Alexandria University
Faculty of Engineering
Electromechanical Department
July, 2013
Fluid Mechanics 1 (EME206)
1ˢᵗ year
Time Allowed: 1.5 hr

جامعة الأسكندرية
كلية الهندسة
قسم هندسه الكهروميكانيكا
يوليو2013
ميكانيكا موائع
السنة الدراسية: الأولي
مدة الأمتحان: ساعة ونصف

Answer the following questions:
Question one (7 marks)

A) Define Density, Kinematic viscosity, Vapor pressure of liquids (with mentioning units).

* Vapour pressure of liquids (P_{vap}) : It is the pressure at which a liquid starts to boil at working temperature.

Boiling temp. increases by increasing pressure on liq. surface
~   ~   decreases ~ decreasing   ~   ~   ~   ~

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

for water
$\nu = 0.01$ cm²/s
$= 0.01$ stoke
$= 1$ centistoke

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

$$= \frac{Pa.s}{Kg/m^3} = \frac{Kg.m.s.m^3}{s^2 m^2 . Kg} = (m^2/s)$$

$$stoke = cm^2/s$$

B) A journal bearing consists of an 80mm diameter shaft in an 80.4mm diameter and a 120mm long sleeve, the clearance space is assumed to be uniform and is filled with oil having an absolute viscosity of 0.11 N.s/m². Calculate the needed power to overcome viscosity when the shaft turns at 150 rpm.
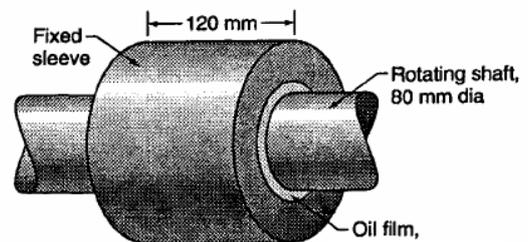
$d = 80$ mm $D = 80.4$ mm $l = 120$ mm
$\mu = 0.11$ N.s/m² $N = 150$ rpm

$$Power = T * \omega = F * \omega * r \longrightarrow ①$$

$$F = \mu A \frac{du}{dy} = \mu * \pi d l * \frac{\omega r}{\left(\frac{D-d}{2}\right)} \longrightarrow ②$$

$$\omega = \frac{\pi d N}{60} = \frac{\pi * 80 * 10^{-3} * 150}{60} = \frac{\pi}{5} = 0.628 \frac{rad}{sec}$$

sub. in ②

$$F = 0.11 * (\pi * 80 * 10^{-3} * 120 * 10^{-3}) * \frac{0.628 * \frac{80 * 10^{-3}}{2}}{\frac{0.4 * 10^{-3}}{2}}$$

$$= 0.4167 \quad N$$

sub. in ①
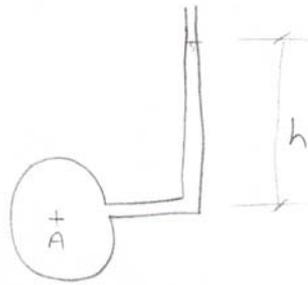$$power = 0.4167 * 0.628 * \frac{80 * 10^{-3}}{2}$$

$$= 0.010467 \quad Watt$$

Question two (7 marks)

A) Differentiate between Piezometer and Inverted U-tube manometer.

* piezometer

pressure tube or piezometer
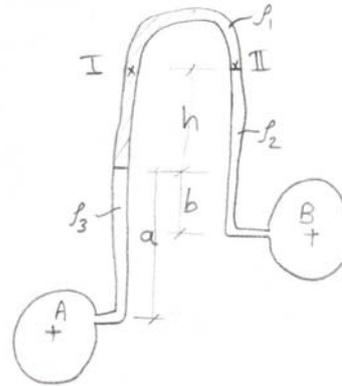consists of a single vertical tube.
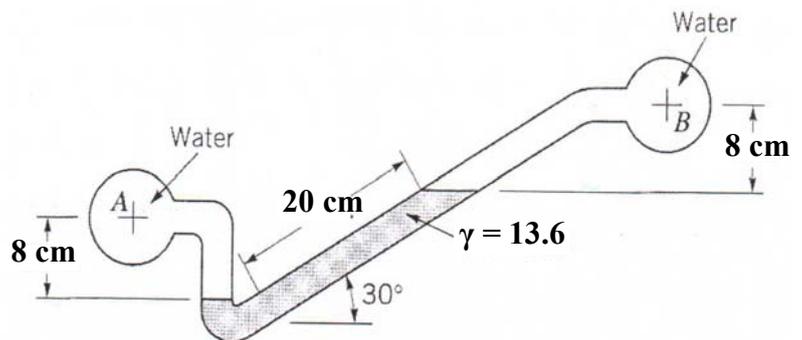
$$P_A = wh$$

* Inverted U-tube

$$P_I = P_{II}$$

$$P_A - \rho_3 g a - \rho_1 g h = P_B - \rho_2 g (h+b)$$

$$P_A - P_B = \rho_3 g a + \rho_1 g h - \rho_2 g (h+b)$$

$$\Delta P = $$

B) For the inclined tube manometer shown in figure, the pressure in pipe A is 10 kPa. The fluid in both pipes A and B is water. The manometer fluid is mercury ($\gamma = 13.6$). What is the pressure in pipe B.

Water

Water

A+

$+_B$

8 cm

8 cm

20 cm

$\gamma = 13.6$

30°

Question three (6 marks)

A 5-m-high. 5-m·wide· rectangular plate blocks the end of a 4-m-deep freshwater channel as shown in Figure. The plate is hinged about a horizontal axis along its upper edge through a point A and is restrained from opening by a fixed ridge at point B. Determine the force exerted on the plate by the ridge.