# VISCOSITY OF FLUID

## Fluid Mechanics

**Mukhtiar Ali Talpur**

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- Causes :
  1- Cohesive force
  2- Intermolecular momentum transfer

# VISCOSITY

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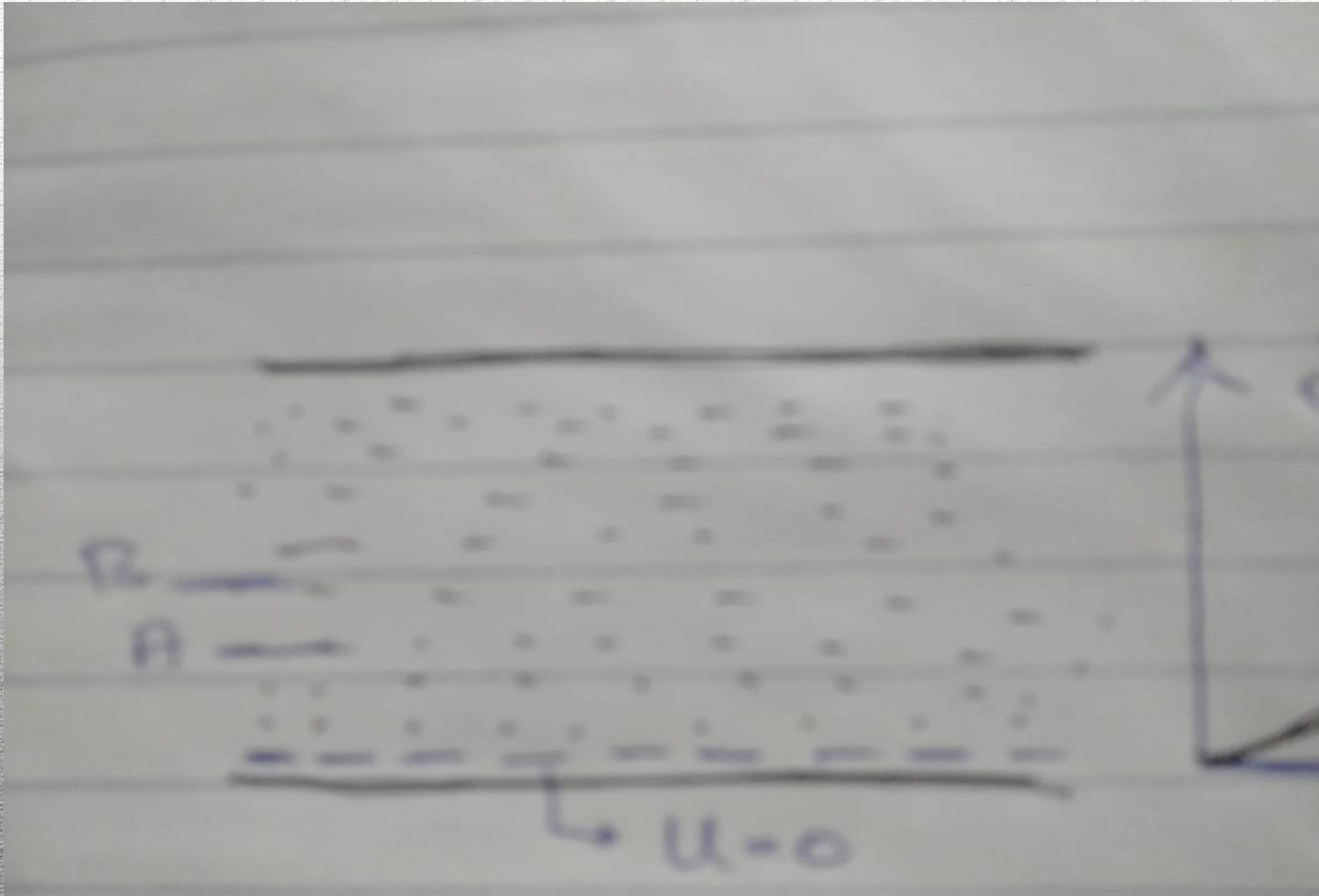
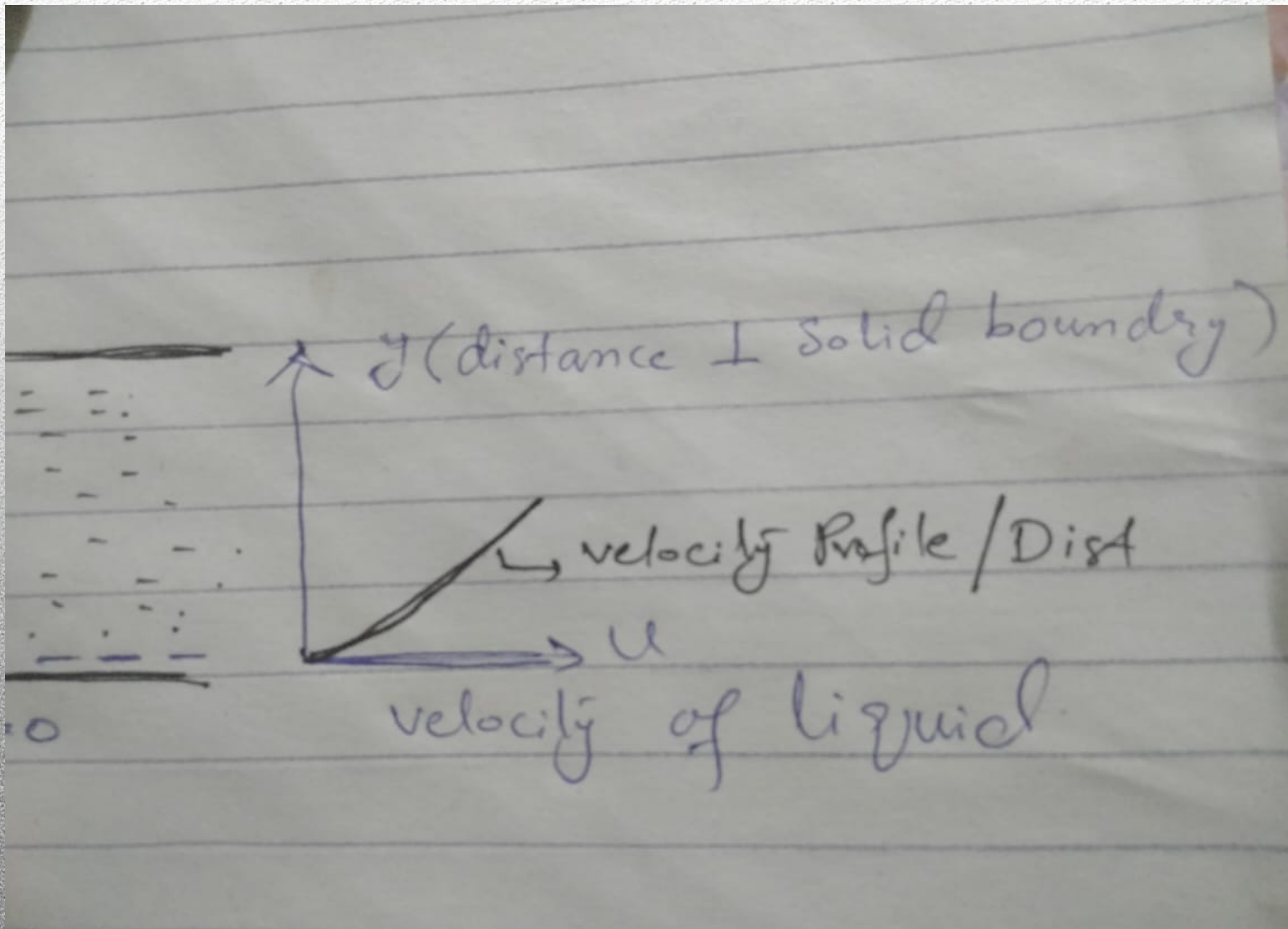
# VISCOSITY

