College of Engineering & Technology

Department: Mechanical Engineering — Marks: 10
Lecturer: Dr. Rola Afify — Time: 9:30 – 10:10
Course Code: ME362 — Date: 25/3/2015

Name: Model Answer — R. N.:

Answer the following questions:
Question one (5 marks)

A) Define:

- Specific weight:

* specific weight : weight per unit volume

$$\omega = \frac{weight}{Volume} = \frac{m * g}{V} = \rho g \qquad N/m^3,\ dyne/cm^3,\ lb_f/ft^3$$

Dim. $\frac{ML}{T^2} * \frac{1}{T^3}$, for water $\omega = 1000 * 9.8 \frac{N}{m^3}$

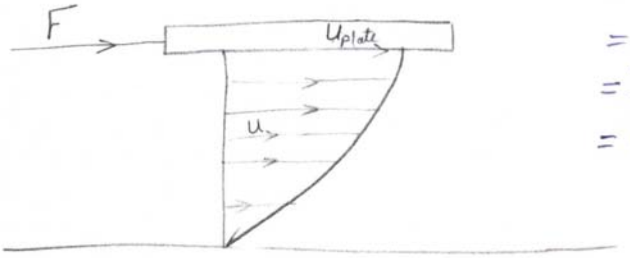
- Vapor pressure of liquid:

* 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 ~ ~ ~

- Viscosity:

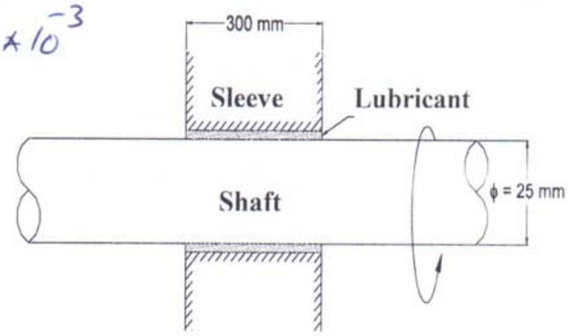
* Viscosity (μ) : The property which causes friction between Fluid and boundary or between fluid layers if there is velocity difference.



μ = Viscosity
= Absolute Viscosity
= Dynamic viscosity
= Coefficient of ~

B) A 25mm diameter shaft is rotated in a 26.2mm diameter 300mm long sleeve containing oil (μ = 0.44 Pa.s) as shown in Figure. Estimate the torque required to rotate the shaft at a speed of 1800 rpm. Also, determine the power lost in viscous friction.

$d = 25 * 10^{-3}$ m
$D = 26.2 * 10^{-3}$ m
$\left.\right\} y = \frac{D-d}{2} = 0.6 * 10^{-3}$
$L = 300 * 10^{-3}$ m
$\mu = 0.44$ Pa.s
$T = ??$ if $N = 1800$ rpm
power = ??



$$F = \mu A \frac{du}{dy} = 0.44(\pi d L) * \frac{\omega r}{0.6*10^{-3}}$$

$$= 0.44 * \pi * 25 * 10^{-3} * 0.3 * \frac{2\pi * 1800 * \frac{25}{2} * 10^{-3}}{60 * 0.6 * 10^{-3}} = 40.7\,N$$

