College of Engineering & Technology

Department: Mechanical Engineering   Marks: 10
Lecturer: Dr. Rola Afify   Time: 11:30 – 12:10
Course Code: ME361   Date: 1/7/2015
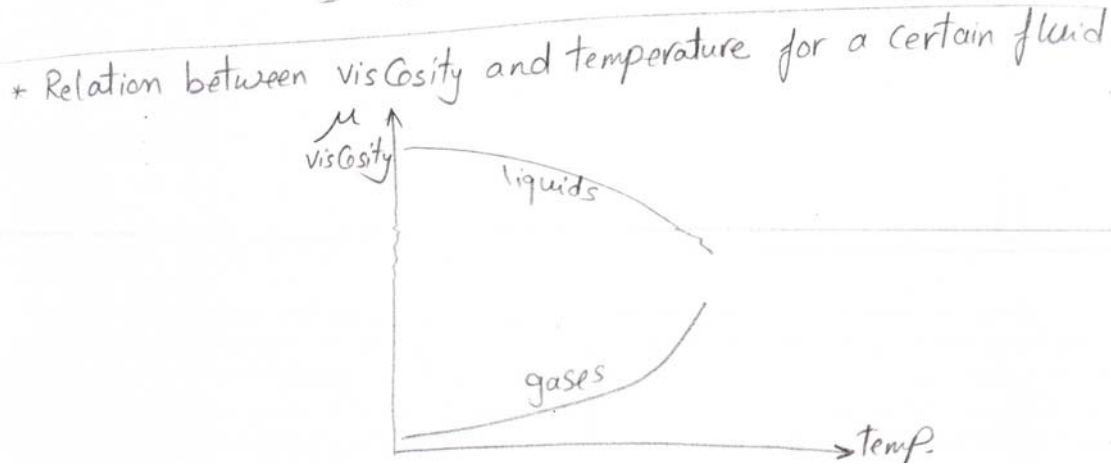
Name: Model Answer   R. N.:

Answer the following questions:
Question one (5 marks)
A) Discuss the relation between Viscosity and Temperature for a certain fluid.

B) Choose the correct answer:
   An oil has a kinematic viscosity of 1.25 *10-4 m^2/s and a specific gravity of 0.80. What is its dynamic (absolute) viscosity in kg/(m.s)?
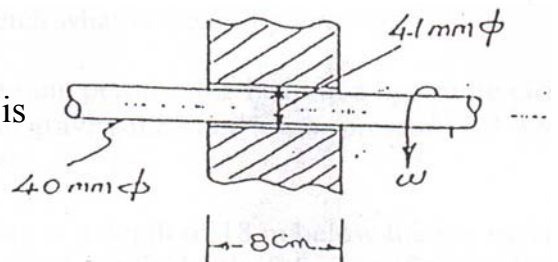   (a) 0.08, (b) 0.10, (c) 0.125, (d) 1.0, (e) 1.25

$$\nu = \frac{\mu}{\rho} \qquad \gamma = \frac{\rho}{\rho_w} \qquad \rho = 0.8 * 1000 = 800 \ Kg/m^3$$

$$\mu = \nu \rho = 1.25 * 10^{-4} * 800$$

$$= 0.1 \quad Kg/m.s$$

(b) the answer

C) The shaft turning inside a stationary journal as shown, with a rotating speed 20 rps the torque is 0.0036 N.m. Estimate the viscosity of oil.

4.1 mm φ
40 mm φ
8 cm

$$d = 40 * 10^{-3} m$$
$$D = 41 * 10^{-3} m$$
$$\left. \right\} \quad y = \frac{D-d}{2} = 0.5$$
$$L = 8 * 10^{-2} m$$
$$\omega = 2\pi * 20 = 40\pi \ rad/sec$$
$$T = 0.036 \ N.m \qquad \mu = ??$$

1/2

$$T = F*r = \mu A \frac{du}{dr} * r$$

$$0.036 = \mu * \left(\pi * 40 * 10^{-3} * 8 * 10^{-2}\right) * \frac{40\pi * \frac{40}{2} * 10^{-3}}{0.5 * 10^{-3}}$$

$$0.036 = \mu * 50.53$$

$$\mu = 7.124 * 10^{-4} \text{ Pa.s.}$$

Question two (5 marks)

A) Prove that the pressure changes in the vertical direction.

$$\rho = \frac{m}{V} \qquad \therefore \quad m = \rho V = \rho A h$$

$$\sum F = 0 \qquad \text{in static}$$

$$\text{vertical} \quad F_1 + mg - F_2 = 0$$

$$P_1 A + \rho A (z_1 - z_2)g - P_2 A = 0 \qquad \boxed{\div A}$$

$$P_1 + \rho h g - P_2 = 0$$

$$\boxed{P_2 - P_1 = \rho g h} \qquad \text{or} \qquad \boxed{P_2 - P_1 = wh}$$

B) A tank is constructed of a series of cylinders having diameters of 0.30, 0.25, and 0.15 m as shown in figure. The tank contains oil (sp.gr. = 0.8), water, and glycerin (sp.gr. = 1.26). A mercury manometer is attached to bottom. Calculate the manometer reading, h.

B) h=??

$$P_I = P_{II}$$

$$\cancel{P_{atm}} + \rho_o g * 0.1 + \rho_w g * 0.1$$

$$+ \rho_G g * 0.2 = \cancel{P_{atm}} +$$

$$\rho_m g h$$

$$\gamma_o \cancel{g} * 0.1 + \gamma_w \cancel{g} * 0.1 + \gamma_G \cancel{\rho_w g} * 0.2$$

$$= \gamma_m \cancel{\rho_w g} h$$

$$h = \frac{0.8 * 0.1 + 0.1 + 1.26 * 0.2}{13.6} = 0.032m$$