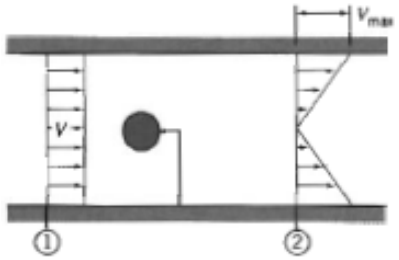
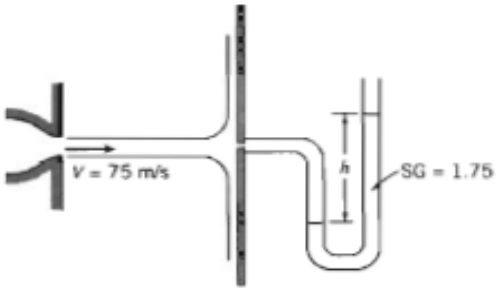
Practice Problems: integral formulation
(ESO-204A)

P1. A small round object is tested in a 1 m diameter wind tunnel. The pressure is uniform across section 1 and 2. The upstream pressure is 20mm H_2O (gage), the downstream pressure is 10mm H_2O (gage), and the mean air speed is 10m/s. the velocity profile at section 2 is linear, it varies from zero at the tunnel centerline to a maximum at the tunnel wall. Calculate (a) the mass flow rate in the wind tunnel, (b) the maximum velocity at section 2, and (c) the drag of the object and its supporting vane. Neglect viscous resistance at the tunnel wall.



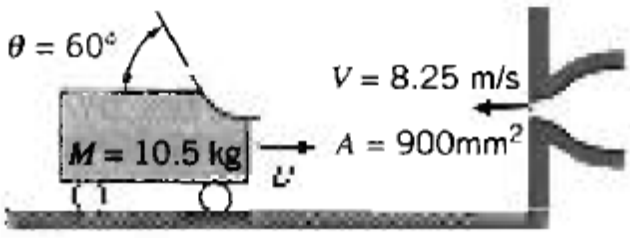
P1

P2. A horizontal axisymmetric jet of air with 10mm diameter strikes a stationary vertical disk of 200mm diameter. The jet speed is 75m/s at the nozzle exit. A manometer is connected to the center of disk. Calculate (a) the deflection, h, if the manometer liquid has SG=1.75 and (b) the force exerted by the jet on the disk.



P2

P3. A small cart that carries a single turning vane rolls on a level track. The cart mass is M=10.5kg and its initial speed is U_o=12.5m/s. At t=0, the vane is struck by an opposing jet of water, as shown. Neglect any external forces due to air or rolling resistance. Determine the time and distance needed for the liquid jet to bring the cart to rest. Plot the cart speed (nondimensionalized on U_o) and the distance traveled as function of time.



P3