الفرقة الأولى
قسم كهرباء ٢٠١٥/٥/٣١

Menoufiya University **College of Engineering, Shebin El-Kom** **Electrical Power Engineering Dept.** **Second Semester, Final Exam** **Date of Exam: 31 / 5 / 2015**		**Subject: Fluid Mechanics** **Year : 2014-2015** **Time Allowed : 180 minutes** **First Year** **Total Marks: 90**

Question (1) **(10 Marks)**

a) Define the following: fluid mechanics, fluid density, specific weight, specific gravity, specific volume, dynamic and kinematic viscosity, surface tension, Newtonian and non-Newtonian fluids and bulk modulus. **[5]**

b) In a **50 mm** long journal bearing arrangement, the clearance between the two concentric cylinders is **0.1 mm**. The shaft is **20 mm** diameter and is rotating at **3000 rpm**. The dynamic viscosity of the lubricant used is **0.01 Pa.s** and the velocity variation in the lubricant is linear. Considering the lubricant to be Newtonian, calculate the frictional torque the journal has to overcome and the corresponding power loss. **[5]**

Question (2) **(17 Marks)**

i) Explain, with sketch, how the atmospheric pressure is measured. **[2]**

ii) Why is the inclined tube manometer used in pressure measurement. **[2]**

iii) Explain, with sketch, how the pressure is measured mechanically. **[2]**

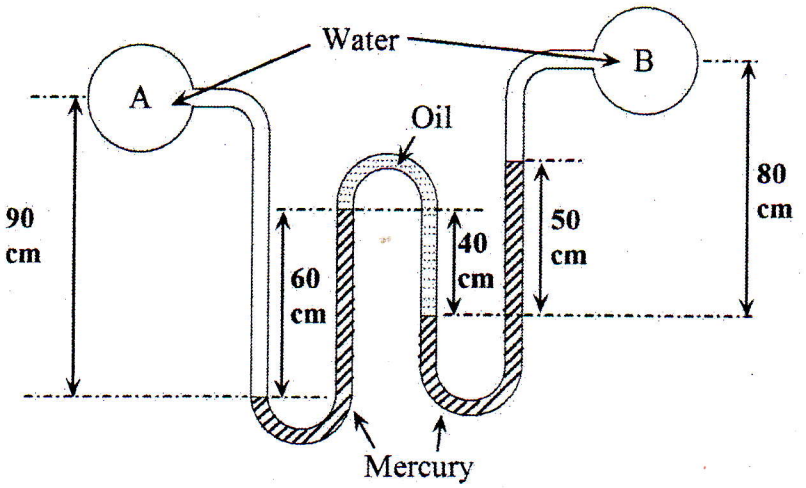
iv) When pressure at a point is so large that the manometric fluid cannot be contained within the height of a single U-tube manometer, use is made of a compound U-tube manometer which essentially consists of a number of simple U-tube manometers arranged in series. For one such unit is shown next, calculate the pressure difference between the points A and B. Take $\gamma_w = 10$ **kN/m^3** for water, $\gamma_m = 136$ **kN/m^3** for mercury and $\gamma_o = 8.5$ **kN/m^3** for oil. **[8]**

