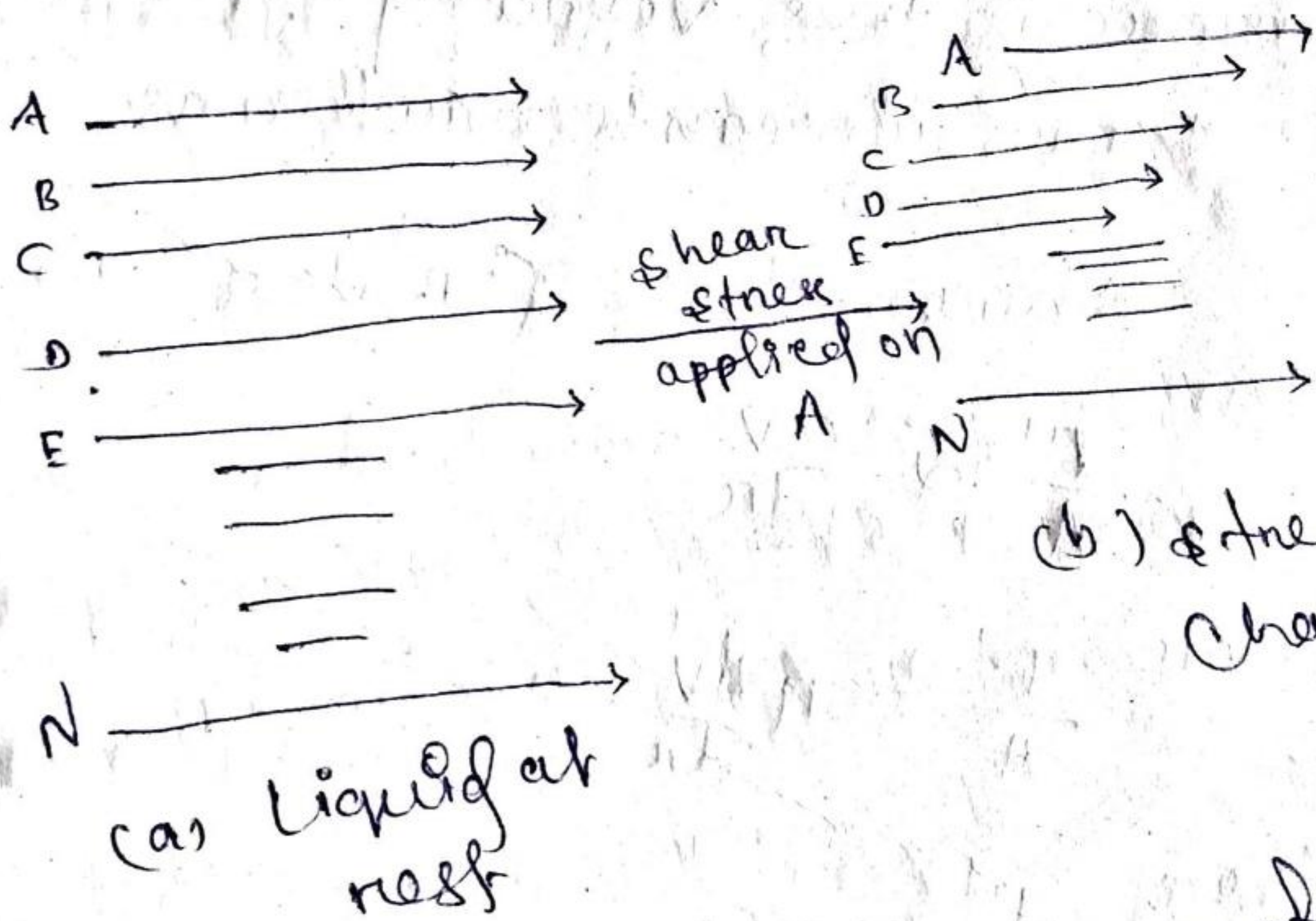


concept of viscosity: -

(3)

consider a block of liquid consisting of parallel layers similar to a deck of cards

- when pressure is applied horizontally on the top layer A, the liquid begins to flow.
- when moving a head the top layer A induces the flow to the second layer B.
- But the velocity of 2nd layer B is less than 1st layer A due to the viscous drag upward by the 3rd layer C and this process is continuous, at last the bottom layer N remain stationary.
- That means the liquid resist the flow when force is applied.
- This resistance is expressed as viscosity



(Newton's flow) diagram shows concept of viscosity

mathematical expression of viscosity: -

shear stress is defined as the force per unit area which is applied to bring about the

(4)

where F' = Force (N)

F = shear stress

= N/m^2

A = Area = m^2

→ when stress is applied then the substance move to flow by changing its shape which can be regarded as rate of shear.

→ Rate of shear is otherwise termed as velocity gradient which is change in velocity w.r.t change in distance

$$\text{Rate of shear } (G) = \frac{dv}{dr}$$

v = velocity = m/sec

r = distance = m

G = Rate of shear = sec^{-1}

The shearing stress is directly \propto to the rate of shear. So more is the force per unit area more is the velocity gradient. So the expression can be written as

shear stress \propto Rate of shear

$$\frac{F'}{A} \propto \frac{dv}{dr}$$

$$\text{or } \frac{F'}{A} = \eta \frac{dv}{dr}$$

$$\text{or } \frac{F'}{A} = \eta G$$

$$\text{or } \boxed{F = \eta G} \quad \text{--- (1)}$$

where $\frac{F'}{A}$ = shearing stress

$\frac{dv}{dr}$ = rate of shear (G)

(a) η = viscosity

the unit of η = N s m⁻²

η is calculated by $\frac{F}{A} = \eta \frac{dv}{dy}$ (a)

co-efficient of viscosity or viscosity is defined as the force per unit area required to maintain a unit difference velocity betⁿ 2 parallel layers in the liquid one metre apart

η in CGS unit the viscosity expressed as

~~poise~~ poise or dyne cm⁻²

in S.I unit it is expressed as pascal.sec