- Cohesive forces more common in liquids
- Intermolecular momentum transfer more common in gases

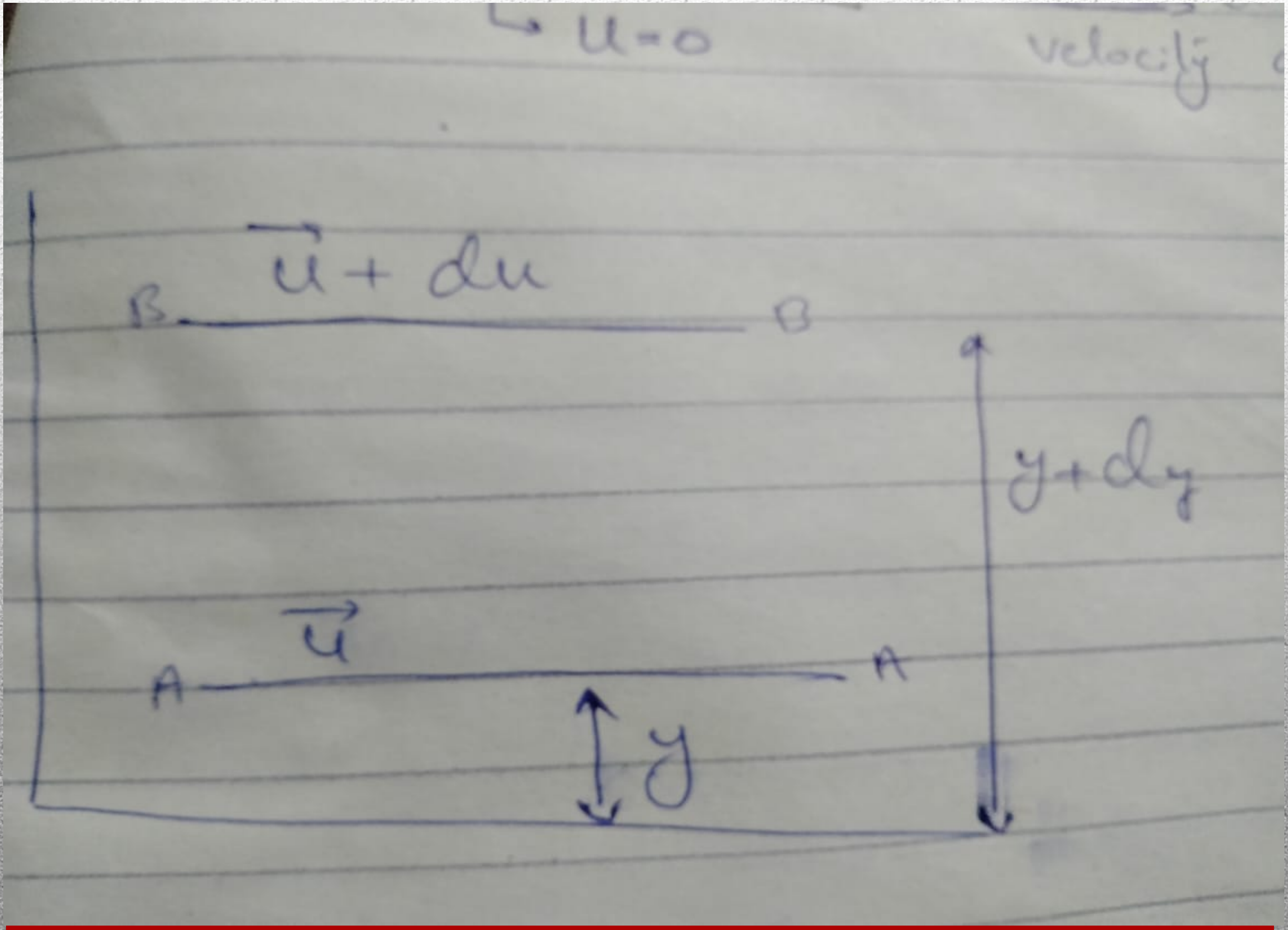
## VISCOSITY



B
A
U = 0

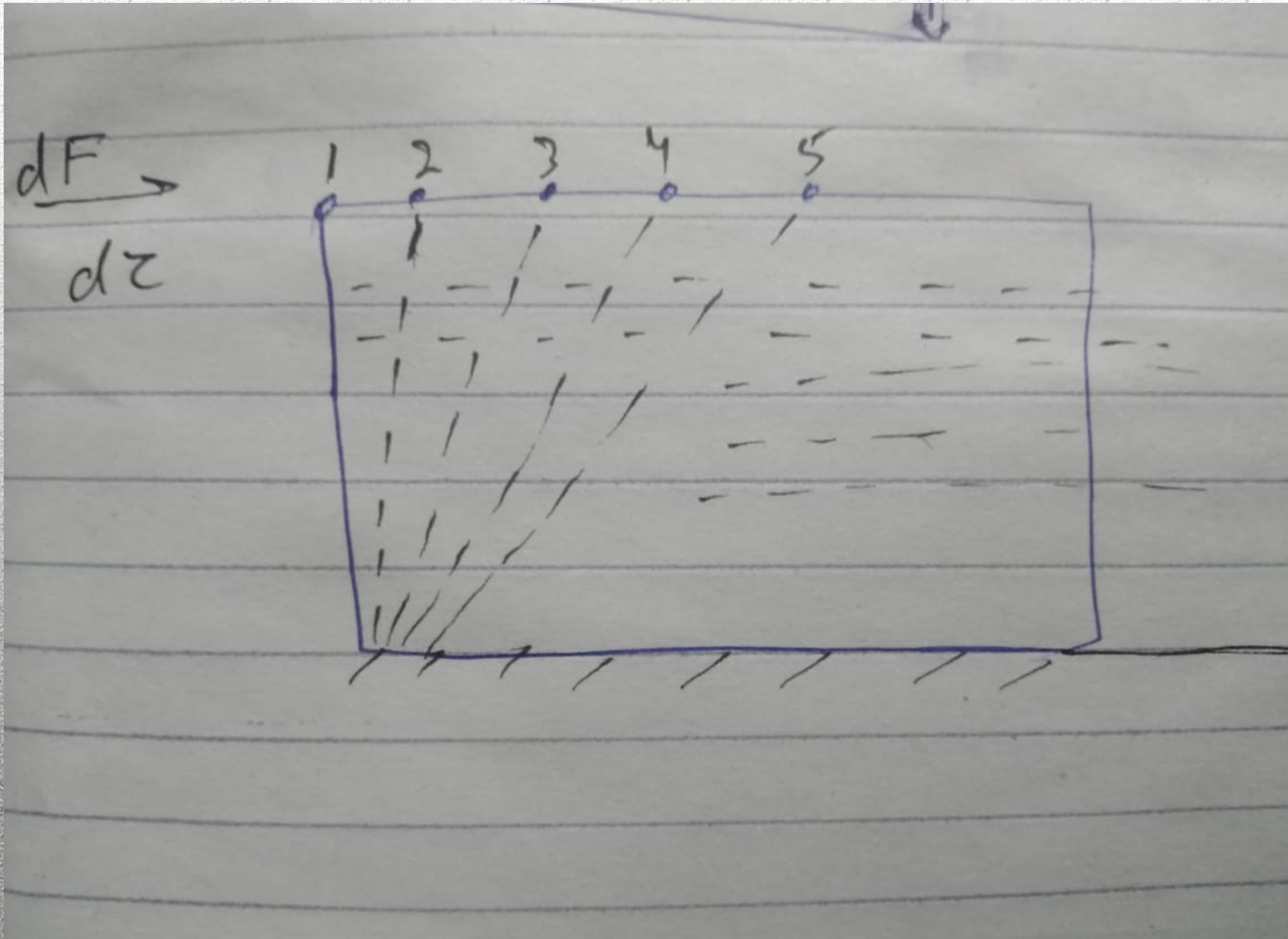


y (distance ⊥ Solid boundry)
velocity Profile / Dist
u
velocity of liquid

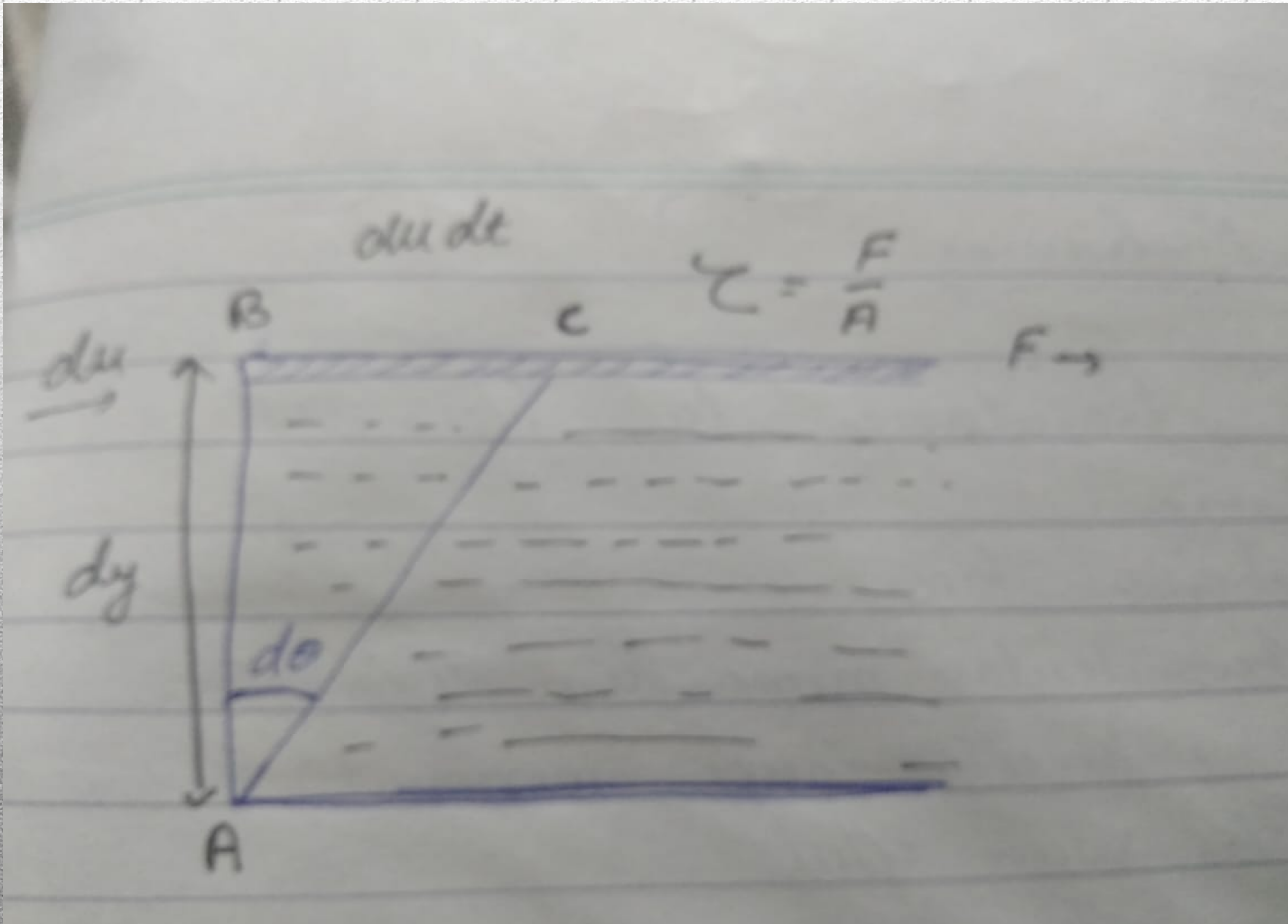

U=0
velocity
u + du
B
B
u
A
A
y
y+dy

# NEWTONS LAW OF VISCOSITY

**Rate of shear stress is directly proportional to rate of shear strain**



dF
dτ
1
2
3
4
5



du dt
$\tau = \frac{F}{A}$
B
C
