

The y -velocity component of a steady, 2D, incompressible flow is given by:

$$u_y = 3xy - x^2y$$

Determine the most general velocity component in the x -direction for this flow.

SOLUTION:

Consider the continuity equation:

$$\frac{\partial u_x}{\partial x} + \frac{\partial u_y}{\partial y} = 0 \quad (1)$$

$$\frac{\partial u_x}{\partial x} = -\frac{\partial u_y}{\partial y} = -\frac{\partial}{\partial y}(3xy - x^2y) = -3x + x^2$$

Integrate u_x with respect to x .

$$\boxed{u_x = -\frac{3}{2}x^2 + \frac{1}{3}x^3 + f(y)} \quad (2)$$

where $f(y)$ is an unknown function of y .