A two dimensional flow field is observed to have the following components:

\[ u = a(x^2 - y^2) \quad v = -2axy \quad w = 0 \]

Is this flow incompressible?

Is this flow irrotational?

**Incompressible** \( \nabla \cdot \mathbf{V} = 0 \)

\[ \nabla \cdot \mathbf{V} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} \rightarrow 2-D \text{ flow, } w = 0 \]

\[ \frac{\partial u}{\partial x} = 2ax \quad \frac{\partial v}{\partial y} = -2ax \]

\[ 2ax + (-2ax) = 0 \quad \text{Flow is incompressible} \]

**Irotational?** \( \nabla \times \mathbf{V} = 0 \)

\[
\begin{vmatrix}
\hat{i} & \hat{j} & \hat{k} \\
\frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\
a(x^2y^2) & -2axy & 0 \\
\end{vmatrix}
\]

\[ \nabla \times \mathbf{V} = 0\hat{i} + 0\hat{j} + (-2ay - (-2ay))\hat{k} \]

\[ \nabla \times \mathbf{V} = 0 \quad \text{Flow is irrotational} \]