College of Engineering & Technology

Department: Mechanical Engineering   Marks: 15
Lecturer: Dr. Rola Afify   Time: 11:30 – 12:10
Course Code: ME362   Date: 20/3/2016

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

Answer the following questions:
Question one (7 marks)
A) Define:

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

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

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

$\quad = 0.01\ stoke \qquad\qquad as\ \ Stoke = cm^2/s$

$\quad = 1\ centi\ stokes$

- Bulk modulus of elasticity:
  It's the rate at which the pressure changes with volumetric strain ($\Delta V/V$)

$$K = \frac{-\Delta P}{\Delta V/V}$$
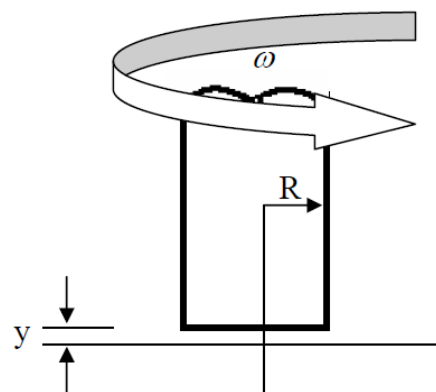
B) Prove that for the shown case the torque

$$T = \frac{2\pi\mu\omega}{4y}\ R^4$$

$$dA = 2\pi\ rdr \quad \& \quad u = \omega r$$

$$dF = \mu(2\pi\ rdr)*\frac{\omega r}{y}$$

$$F = \frac{\mu.2\pi\omega}{y}\ \int_0^R r^2 dr$$
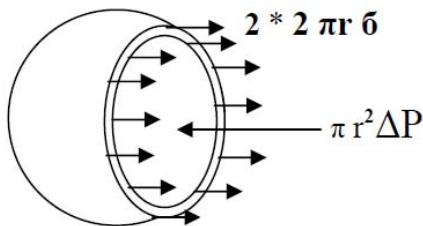
$$\boxed{F = \frac{2\pi\omega\mu}{3y}\ R^3}$$

$$dT = r.dF$$

$$= r * \frac{\mu \, 2\pi \, rdr \, \omega r}{y}$$

$$\int_0^T dT = \frac{2\pi\mu\omega}{y} \int_0^R r^3 dr$$

$$\boxed{T = \frac{2\pi\mu\omega}{4y} R^4}$$

Question two (8 marks)

A) A soap bubble has a radius of 4mm. Determine the pressure difference between the inside and outside the droplet. Surface tension of soap is $\sigma = 0.15$ N/m.

half of a soap bubble

$$4 \pi r \sigma = \pi r^2 \Delta P$$

$$\Delta P = \frac{4 \sigma}{r}$$
$\qquad\qquad\qquad$ $\Delta P = 2 \times 0.15 / (4 \times 10^{-3}) = 75$ Pa

B) A clean glass tube having a 2mm radius is placed in water ($\sigma = 7.34 \times 10^{-2}$ N/m), how high will the water rise in this tube due to capillary action?

$W = \sigma \, 2\pi \, r \cos\Theta$
$\gamma \, \pi \, r^2 \, h = \sigma \, 2\pi \, r \cos\Theta$
$9800 \times \pi \times (2 \times 10^{-3})^2 \, h = 7.34 \times 10^{-2} \times 2\pi \times 2 \times 10^{-3} \times 1$
$h = 7.34 \times 10^{-2} / (9800 \times 10^{-3})$
$h = 7.5 \times 10^{-3}$ m
$h = 7.5$ mm