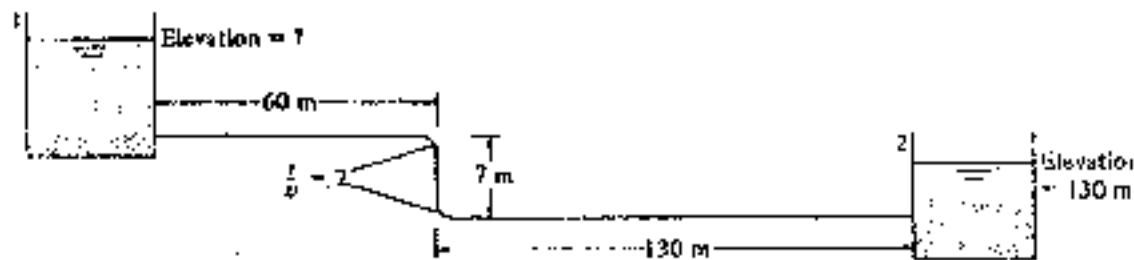


1. Derive the Darcy-weisbach equation and Manning equation. (20%)

2. If oil ($\nu = 4 \times 10^{-3} \text{ m}^2/\text{s}$, $sp.gr. = 0.9$) flows from the upper to lower reservoir at a rate of $0.028 \text{ m}^3/\text{s}$ in the 15-cm smooth pipe, What is the elevation of the oil surface in the upper reservoir? The loss coefficients for bend, entrance and outlet, respectively are 0.19, 0.5, and 1.0. (20%)

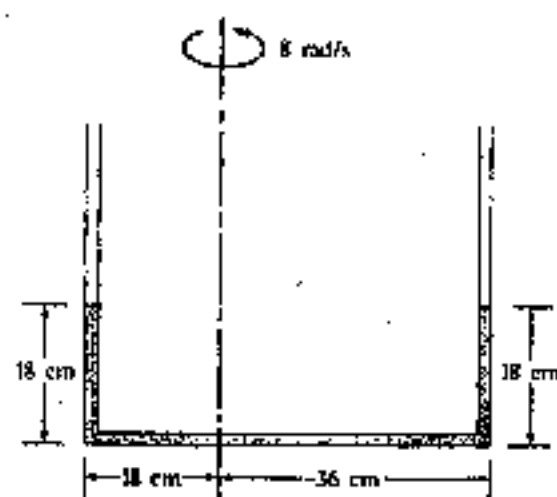


(problem 2)

3. Draw the hydraulic grade line and energy grade line in the figure used in problem 2. (10%)

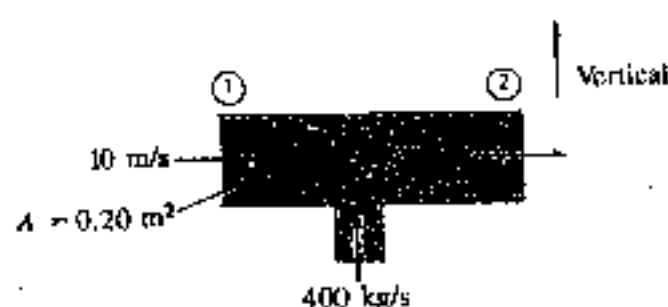
4. A $\frac{1}{49}$ scale model of a proposed dam is used to predict prototype flow conditions. If the design flood discharge over the spillway is $16,000 \text{ m}^3/\text{s}$, what water flow rate should be established in the model to simulate this flow? If a velocity of 1.2 m/s is measured at a point in the model, what is the velocity at a corresponding point in the prototype? (20%)

5. When the U-tube is not rotated, the water stands in the tube as shown. If the tube is rotated about the eccentric axis at a rate of 8 rad/s , what are the new levels of water in the tube? (10%)

