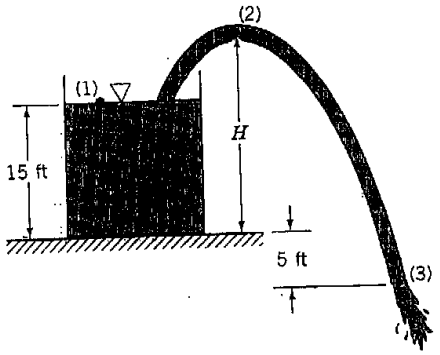
1. Water at 80°F is siphoned from a large tank through a constant diameter hose as shown in figure. Atmosphere pressure is 14.7 lb/in^2 and the physical properties of water at 80°F are as follows.

Physical Properties of Water (BG Units)[a]

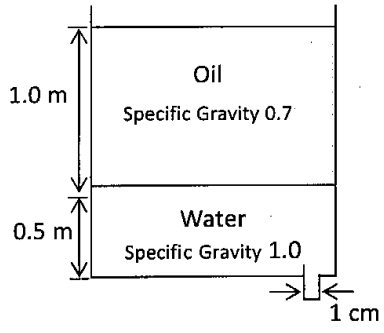
Temperature (°F)	Density, ρ (slugs/ft^3)	Specific Weight[b], γ (lb/ft^3)	Dynamic Viscosity, μ (lb·s/ft^2)	Kinematic Viscosity, ν (ft^2/s)	Surface Tension[c], σ (lb/ft)	Vapor Pressure, p_v [lb/in.^{2}(abs)]
80	1.934	62.22	1.791 E − 5	9.262 E − 6	4.91 E − 3	5.069 E − 1



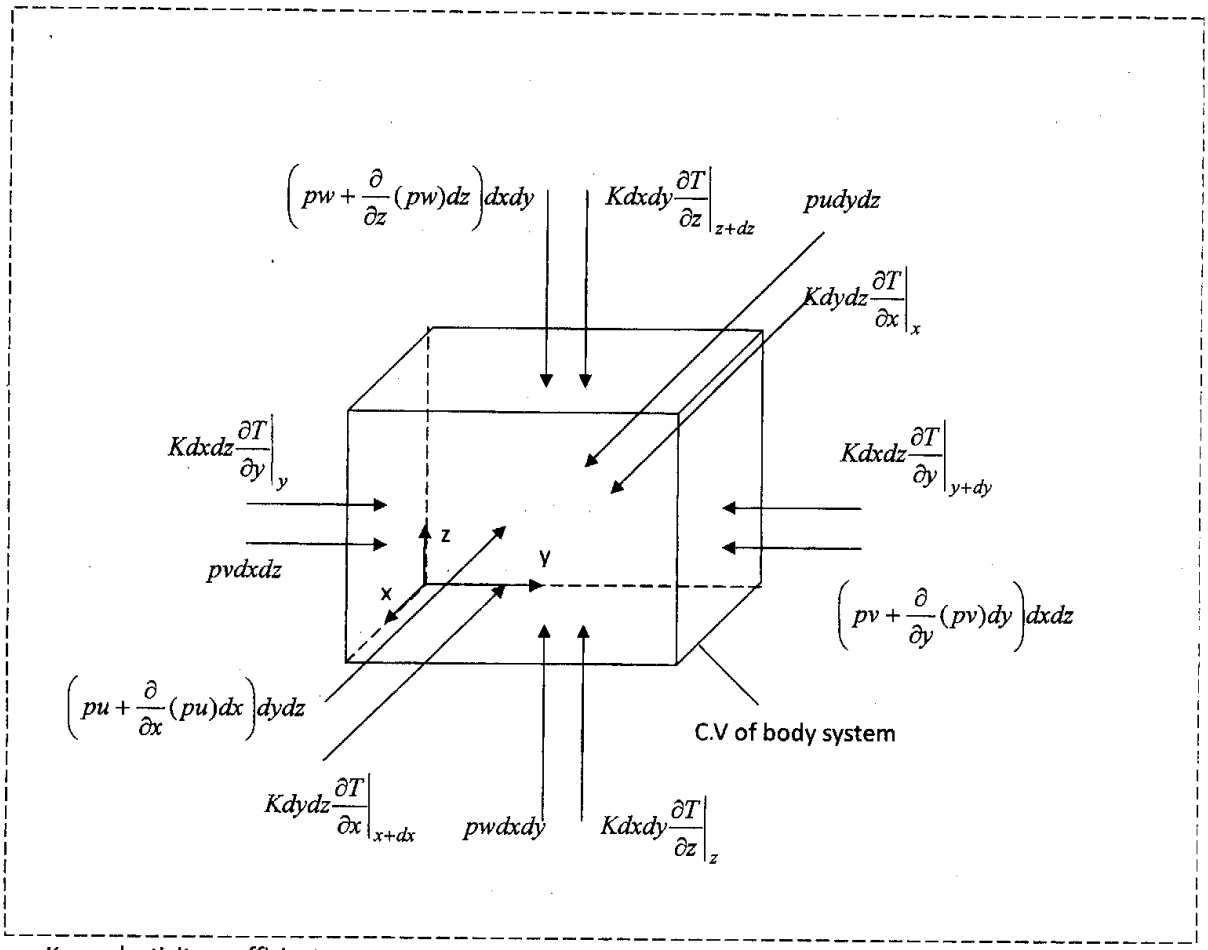
(a) Please determine the speed of the water in the hose. (10%)

