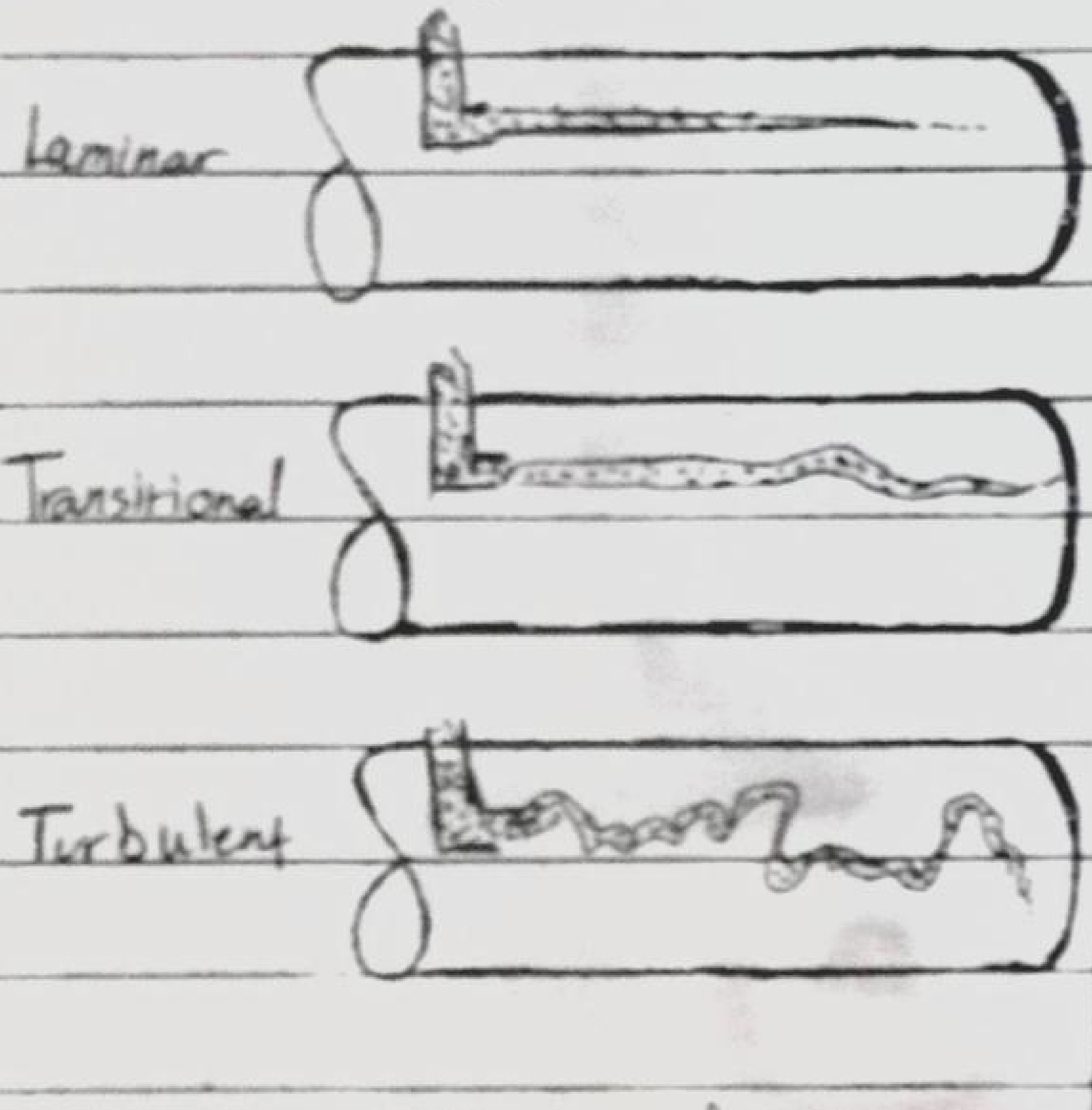
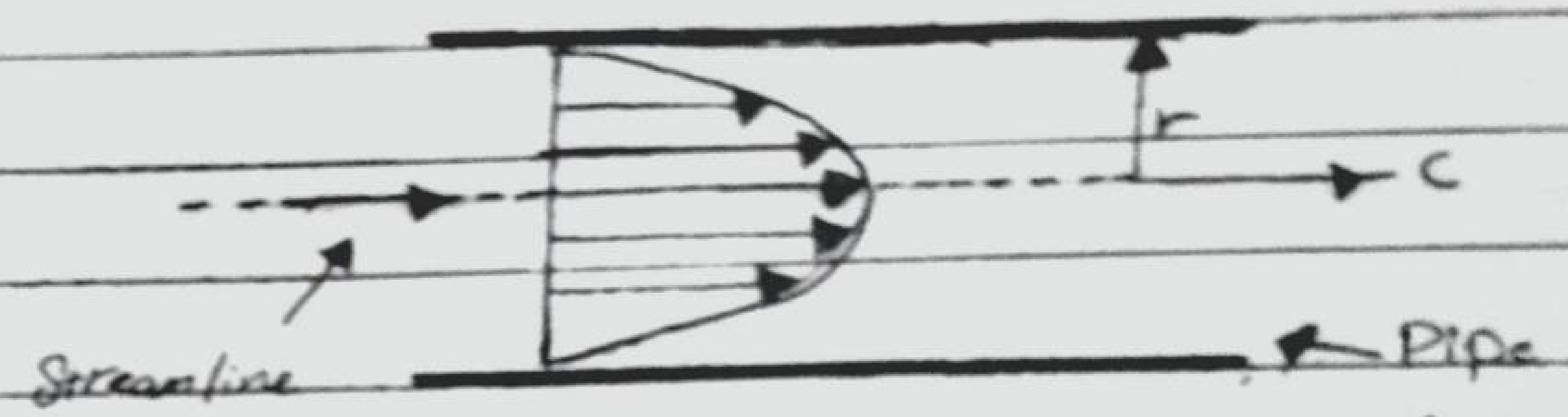
Experiment 5

