WITH A THREE-DIMENSIONAL SCALAR FIELD:

$$\overrightarrow{\text{grad}}\, g = \vec{e}_\rho \frac{\partial f}{\partial \rho} + \vec{e}_\theta \frac{1}{\rho}\frac{\partial f}{\partial \theta} + \vec{e}_z \frac{\partial f}{\partial z}$$

Where $\frac{\partial f}{\partial \rho} = \sin\theta - 2\rho\cos\theta\sin\theta$

$\frac{\partial f}{\partial \theta} = \rho\cos\theta + \rho^2 - 2\rho^2\cos^2\theta$

$\frac{\partial f}{\partial z} = 1$

So

$$\overrightarrow{\text{grad}}\, g = (\sin\theta - 2\rho\cos\theta\sin\theta)\vec{e}_\rho + (\rho\cos\theta + \rho^2 - 2\rho^2\cos^2\theta)\vec{e}_\theta + \vec{e}_z$$

I NEED TO FIND THE MAGNITUDE, SO

$$\text{MAG} = \sqrt{(\sin\theta - 2\rho\cos\theta\sin\theta)^2 + (\rho\cos\theta + \rho^2 - 2\rho^2\cos^2\theta)^2 + 1^2}$$

I KNOW IT CANCELS TO

$$= \sqrt{2 + \rho^2 - 2\rho\cos\theta}$$

FROM HERE TO HERE

(Q) WHY?

BUT I DO NOT KNOW WHY???

TRIGONOMETRIC IDENTITIES ($\sin^2\theta + \cos^2\theta = 1$?)

PLEASE HELP ME FINISH THIS QUESTION