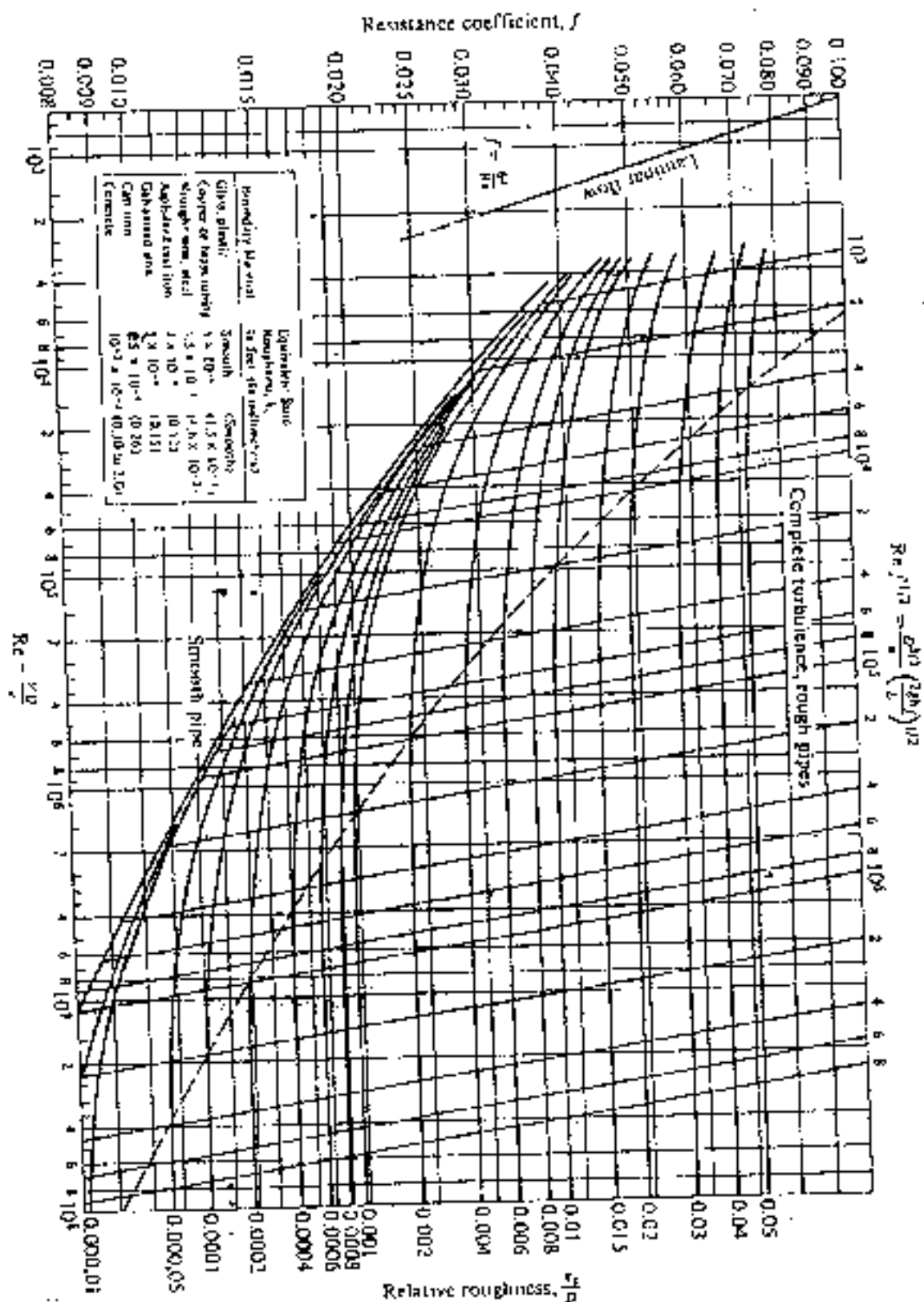


(problem 5)

6. Water flows in a duct as shown. The inlet water velocity is 10 m/s . The cross-sectional area of the duct is 0.2 m^2 . Water is injected normal to the duct wall at the rate of 400 kg/s midway between stations 1 and 2. Neglect frictional forces on the duct wall. Calculate the pressure difference $(p_1 - p_2)$ between stations 1 and 2. (20%)



(problem 6)



(Table for problem 2)