# Flow Visualization and Reynolds Number

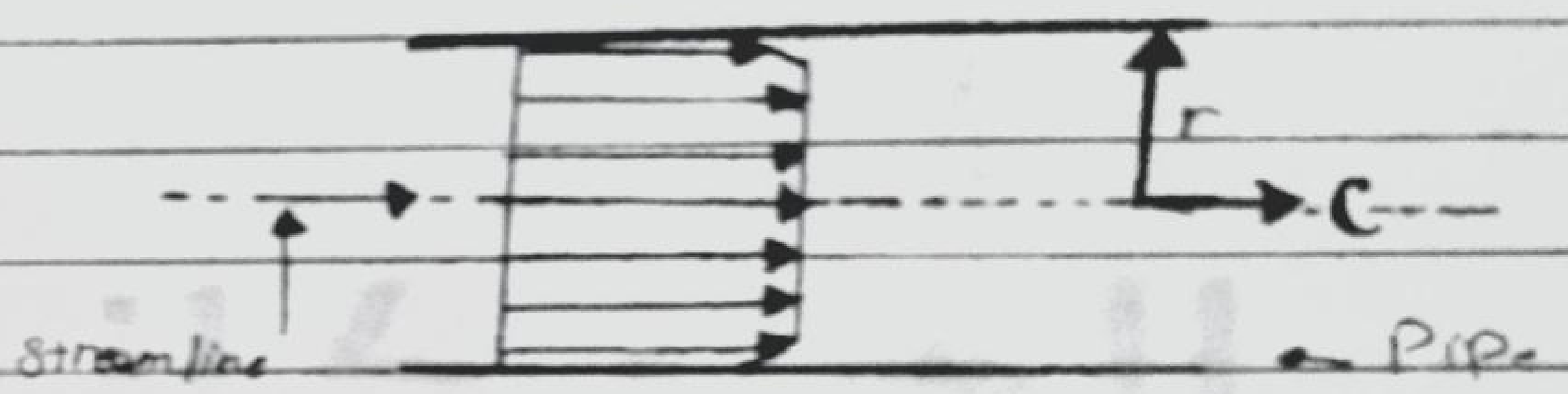
- Laminar flow: denotes a steady condition where all stream lines follow Parallel Paths.
- Transitional flow: the transition from laminar to turblent flow
- Turbulent flow: denotes an unsteady condition where stream lines interact causing shear Plane collapse and mixing of the fluid.