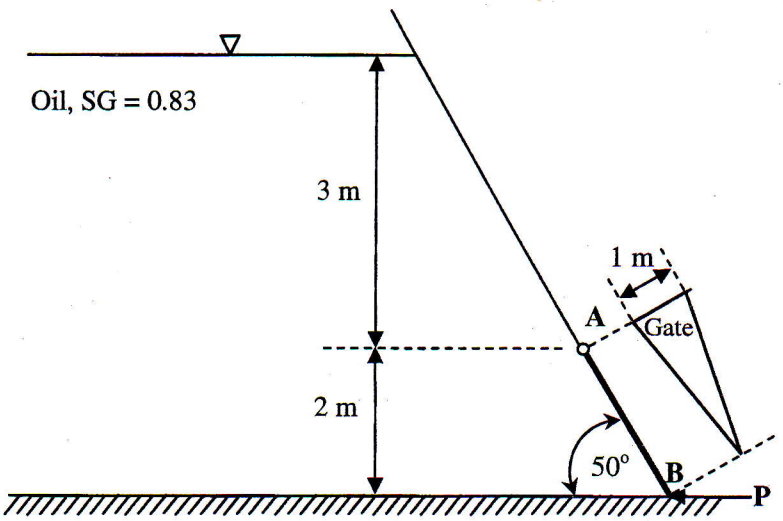
v) If a linear acceleration of **3 m/s^2** is given to a horizontal tank which is **3 m** long. The water depth in the tank when at rest is **1.5 m**. Calculate:

a) The angle of the water surface to the horizontal.

b) The maximum pressure intensity on the bottom.

c) The minimum pressure intensity on the bottom. **[3]**





Question (3) **(18 Marks)**

i) Explain, with sketch, how stable equilibrium is ensured for floating bodies. **[2]**

ii) State clearly Archimedes principle for buoyancy. **[2]**

iii) An isosceles triangle gate **AB**, as shown above, is hinged at A and weighs **1500 N**. What horizontal force **P** is required at point **B** for equilibrium? **[9]**

iv) A spherical object of **1.5 m** diameter is completely immersed in a water reservoir and chained to the bottom. If the chain has a tension of **5.3 kN**, find the weight of the object when it is taken out of the reservoir into air. **[5]**

Question (4) **(15 Marks)**

4-a) Define the following;

Uniform flow – Two-dimensional flow – Ideal flow - Stream line **[4]**

4-b) Derive Euler's equation of motion along a stream line for an ideal fluid, and state clearly the assumptions. **[5]**

4-c) A closed cylindrical tank is 3.5 m high and contains an oil of relative density 0.85 to a height of 3 m above the bottom. The space above the oil surface contains air under a pressure of 50 kPa. If an 8 cm diameter orifice is provided on the side of the tank with its center 25 cm above the bottom, estimate the weight of the fluid discharged in one minute. (take C_d=0.6). **[6]**

Question (5) **(15 Marks)**

5-a) Mention three differences between Venturi meter and orifice meter. **[3]**

5-b) What do you understand by laminar and turbulent flows. What is the criterion used to distinguish between them? **[3]**

5-c) A pump is employed for lifting water from a sump (بئر) to a point 10 m above the sump level. The pipe used is smooth, 0.1 m diameter, and 650 m long. If it is required to deliver 60 liters/s of water, what is the power required to drive the pump. (Take the pump efficiency as 70% and the water viscosity as 0.001 Pa.s, and neglect minor losses). **[9]**

Question (6) **(15 Marks)**

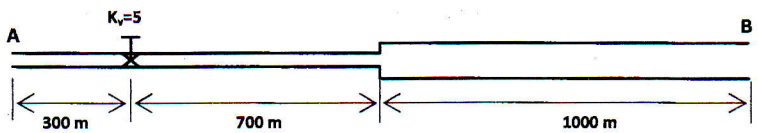
6-a) What do you understand from moody chart? **[3]**

6-b) If the velocity distribution for laminar flow in a pipe is given by the relation;

$$u = \frac{1}{4\mu}\left(-\frac{\partial p}{\partial x}\right)\left(R^2 - r^2\right)$$

Prove that the average velocity is half the maximum velocity. **[5]**

6-c) Water is flowing from point A to point B, as shown below, at a rate of 50 liters per second. Two pipes of diameters 20 cm and 30 cm are used. The Darcy friction factor (F) is 0.02. The pressure at point A is 98 kPa. Draw the total energy line and the hydraulic gradient line through A to B. **[7]**



With our best wishes, Dr. Ali M. Abdelsalam, Dr. Tarek Ghonim