VISCOSITY OF FLUID

Fluid Mechanics

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VISCOSITY

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- Causes :

  1- Cohesive force

  2- Intermolecular momentum transfer

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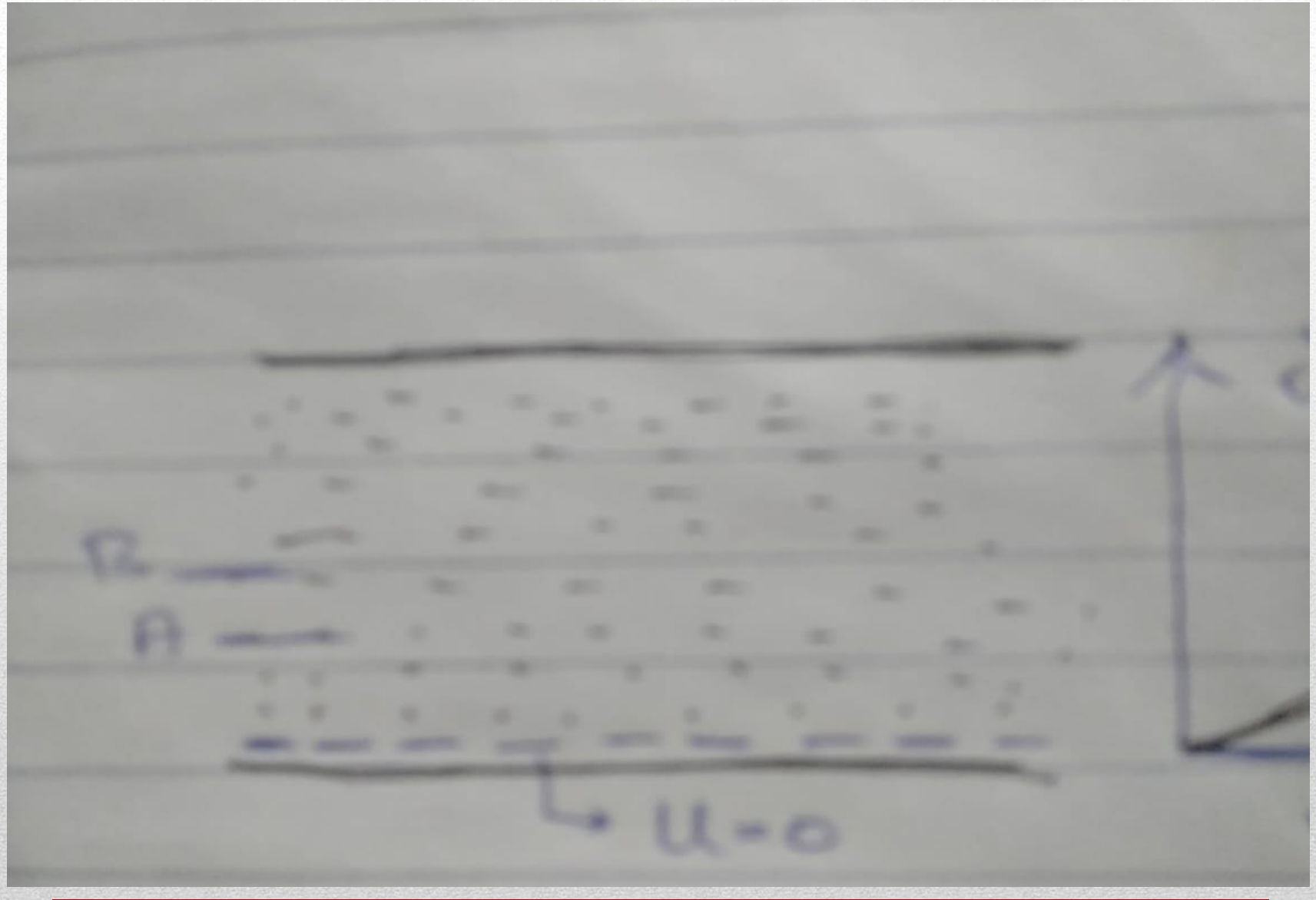
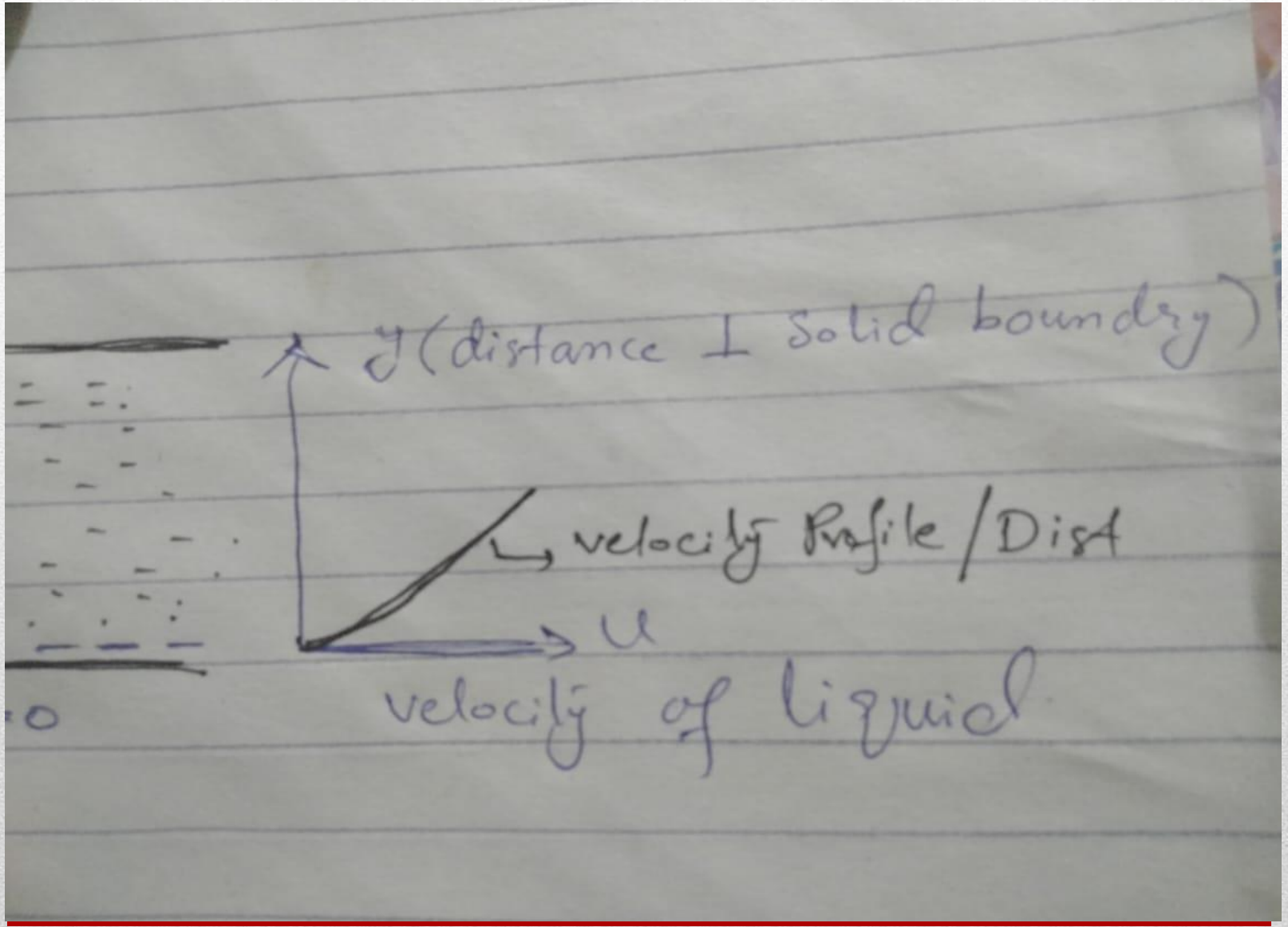
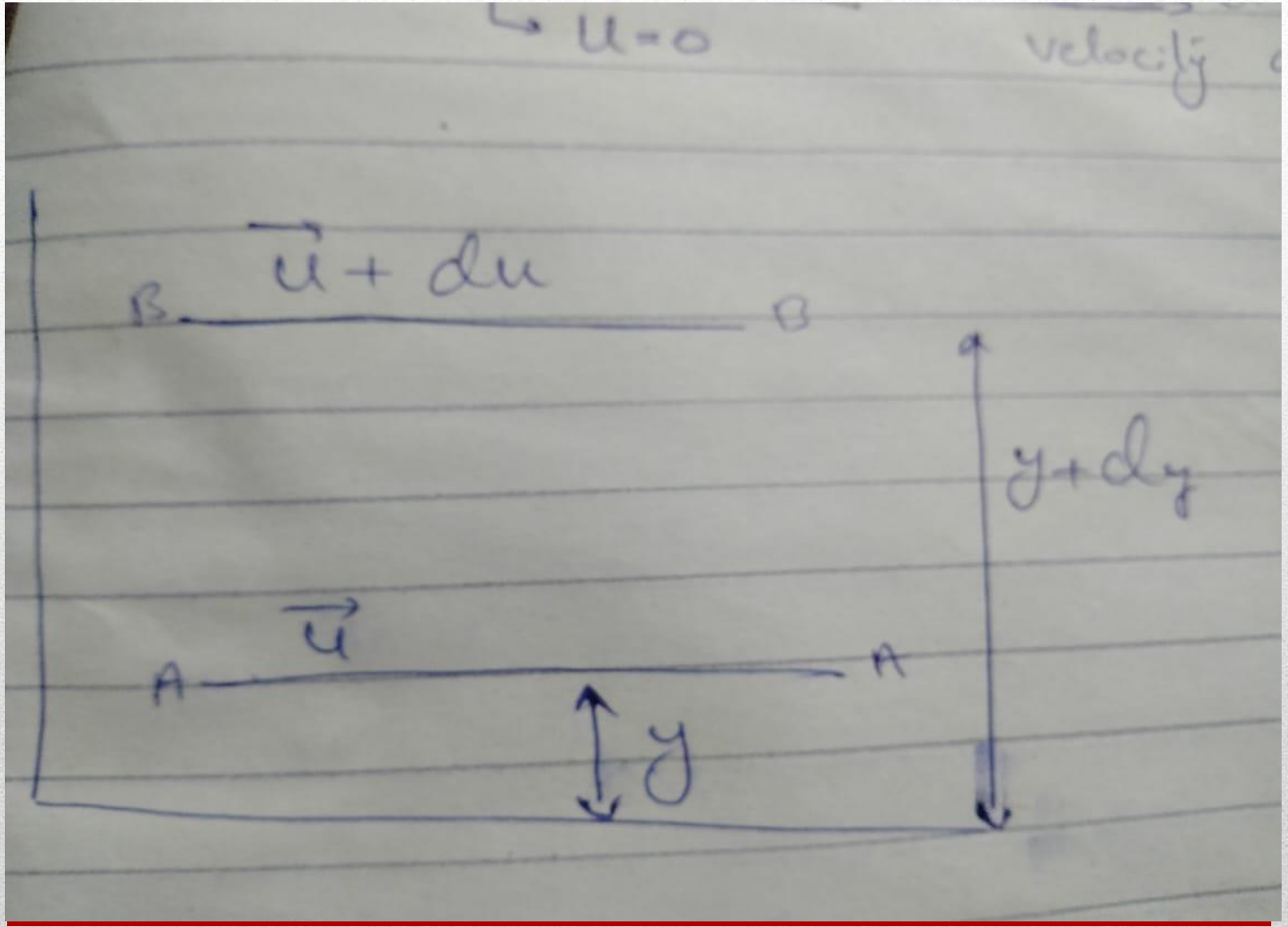
VISCOSITY