« Types of flow »




« The Velocity mean across the pipe for laminar flow »




« The Velocity mean across the Pipe for turbulent flow »

* Reynolds number (Re): is the internationally recognized criterion denoting fluid flow condition.

$$Re = \frac{\rho v d}{\mu} = \frac{V d}{\nu}$$

$\rho \rightarrow$ density $kg/m^3$

$V \rightarrow$ Velocity $m/s$

$d \rightarrow$ diameter $m$

$\mu \rightarrow$ viscocity $pa.s$

$\nu \rightarrow$ kinematic viscocity $m^2/s$

$Re < 2000 \Rightarrow$ laminar.

$2000 < Re < 3000 \Rightarrow$ Translent.

$Re > 3000 \Rightarrow$ Turbulent.

$Q = \frac{Volume}{time}$ $m^3/s$ , $Q = VA$ (V → Velocity)

$A = \frac{\pi}{4} d^2$

الادوات المستخدمة

1- Tanke
2- gage level
3 - Tube
4 - ~~[illegible]~~ valve
5 - Liquid

Laminar flow ;- is characterized by fluid particles following smoth path in layers, with each layer moving smothly where adjacent layers is little or nomixing with each other.

Turbulence flow ;- is fluid motion characterized by chaotic change in pressure and flow velocity. It is in contrast to Laminar flow, which ~~occurre~~ occurs when a fluid flows in parallel layers with no - disruption between these layers

~~Transition~~ ;- ~~the flow that may~~

Transition flow :- The flow that transition between Laminer and Turbulence flow dependon boundary condation.

For plate /

$Re > 10^5 \times 5 \Rightarrow$ Turbulence flow

$Re < 10^5 \times 5 \Rightarrow$ Laminar flow

For Tube /

$Re > ~~2400~~$ 4000 $\Rightarrow$ Turb.

$Re \leq 2100 \Rightarrow$ Laminar

$2100 < Re < ~~2400~~$ 4000 $\Rightarrow$ ~~Transion~~ Transition

Discussion /

1- Define the type of flow?

2- what the practical used for Re number and what Common type?

3- what effects of [density of fluid, velocity, radius viscosity ( dynamic, Kinematic)]?

*Sample: Laminer → time = 159.7 s , Volume = 3L

$\nu = 1.004 \times 10^{-6}\ m^2/s$

Find Re.                                  D = 2 cm

$$Q = \frac{V}{time} = \frac{3 \times 10^{-3}}{159.7} = \boxed{1.878 \times 10^{-5}\ m^3/s}$$

$$Q = VA \Rightarrow V = \frac{Q}{A} = \frac{1.878 \times 10^{-5}}{\frac{\pi}{4}(2 \times 10^{-2})^2} \Rightarrow V = 0.0598\ m/s$$

$$Re = \frac{VD}{\nu} = \frac{0.0598 \times 2 \times 10^{-2}}{1.004 \times 10^{-6}} \Rightarrow \boxed{Re = 1191.2}$$

$$Re = \frac{\rho u D}{\mu}$$

$t = 100(s)$, $V = 5L$, $D = 5cm$, $\nu = 10^{-7}$

$$Q = \frac{V}{t} = \frac{3 \times 10^{-3}\ m^3}{100\ (s)} = 3 \times 10^{-5}\ m^3/s$$

$$Q = uA \Rightarrow u = \frac{Q}{A} = 0.0152\ m/s$$

Re = 7600

$t = 50(s)$, $V = 2L$, $D = 8cm$, $\nu = 10^{-5}$

$t = 200(s)$, $V = 10L$, $D = 4cm$, $\nu = 10^{-7}$

$t = 180(s)$, $V = 7L$, $D = 6cm$, $\nu = 10^{-6}$