F
du
dy
dθ
A

- At point A velocity is U= zero
- At point B velocity is dU
- Fluid particle from point B to point C will travel distance of dU.dt ( in time interval dt)
- $\tan d\Theta = \frac{du.\,dt}{dy}$
- $d\Theta = \frac{du.\,dt}{dy}$

- $$\frac{d\Theta}{dt} = \frac{du}{dy}$$
- $\frac{du}{dy} =$ change in velocity due with respect to distance is know as velocity gradient
- $\frac{d\Theta}{dt}$ = rate of shear strain
- Rate of shear strain = velocity gradient

- $\tau$ proportional to $\frac{d\Theta}{dt}$

Or

- $\tau$ proportional to $\frac{du}{dy}$
- $\tau = \mu \frac{du}{dy}$ ( newtons law of viscosity )

Dynamic viscosity (μ)

- $\tau = \mu \frac{du}{dy}$

S.I Unit

$\frac{N}{m2}$ = m/s . 1/ m

$\mu$ = N.S/ $m^2$

$\mu$ = Pa . S

C.G.S

$\tau$ (dyne/ cm$^2$ ) = $\mu \frac{du}{dy}$ (cm/sec . 1/cm)

$\mu$ = (dyne.s / cm$^2$ ) = poise

1 Pa.S = 10 poise

## KINEMATIC VISCOSITY $(\nu)$

$$\nu = \frac{\mu}{\varrho}$$

(S.I Units $m^2$/sec)
(C.G.S Units $cm^2$ / sec) also known as stokes

1 stokes = $10^{-4}$ $m^2$/sec