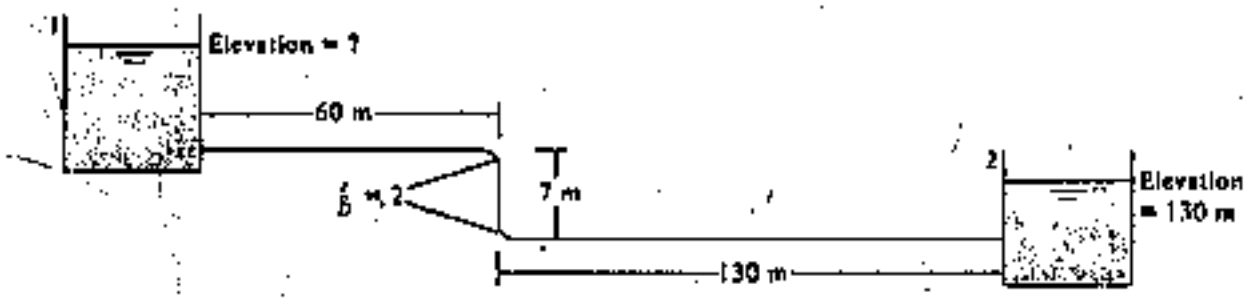
1. Derive the Darcy-weisbach equation and Manning equation. (20%)

2. If oil ($\nu = 4\times10^{-5} m^2/s$, $sp.gr. = 0.9$) flows from the upper to lower reservoir at a rate of $0.028 m^3/s$ 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%)

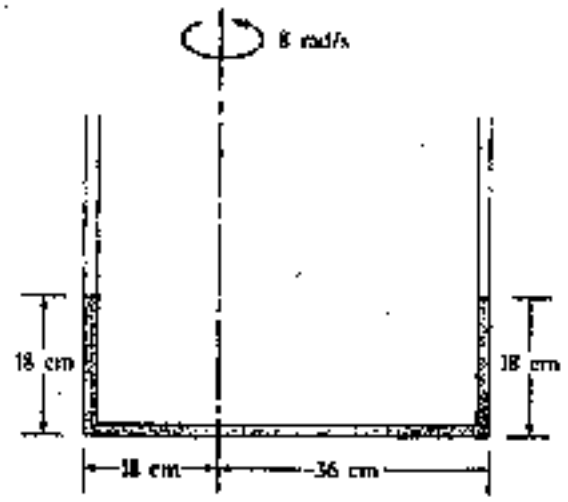


(problem 2)

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

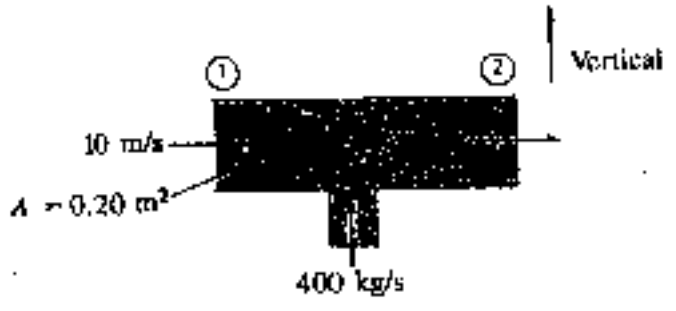
4. A $\frac{1}{49}$ scale model of a proposed dam is used to predict prototype flow conditions. If the design flood discharge over the spillway is $16{,}000 m^3/s$, what water flow rate should be established in the model to simulate this flow ? If a velocity of 1.2 m/s is measured at a point in the model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

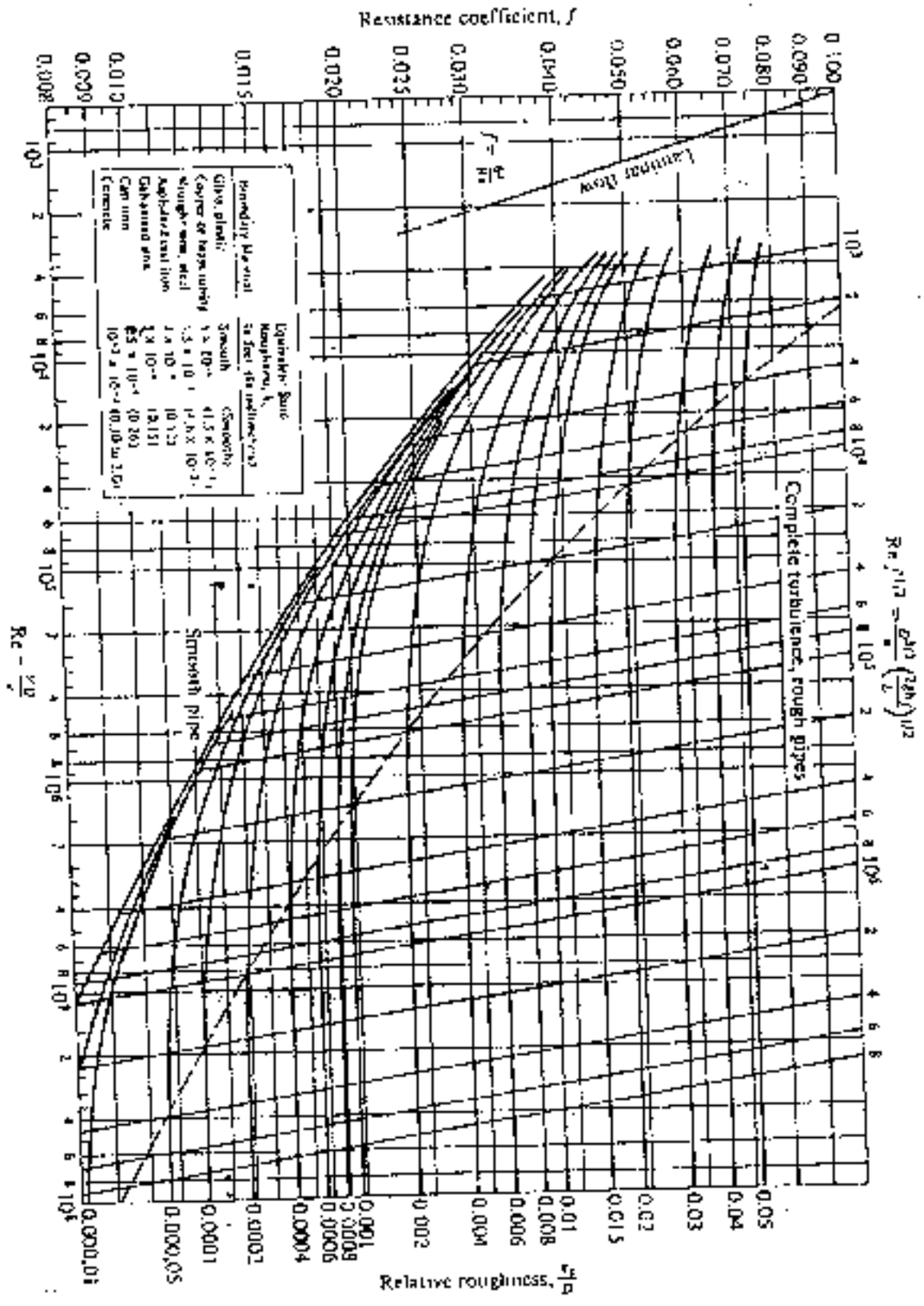


(problem 5)

6. Water flows in a duct as shown. The inlet water velocity is 10 m/s. The cross-sectional area of the duct is $0.2m^2$. 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)