Problem 47 cont:

1. Suppose \( m = 3 \). Then we have

\[
\sum_{b=1}^{3} c_b (2) \, dz_b = \hat{F}(\hat{F}) \cdot d\hat{F} \quad \text{and}
\]

\[
(\hat{\nabla} \times \hat{F})_1 = \frac{\partial F_2}{\partial x_3} - \frac{\partial F_3}{\partial x_2}, \quad \text{etc}.
\]

So, we have that there exists a \( \phi \) such that \( \hat{F} = \nabla \phi \) if and only if \( \hat{\nabla} \times \hat{F} = 0 \).