15

College of Engineering & Technology

Department: Mechanical Engineering   Marks: 15
Lecturer: Dr. Rola Afify   Time: 9:30 – 10:10
Course Code: ME362   Date: 20/3/2016

Name: **Model Answer**   R. N.:

Answer the following questions:
Question one (15 marks)

A) Define:

*** Kinematic viscosity** **(υ):** is defined as the ratio of dynamic viscosity of water to density

$$\upsilon = \frac{\mu}{\rho} = \frac{Pa.S}{kg/m^3} = \frac{kg.m.s\ m^3}{s^2 m^2\ kg} = (m^2/s)$$

$\upsilon = 0.01\ cm^2/s$

$= 0.01$ stoke   as Stoke $= cm^2/s$

$= 1$ centi stokes

- Vapour Pressure of a liquid:
It is the pressure at which a liquid start to boil at working temperature.
Boling temp increases by increasing pressure on liquid surface.
Boling temp decreases by decreasing pressure on liquid surface.

B) Compare between Newtonian and Non-Newtonian Fluids.

$$\tau = \frac{F_{vis}}{A} = \mu \frac{du}{dy}$$

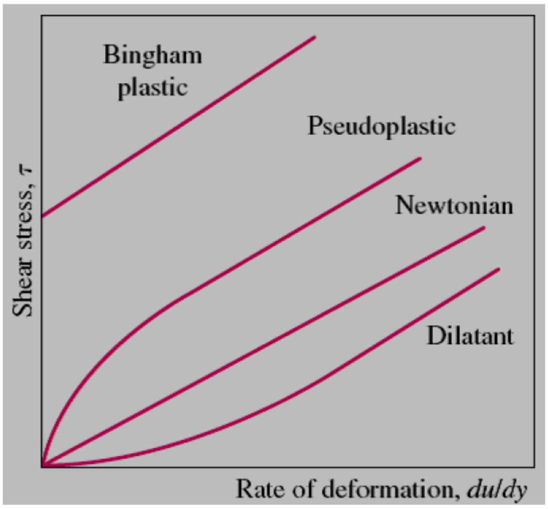
as τ: Shear stress

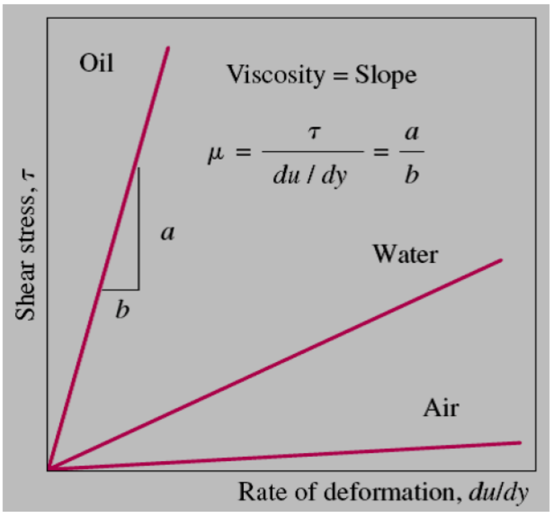
$\frac{du}{dy}$: rate of shear strain

If $\tau\ \alpha\ \frac{du}{dy}$ $\therefore\ \mu = const.$ $\therefore$ It is a Newtonian fluid

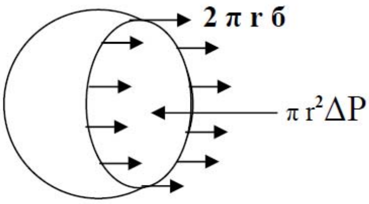
$\mu = const.$ ⟶ Newtonian fluid

$\mu = \uparrow\downarrow$ ⟶ Non Newtonian





C) A water bubble has a radius of 4mm. Determine the pressure difference between the inside and outside the droplet. Surface tension of water is $\sigma = 7.34 \times 10^{-2}$ N/m.



Half of droplet

$$2 \pi r б = \pi r^2 \Delta P$$

$$\Delta P = \frac{2\pi r б}{\pi r^2} = \frac{2 б}{r}$$

$\Delta P = 2 \times 7.34 \times 10^{-2} / (4 \times 10^{-3}) = 36.7$ Pa

D) Two vertical parallel clean glass plates are spaced a distance of 2mm apart. If the plates are placed in water ($\sigma = 7.34 \times 10^{-2}$ N/m), how high will the water rise between the plates due to capillary action?

For equilibrium in the vertical direction,

$$W = 2(\sigma \ell \cos\theta)$$

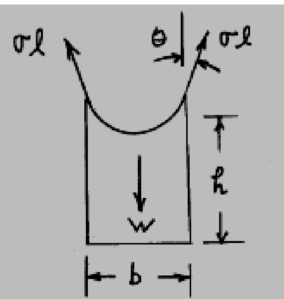
Since,

$$W = \gamma h b \ell$$

$$\gamma h b \ell = 2 \sigma \ell \cos\theta$$

or,

$$h = \frac{2\sigma \cos\theta}{\gamma b}$$



(ℓ ~ width of plates)

Thus, (for $\theta = 0$)

$$h = \frac{2(7.34\times10^{-2}\ \frac{N}{m})(1)}{(9.80\times10^{3}\ \frac{N}{m^3})(0.002\ m)} = 7.49\times10^{-3}\ m = \underline{7.49\ mm}$$

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