1. What is the unit weight of water at 4°C in terms of N/m^3 and dyn/cm^3 ? (10%)

2. Assume the sewer line grade gives a sewer velocity of 2 ft/sec with a half full sewer flow. The slope of the lone is 0.04. Manning's coefficient of roughness is 0.013 (n). What is the diameter of the uncoated cast iron sewer line? (10%)

3. The pipe-flow relationship of the pipe network can be expressed by $h_L = kQ^n$, where k, n are constants, Q is the flowrate, and h_L is the head loss. (1) Write down two requirements of the basic relations of continuity and energy for analysis of flow in a pipe network, (2) Explain the Hardy Cross method. (15%)

4. Find the lapsing time for the complete drainage of water from the device (shown in Fig. 1, A circular cylinder with bottom orifice discharge). (15%)

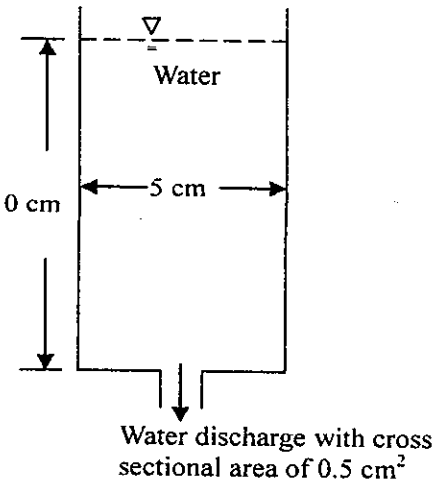

Fig. 1

5. Consider the velocity field:

$$v_x = 2x;\ \ v_y = 4x;$$

Determine the corresponding stream function and plot several streamlines. Indicate the direction of flow along the streamlines. Is continuity satisfied? Why or why not? Identify regions in the flow where fluid velocities are relatively small and other regions where they are relatively high (you can just circle or point to regions on your plot and tell us how you made the determination). Is this flow irrotational? Why or why not? Show what would happen to a little piece of straw placed in the fluid – just make sketches. (20%)

6. A 25% scale model of an undersea vehicle which has a maximum speed of 16 m/s is to be tested in a wind tunnel with a pressure of 6 atm to determine the drag characteristics of the full-scale vehicle. The model is 3 m long. Find the air speed required to test the model and find the ratio of the model drag to the full-scaled drag. (10%)

見背面

7. Consider boundary layer development on a flat plate with an external velocity

$$U_\infty = Gx$$

Assuming the velocity profile inside a boundary layer over the flat plate is given by:

$$\frac{U_x}{U_\infty} = a + b\left(\frac{y}{\delta}\right) + c\left(\frac{y}{\delta}\right)^2 + d\left(\frac{y}{\delta}\right)^3$$

where U_∞ is the velocity profile outside the boundary layer and δ is the boundary layer thickness. Find coefficient a, b, c and d and evaluate the shear stress on the flat plate. The expression for the shear stress should only contain the fluid properties and U_∞. Will this expression depend on δ? Please explain. (20%)

試題隨卷繳回