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

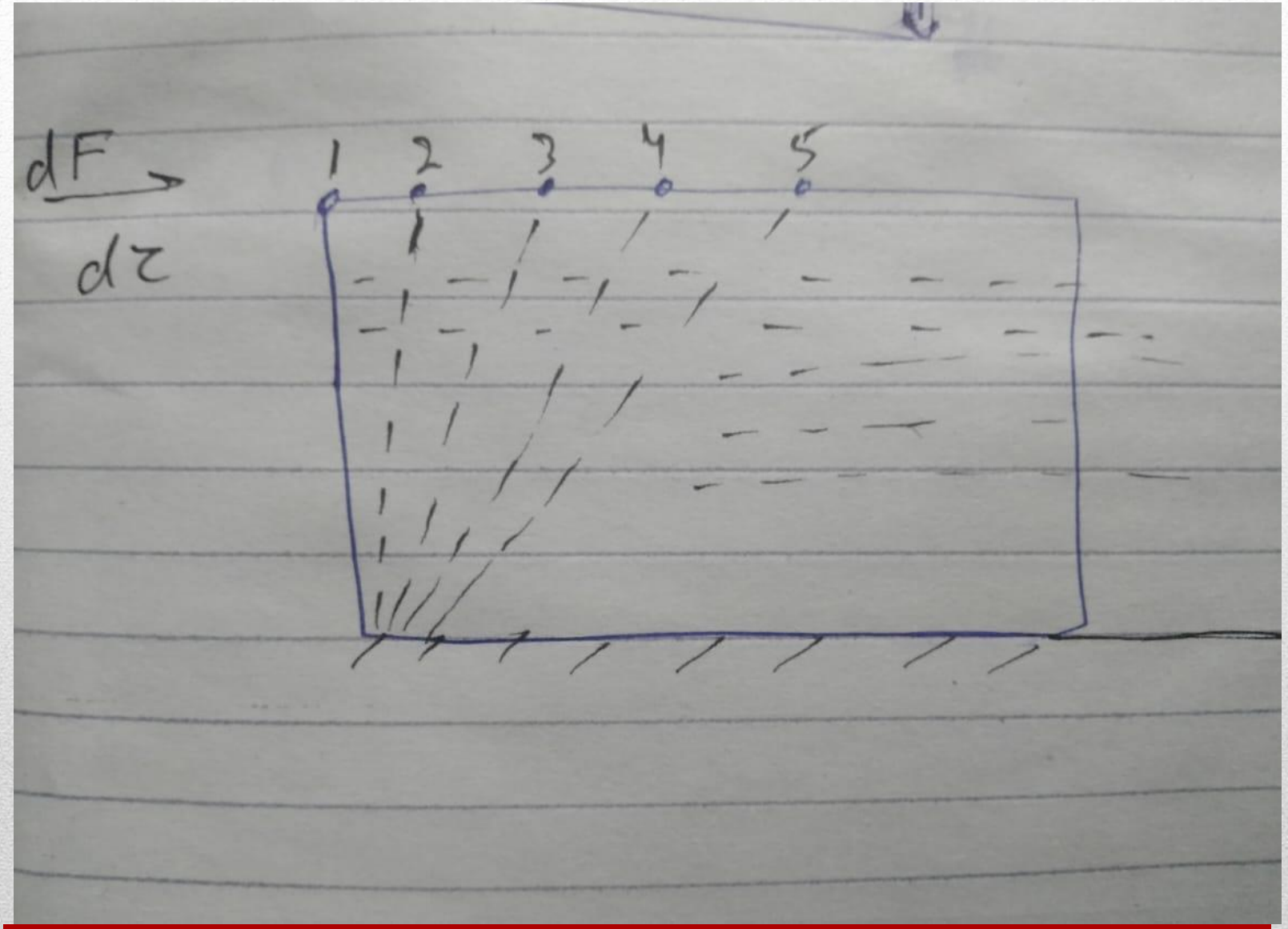

U = 0

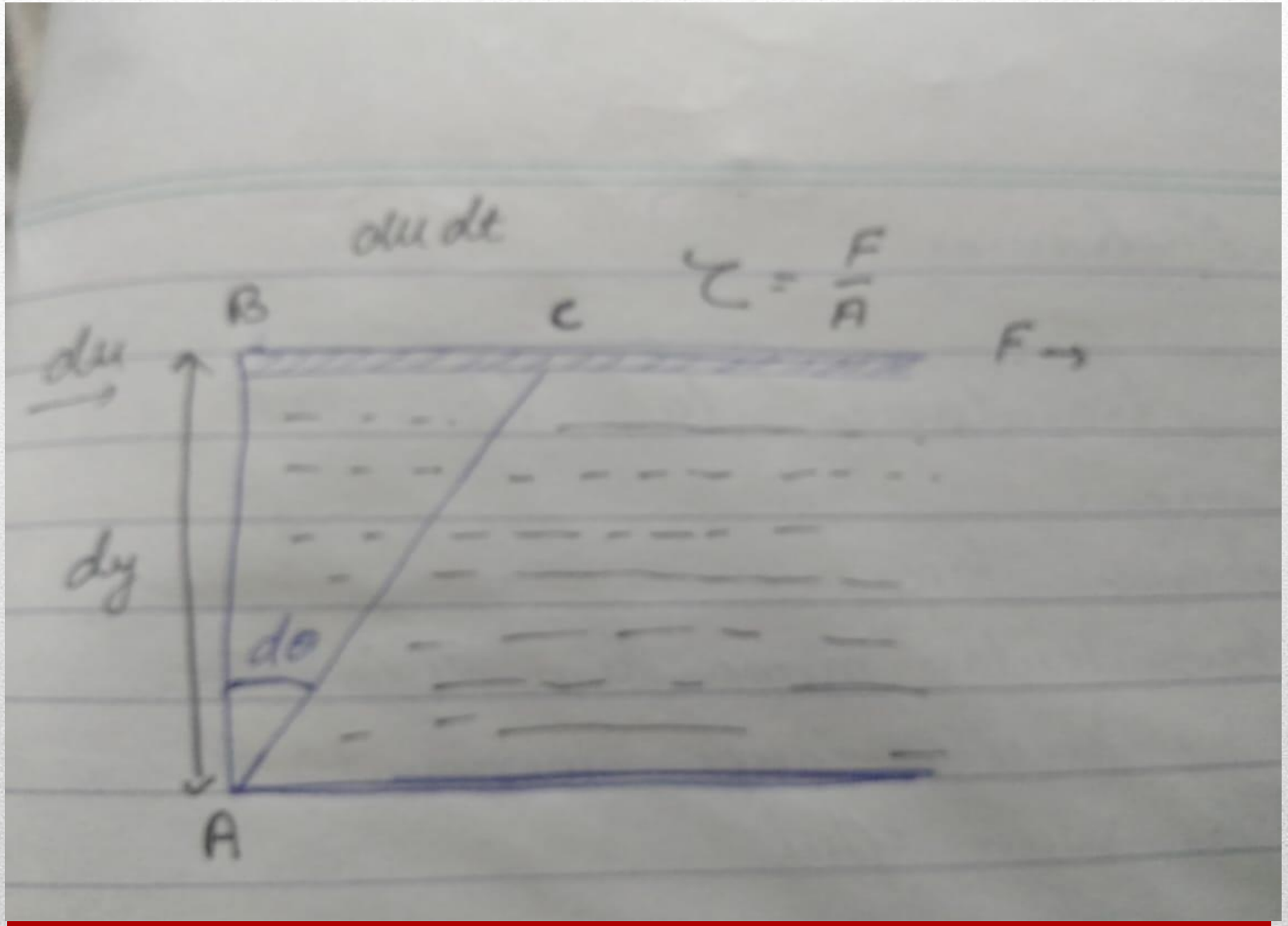

y (distance I solid boundry)
velocity Profile / Dist
u
velocity of liquid


u=0
velocity
$\vec{u} + du$
B
B
$y + dy$
$\vec{u}$
A
A
y

NEWTONS LAW OF VISCOSITY

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


dF
dz
1
2
3
4
5


du dt
τ = F/A
B
C
du
F
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

- τ proportional to $\frac{d\theta}{dt}$

Or

- τ 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

$\frac{N}{m^2}$ = m/s . 1/ m

μ = N.S/ m^2

μ = Pa . S

C.G.S

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

U = (dyne.s / cm^2) = poise

1 Pa.S = 10 poise

KINEMATIC VISCOSITY (ν)

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

(S.I Units m^2/sec)

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

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