Menoufiya University **Faculty of Engineering** **Shebin El-Kom** **Final Examination** **Academic Year: 2014-2015**	Minufiya University	**Year: Second year** **Department: Production Dept.** **Subject: *Fluid Mechanics (I)*, MPE 228** **Time Allowed: 3 hr** **Date: 3 .06.2015**

Allowed Tables and Charts: none, Assume any missing data
Final Exam: *2 pages + charts*, Note: For water use: density=1000 kg/m^3, Dynamics Viscosity=0.001 (Pa.s)

Answer all the following Questions *(Two Page)* **[90 Marks for all]**

Question (1) ***(20 Marks)***

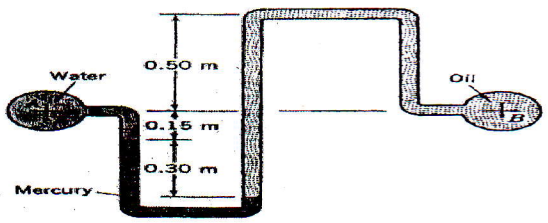
a) **Define** the fluid mechanics. **Explain** its applications (3 only).

b) **Explain** the following terminology: - i)- the dynamics and kinematic viscosity. ii)-the capillary effect. iii)-the bulk modules for liquid and gases. v)-The surface tension.

c) In the fluid case, the dynamics viscosity depends on the temperature. How and why?

d) A square plate of 0.255 kg mass and 0.5 m side slides down a plane, inclined at an angle of 30o to the horizontal. A fluid film separates the plate from the plane. It has a viscosity of 0.02 Pa.s. and its thickness is 1.2 mm. Assume linear velocity profile in the film. **Determine** i)-The uniform velocity at which the plate slides down. ii)-The power dissipated due to friction.

e) The mercury manometer of the shown figure indicates a differential reading of 0.30 m when the pressure in pipe A is 30 mm Hg vacuum. **Determine** the pressure in pipe B. (Soil=0.9)



Question (2) ***(25 Marks)***

a) "The pressure is the same in all directions at any point inside the fluid at rest." **Comment** on this statement and prove your answer.

b) For the hydrostatic pressure on a flat inclined surfaces, what is meant by the total pressure force, and the center of pressure force?

c) Prove that the free surface of the liquid in a vertical cylindrical container subjected to a constant rotation speed (at symmetrical axe) is parabolic.

d) An open 1-m-diameter tank contains water at a depth of 0.7 m when at rest. As the tank is rotated about its vertical axis the center of the fluid surface is depressed. At what angular velocity will the bottom of the tank first be exposed? No water is spilled from the tank.

e) Circular (diameter 2m) vertical gate ABC is hinged at B. Compute the force just sufficient to keep the gate from opening when h (the distance between free surface of water and B) = 8 m. Neglect atmospheric pressure.

Question (3) ***(20 Marks)***

a) **Explain** the difference between the flows as indicated below giving examples of each flow: **i)**-Uniform and Non-uniform flows, **ii)**-laminar and turbulent flows, **iii)**-steady and unsteady, **v)**-compressible and incompressible, **iv)** - rotational and irrotational. ***(5 Marks)***

b) **Explain** the different types of hydraulic energy for a steady flow. ***(5Marks)***

c) **Derive** an equation expressing the actual discharge of water with installing an orifice-meter a horizontal pipeline. ***(5 Marks)***

d) An orifice plate is to be used to measure the rate of air flow through a 2 m diameter duct. The mean velocity in the duct will not exceed 15 m s−1 and a water tube manometer, having a maximum difference between water levels of 150 mm, is to be used. Assuming the coefficient of discharge to be 0.64, **determine** a suitable orifice diameter to make full use of the manometer range. Take the density of air as 1.2 kg m^{-3}.

(5 Marks)

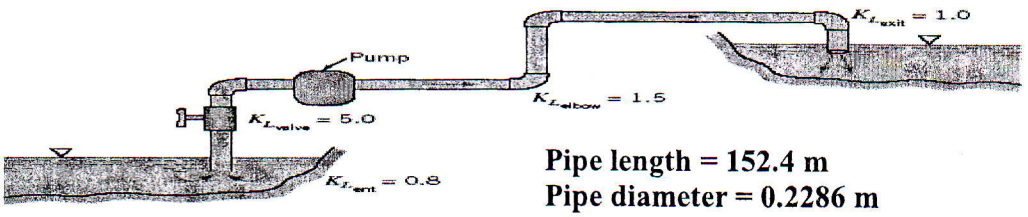
Question (4) ***(25 Marks)***

a)**What** are losses in pipelines. **Explain** minor losses and major losses. ***(5 Marks)***

b) The pump shown in the **Fig. (5)** sucks water from the lower sump and delivers it to a storage tank of 60.96 m above the sump. The steady water flow rate is registered to be $0.16092 m^3/s$ through a pipe system of internal smooth surface (Darcy friction factor = 0.02). All fitted elbows have the same dimensions.

(i) **Determine** the power that the pump adds to the water ($\mu_{water} = 0.001 N.s/m^2$).

(ii) After 10 years, the maintenance engineer noticed that the internal surface is covered with **roughness** of mean thickness ($\varepsilon = 5$ mm). **Determine** the new pump power.



Pipe length = 152.4 m
Pipe diameter = 0.2286 m

Fig.(5) ***(10 Marks)***

c) A system of pipes conveying water is connected in parallel and in series, as shown in **Fig. (6)** The section DE represents the resistance of a valve for controlling the flow, which has a resistance coefficient $K_{DE} = (4000/n)^2$, where n is the percentage valve opening. The Darcy friction factor F is 0.024 for all pipes, and their lengths and diameters are given by

Pipe	AA_1B	AA_2B	BC	CD	CF
Length (m)	30	30	60	15	30
Diameter (m)	0.1	0.125	0.15	0.1	0.1

The head at A is 100 m, at E is 40 m and at F is 60 m. If the valve is adjusted to give equal discharge rates at E and F, **calculate** the head at C, the total volume rate of flow through the system and the percentage valve opening. Neglect all losses except those due to friction. ***(10 Marks)***

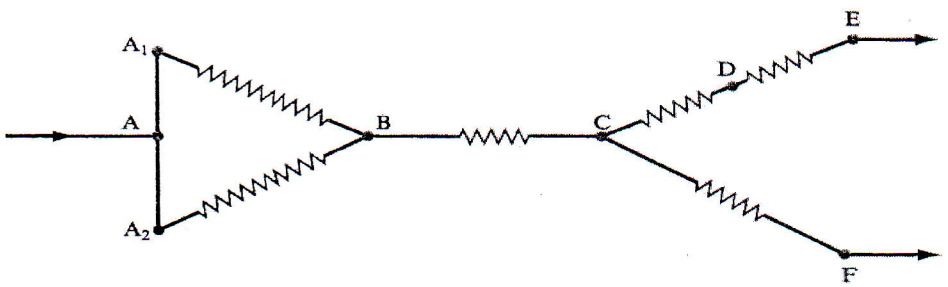


Fig. (6)

Questions	*1*	*2*	*3*	*4*	*5*
ILO's	*A8,A13,B1*	*A8,B1,B2,B3,A13*	*A8,B3,C5*	*A8,C1,B1*	*A8,D7,B1,B2*