Assignment 4

1. The velocity components for a certain incompressible, steady flow field are:

$u = x^2 + y^2 + z^2$ $\quad$ $v = xy + yz + z$

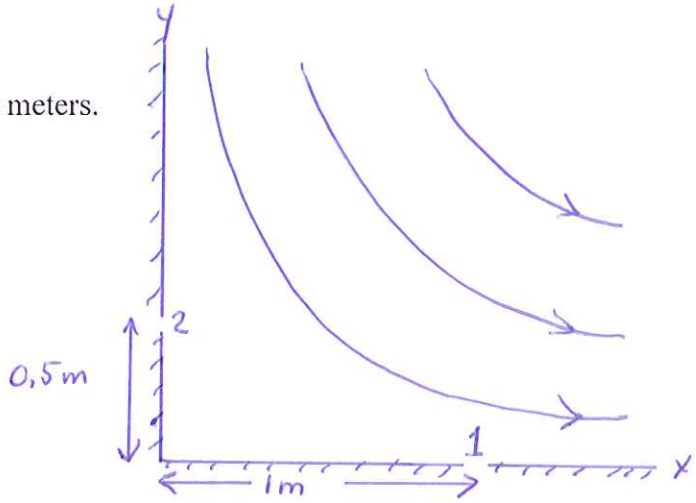
Determine the form of the z component w required to satisfy the continuity equation.

2. The velocity components in a steady, two dimensional incompressible flow field are u = 2y and v = 4x. Determine the corresponding stream function and sketch several streamlines indicating the direction of flow.

3. The two dimensional flow of a nonviscous, incompressible fluid in the vicinity of the 90° corner shown below is described by the stream function

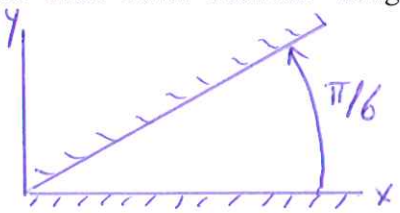
$\psi = 2r^2 \sin 2\theta$

where ψ has units m^2/s when r is in meters.



a) Determine the corresponding velocity potential.
b) If the pressure at point 1 on the wall is 30 kPa, what is the pressure at point 2? Assume the fluid density is 10^3 kg/m^3 and the x-y plane is horizontal.

4. A nonviscous incompressible fluid flows between wedge/shaped walls into a small opening as shown below.



The velocity potential in m^2/s which approximately describes the flow is

$\phi = -2 \ln r$

Determine the volume rate of flow (per unit length) into the opening.