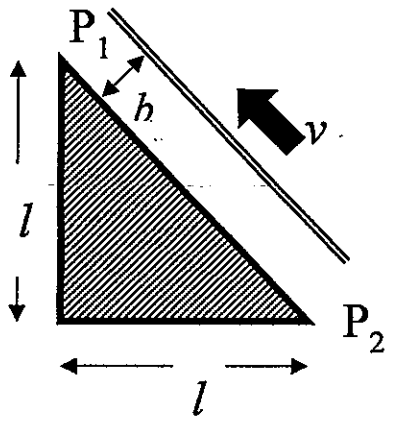
1. Three pipes are connected end-to-end in series with a flowrate of 2 m^3/s. The pipes are 2000 m in length though have inner diameters of 300 mm, 200 mm, and 150 mm. Suppose the three pipes are to be replaced by a single 2000 m pipe, what should be its diameter if the same frictional loss is maintained? (25%)

2. The pump of a 500-m-long rising main develops a pressure head of 30 m. The main size is 0.3 m and carries a discharge of 0.15 m^3/s. A sluice valve is fitted in the main, and the main has a confusor outlet of size 0.2 m. The form-loss coefficients of the sluice valve and the confusor may be assumed to be 0.15 and 3.25, respectively; a friction factor of 0.02 may be assumed for the pipe. Calculate terminal head at the outlet. (25%)

3. Consider the flow between two inclined plates, as shown in the figure. The upstream and downstream pressures are P_1 and P_2, respectively. The fluid has a viscosity of μ Pa·s and a density of ρ kg/m^3.
(i) Determine the expression of the volumetric flow rate if the top plate is stationary, assuming the width of the plate is 'a'. (8%)
(ii) Determine the expression of the volumetric flow rate if the top plate is moving upwards at a velocity of v m/s. (8%)
(iii) Find the pressure difference that needs to be applied in order that there is no net volumetric flow. For this case, please also derive the expressions of the shear stress on the top and bottom plates. (9%)



4. Consider a steady, two-dimensional (2-D), incompressible flow described by the following velocity field: $u = x^2 - y^2$, $v = -2xy$, $w = 0$, where u, v, and w are the velocity components in the x, y, and z directions, respectively. Gravity acts only in the z direction and has no effect in the x or y directions. Determine an expression for the pressure field $P(x, y)$. (10%)

5. For a horizontal pipe with a constant diameter, the Hydraulic Grade Line (HGL) and Energy Grade Line (EGL) at location 1 are 6.85 cm and 8.56 cm, respectively. At location 2, the HGL and EGL are 5.63 cm and 7.34 cm, respectively.
(i) Calculate the water velocity at locations 1 and 2 in meters per second (m/s) and determine which location is upstream. (5%)
(ii) Assess whether the flow is fully developed, providing reasons for your conclusion. (5%)
(iii) Calculate the irreversible head loss in this pipe flow between locations, expressing your answer in Pascals (Pa). (5%)

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