(b) Please determine the maximum height of the hill, H, over which the water can be siphoned without cavitation occurring. (5%)

2. Water drain from the tank through a 1 cm diameter drain hole as shown in the figure. Please determine the flow rate of the drain hole. The viscous effects are negligible. (10%)



3.



K: conductivity coefficient.

u, v, w : velocity at x-y-z direction corresponding

p: pressure

T: temperature

Please answer following problems.

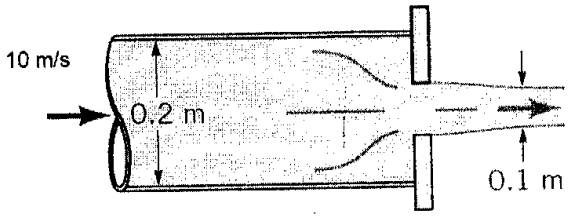
(a) Provide physical meaning for the relation of $\dot{Q}-\dot{W}=\frac{DE}{Dt}$ (5%)

(b) Provide physical meaning for the relation of $\dot{Q}=-KA\frac{\partial T}{\partial n}$ and $\dot{W}=pAV$ (10%)

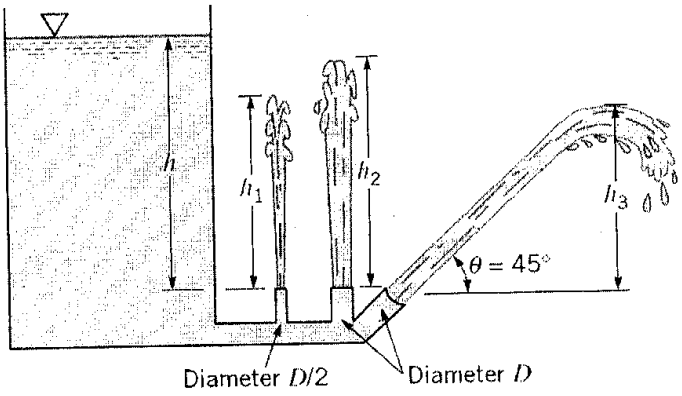
(c) Use equations in (a) and (b) to derive differential energy equation($\rho\frac{D\vec{u}}{Dt}=K\nabla^2T-p\nabla\bullet V$). (10%)

4. In a steady-state flow field, the velocity changes from 5 m/s at point A to 10 m/s at point B. The distance between points A and B is 0.1 m. Assuming the velocity is one-dimensional (flowing from point A to point B) and a linear function of the distance along the streamline between points A and B, please find the velocity distribution as a function of distance between points A and B (5%) and the acceleration at the middle point between points A and B (5%).

5. Assume that the water flowing at 10 m/s in a 0.2 m pipe shown below is inviscid. The exit plane of the pipe is partially blocked by a plate with a hole in it that produces a 0.1-m-diameter water stream. Ignore the gravity effect. Please determine the flow velocity at the hole (5%), the pressure within the pipe (5%), and the force required to hold the plate against the pipe (5%).



6. Water flows from the large open tank shown in the following figure. The jets of water rise to different heights due to the static pressure. If viscous effects are neglected, determine the heights of the streams rise, h_1, h_2, and h_3, in terms of h. (10%)



7. One way of measuring flow rates is to use the flow nozzle, which is a device inserted into the pipe as shown in the following figure.

(a)Determine an equation for p_A-p_B in terms of the specific weight of the flowing fluid γ_1, the specific weight of the gage fluid, γ_2, and the various heights indicated (10%)

(b)For γ_1=10 kN/m^3, γ_2=136 kN/m^3, h_1=20 cm and h_2=2 cm , what is the value of the pressure drop (5%)