0.1 Tutorial Week 1: Continuity Equation

0.1.1 Exercise 2

Is the system steady?

The system is steady due to the fact that our velocity field has no terms in t, meaning that our flow does not change with time - steady flow.

Is the fluid incompressible?

The fluid is compressible due to the fact that there is a y component in the velocity field

Make a vector map of the velocity field

Using the following code, a vector field was mapped.

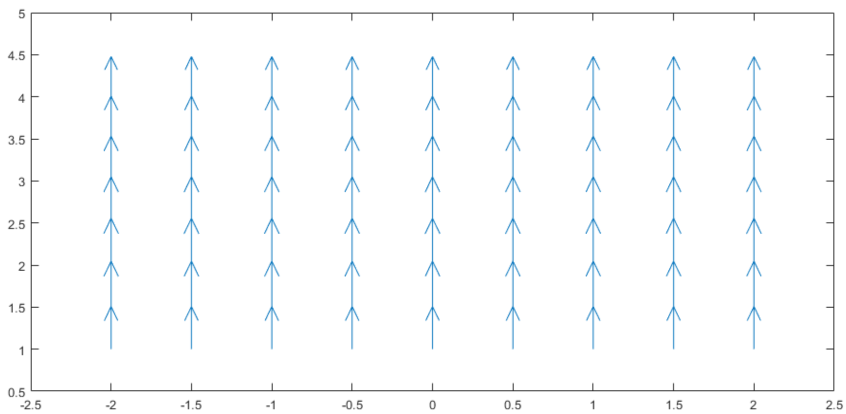
```
%Hasha Dar

[x,y]=meshgrid(-2:0.1:2,1:0.1:4); %field

u = 0.*x; %x vector
v = (4.*log(y) -2.*y + 10); %y vector

quiver(x, y, u, v, 1) %plots quiver with arrow base at x, y
and direction u, v, scaling 1
```

This produced the following plot:



Determine the variation of the volume dilatation rate in the flow domain

$$v = 4 \ln y - 2y + 10 \tag{1}$$

$$\text{Volume dilatation} \rightarrow \frac{\partial v}{\partial y} = \frac{4}{y} - 2 \tag{2}$$

$$\text{Variation in volume dilatation} \rightarrow \frac{\partial^2 v}{\partial y^2} = -\frac{4}{y^2} \tag{3}$$

For the range $1 < y < 4$, the variation in the volume dilatation is negative, hence our fluid is compressible.

Estimate the volume dilatation rate in pints $(0,\ 1)$ **and** $(0,\ 3)$ **of the flow domain**

$$(0,\ 1) \rightarrow \frac{4}{1} - 2 = 2\ \mathrm{s}^{-1} \tag{4}$$

$$(0,\ 3) \rightarrow \frac{4}{3} - 2 = -\frac{2}{3}\ \mathrm{s}^{-1} \tag{5}$$

Sketch how a squared fluid parcel located in the points above would deform