Egyptian Russian University | **Fluid Mechanics ME102**
Faculty of Engineering | **Final Exam, Fall 2019**
Construction Dept., **Dr. Osama Khorais** | **Two Hours**

Problem No (1) (12 Points):

Consider laminar flow of a Newtonian fluid of viscosity μ between two parallel plates shown in Fig (1). The flow is one-dimensional, and the velocity profile is given as;
$u = 4u_{max}\,[\,y/h - (y/h)^2]$, where **y** is the vertical coordinate from the bottom surface, **h** is the distance between the two plates, and u_{max} is the maximum flow velocity that occurs at midplane.

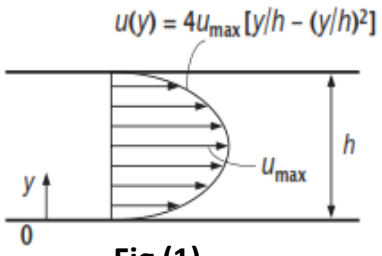

Fig (1)

Develop a relation for the friction force exerted on both plates by the fluid in the flow direction per unit area of the plates.

Problem No (2) (12 Points):

Gate **AB** in **Fig.(2)** is **180 kg** of homogenous mass, **1.2 m** wide into the paper, hinged at **A**, and resting on a smooth bottom at **B**. For what water depth **h** will the force at point **B** equal zero - just to open the gate? The density of Glycerin as 1260 kg/m^3

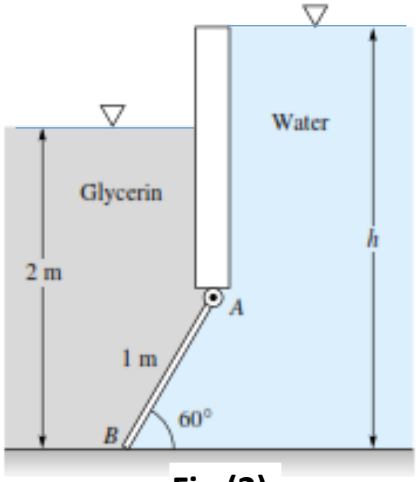

Fig.(2)

Problem No (3) (12 Points):

Find the power requirement of pump shown in **Fig. (3)** if the head losses through the whole pipe is $\mathbf{h_{Loss}}$**=15 m**. Neglect the losses in the exit nozzle. Draw the **T.E.L.** and **H.G.L**. for the system.

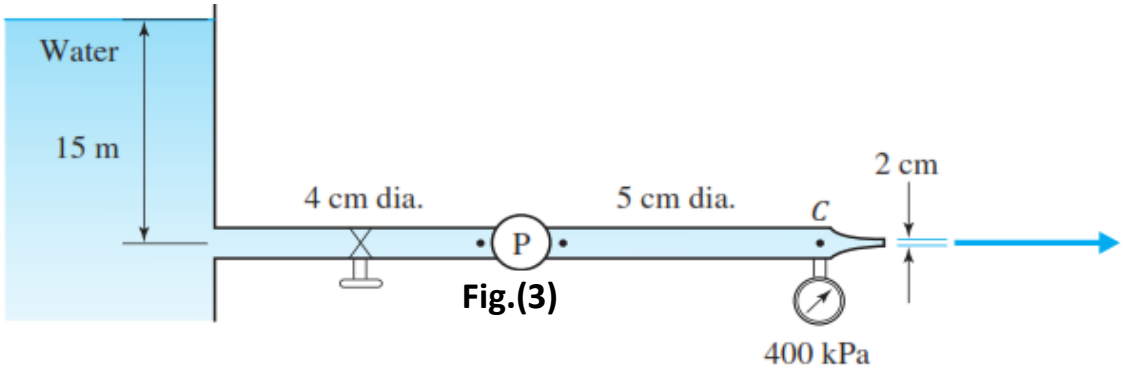

Fig.(3)

Problem No (4) (14 Points):

Find the horizontal force components of the water on the horizontal bend shown in **Fig. (4)** if $\boldsymbol{p_1}$**= 200 kpa**.

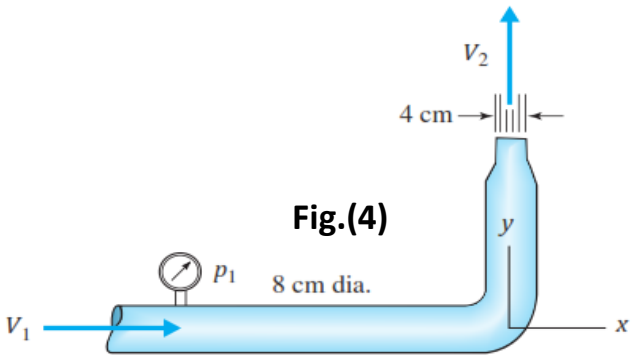

Fig.(4)