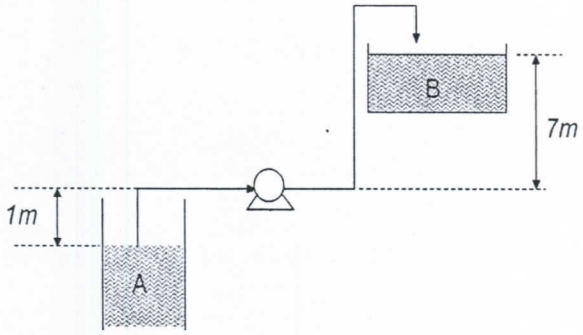
1. There is a fluid flowing through a horizontal cylindrical tube at 26℃ with density= 1.26g/cm^3. The tube has 30cm in length and 0.25cm in diameter. It was measured the volume flow rate of the fluid is 0.113 L/min at 40 psi. Please determine the viscosity of the fluid by using above data and Hagen-Poiseuile principle. (20 points)

2. A pump is used to pump water from a well to a reservoir through a 2-cm ID pipe. The levels of water are 1m below the pump and 7m above the pump, respectively. The volume flow rate of the water is 2.0 L/s. All of the friction loss are negligible and the efficiency of pump is 55%. Please calculate the power of the pump in watt (20 points)



3. A cylindrical rod 3 cm in diameter is partially inserted into a furnace with one end exposed to the surrounding air, which is at 300 K. The temperatures measured at two points 8 cm apart are 400 K and 350 K, respectively.
   (a) If the convective heat-transfer coefficient is 15 W/m$^2 \cdot$ K, determine the thermal conductivity of the rod material. To answer this question, you have to derive an energy balance equation and solve it with proper boundary conditions. For one of conditions you may assume that the temperature of rod at the distance very far away from the finance approaches to the temperature of the surrounding air. (15 points)
   (b) If the surrounding air is moving with a velocity of 5 m/s, what happens to the value of the convective heat-transfer coefficient? (5 points)

4. Briefly define the following terms and when there is more than one, compare and contrast their general characteristic with those of others in the same groups: (註：只是將名詞翻譯不給分)
   (a) Prandtl unmber, Nusselt number (5 points)
   (b) leaching, liquid extraction (5 points)
   (c) minimum number of plates, minimum reflux ratio
   (Using distillation as a model process for your explanation) (5 points)
   (d) packed column, plate column, wetted wall column (for absorption) (5 points)

5. Component A diffuses through a stagnant film to the catalytic surface where it is instantaneously converted to B by the reaction

$$A \rightarrow 2B$$

B diffuses away from the catalytic surface, back through the stagnant film. The catalyst is considered a **cylindrical** surface. The thickness of the stagnant film is δ and the mole fraction of A outside the stagnant film is y_{A0}. Determine the rate at which A enters the gas film if this is a steady-state process and evaluate the concentration profile, that is, the distribution of mole fraction of A in the stagnant film. (20 points)