ \pi^{\wedge} 2 x+\pi^{\wedge} 2 y+2 z=0\end{array}\right.$

## Solution

$\left\{\begin{array}{c}x+y+z=\pi \\ -\pi x+\pi y+\sqrt{ } 2 z=0 \\ \pi^{\wedge} 2 x+\pi^{\wedge} 2 y+2 z=0\end{array}\right.$
Find the determinant, $D$, by using the $x, y$, and $z$ values from the problem
$D=\left|\begin{array}{ccc}1 & 1 & 1 \\ -\pi & \pi & \sqrt{2} \\ \pi^{2} & \pi^{2} & 2\end{array}\right|=-2 \pi^{3}+4 \pi \neq 0$
Cramer's rule is applicable. Apply it

Find the determinant, $D_{x}$, by replacing the $x$-values in the first column with the values after the equal sign leaving the $y$ and $z$ columns unchanged.
$D_{x}=\left|\begin{array}{ccc}\pi & 1 & 1 \\ 0 & \pi & \sqrt{2} \\ 0 & \pi^{2} & 2\end{array}\right|=-\pi^{2}(\pi \sqrt{2}-2)$
Use Cramer's Rule to find the values of $x$
$x=\frac{D_{x}}{D}=\frac{-\pi^{2}(\pi \sqrt{2}-2)}{-2 \pi^{3}+4 \pi}=\frac{\pi(\pi \sqrt{2}-2)}{2\left(\pi^{2}-2\right)}$
Find the determinant, $D_{y}$, by replacing the $y$-values in the second column with the values after the equal sign leaving the $x$ and $z$ columns unchanged.
$D_{y}=\left|\begin{array}{ccc}1 & \pi & 1 \\ -\pi & 0 & \sqrt{2} \\ \pi^{2} & 0 & 2\end{array}\right|=2 \pi^{2}+\pi^{3} \sqrt{2}$
Use Cramer's Rule to find the values of $y$
$y=\frac{D_{y}}{D}=\frac{2 \pi^{2}+\pi^{3} \sqrt{2}}{-2 \pi^{3}+4 \pi}=-\frac{\pi(\pi \sqrt{2}+2)}{2\left(\pi^{2}-2\right)}$
Find the determinant, $D_{z}$, by replacing the $z$-values in the third column with the values after the equal sign leaving the $x$ and $y$ columns unchanged.
$D_{z}=\left|\begin{array}{ccc}1 & 1 & \pi \\ -\pi & \pi & 0 \\ \pi^{2} & \pi^{2} & 0\end{array}\right|=-2 \pi^{4}$
Use Cramer's Rule to find the values of $z$.
$z=\frac{D_{z}}{D}=\frac{-2 \pi^{4}}{-2 \pi^{3}+4 \pi}=\frac{\pi^{3}}{\pi^{2}-2}$

## Answer

$x=\frac{\pi(\pi \sqrt{2}-2)}{2\left(\pi^{2}-2\right)}$

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y=-\frac{\pi(\pi \sqrt{2}+2)}{2\left(\pi^{2}-2\right)} \quad z=\frac{\pi^{3}}{\pi^{2}-2}
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