$$T = F * r = 40.7 * \frac{25}{2} * 10^{-3} = 0.51\ N.m$$

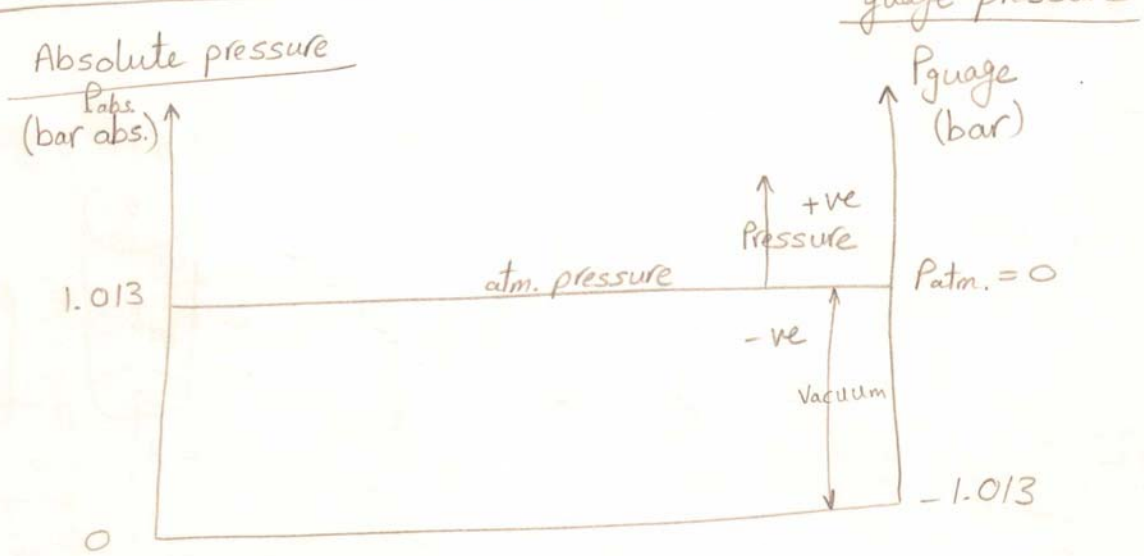
$$\text{power} = T * \omega = 0.51 * \frac{2\pi * 1800}{60} = 95.93\ \text{Watt}$$

\#

<u>Question two (5 marks)</u>

A) State the relation between absolute, atmospheric and gage pressure.

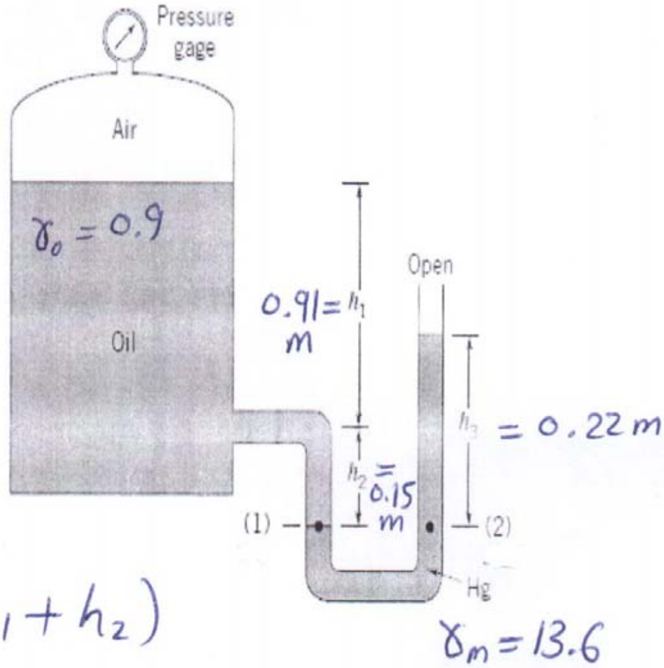
* Absolute, atmospheric and guage pressure



Absolute pressure = true pressure

$$P_{abs.} = P_{guage} + P_{atm.}$$

B) A closed tank contains compressed air and oil ($\gamma_{oil} = 0.9$) as shown in figure. A u-tube manometer using mercury ($\gamma_{mercury} = 13.6$) is connected to the tank as shown. For column heights $h_1 = 91$ cm, $h_2 = 15$ cm, $h_3 = 22$ cm, determine the pressure gage's reading.



$$P_1 = P$$

$$P_{gage} + \rho_o g (h_1 + h_2) = \rho_m g h_3$$

$$P_{gage} = \rho_m g h_3 - \rho_o g (h_1 + h_2)$$

$$= 13600 * 9.8 * 0.22 - 900 * 9.8 (0.91 + 0.15)$$

$$= 19972.4 \text{ Pa}$$

$$= 19.97 \text{ KPa}$$

Dr. Rola Afify