Con. 6435-13. **LJ - 10479**

(3 Hours) **[Total Marks : 100**

N. B. : (1) Question No. **1** is **compulsory**.
(2) Solve any **four** questions from remaining **six** questions.
(3) Assume any **suitable data** if necessary and state **clearly**.

1. Solve any **four** of the following:– **20**
   (a) Derive Dary's Weisbach equation for calculating loss of head due to friction in pipe.
   (b) Define Mach number. What is the significance of it in compressible fluid flow.
   (c) Describe the phenomenon of water hammer.
   (d) Describe hydraulic gradient line and total energy line.
   (e) Explain Prandtl's mixing length theory.

2. (a) A 400 mm diameter horizontal pipe is suddenly enlarged to 700 mm. The rate mf flow of water through this pipe is 0.5 m^3/s. If the intensity of pressure in the smaller pipe is 130 kN/m^2. Determine, **10**
   (i) Loss of head due to sudden enlargement
   (ii) Intensity of pressure in the larger pipe.
   (iii) Power lost due to enlargement.

   (b) A pipe line 600 mm diameter is 2 km long. To increase the discharge another line of same diameter is introduced parallel to the first in the second half of the length. **10**
   If f = 0.01 and head at inlet is 350 mm. Calculate the increase in discharge. Neglect minor losses.

3. (a) Derive an expression for the equivalent size of the pipe to replace the pipes in series. A piping system consist of three pipes arranged in series. The lengths of the pipes are 1000 m, 800 m, and 300 m and of diameters 500 mm, 400 mm and 300 mm respectively, are connected in series. These pipes are to be replaced by a single pipe of length 2100 m. Find the diameter of single pipe. **10**

   (b) A nozzle is fitted to a pipe 130 mm diameter, and 300 m long with coefficient of friction as 0.01. If the head available at the nozzle is 150 m. Find the diameter of the nozzle and maximum power transmitted by jet of water freely out of a nozzle. **10**

4. (a) Calculate the discharge in each pipe of network as shown in Figure 1. The pipe network consists of 5 pipes. The head loss `hf' in pipe is given by $hf = rQ^2$. The values of `r' for various pipes and also the inflow or outflow at nodes are shown in the Figure 1. **10**

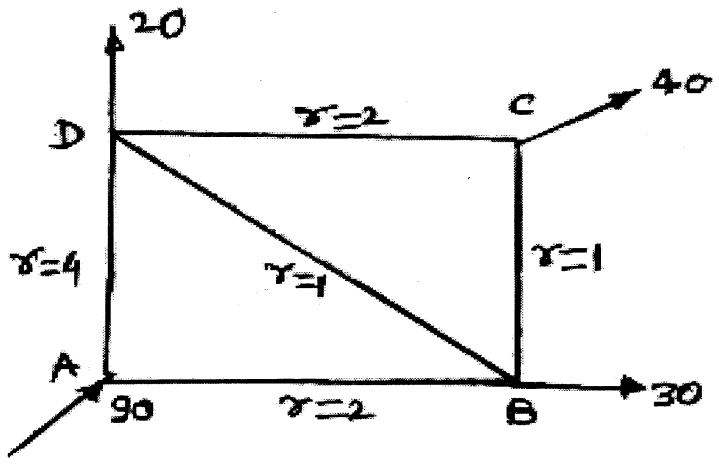

Figure 1

(b) Three reservoirs A,B,C are connected by a pipe system as shown in Figure below 2. Find the discharge into or from the reservoir B and C, if the rate of flow from reservoir A is 80 lit/sec. Find the height of water level in the reservoir C. Take friction factor `f' = 0.030 for all the pipes. **10**

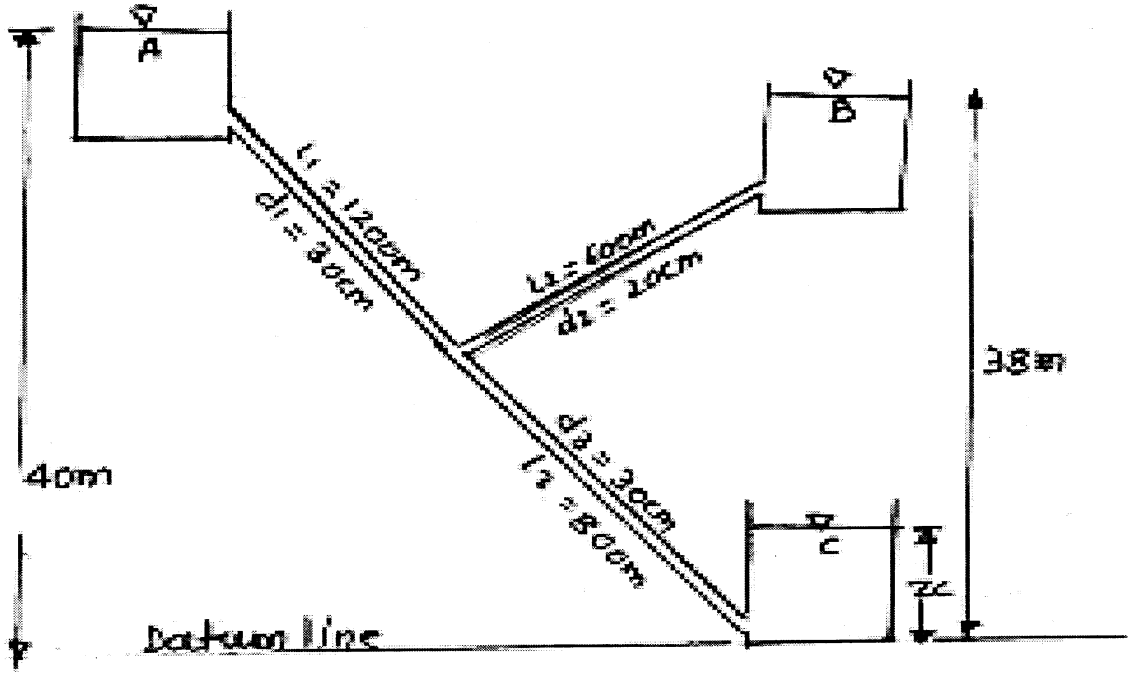

Figure 2

TURN OVER

5. (a) Define subsonic, sonic and supersonic flow. A supersonic aircraft files at an altitude of 2 km where temperatre is 4°C. Determine the speed of aircraft if its sound is heared 4 seconds after its passage over the head of an observer. Take R = 287 J/kg.k and K = 1.4 **12**

   (b) Prove that velocity of sound wave in a compressible fluid isgiven by $c = \sqrt{k/\rho}$ where K and ρ are the bulk modulus and density of fluid respectivly. **8**

6. (a) Derive an expression for the coefficient of viscosiqy in case of dashpot arrangement. **8**

   (b) A pipe 70 mm diameter and 500 m long slopes upword at 1 in 50. An oil of specific gravity 0.9 N.S/m^2 and specific gravity 0.9 is required to be pumped at the rate of 5 lit/sec. **12**
   (i) Is the flow is laminar
   (ii) What pressure difference is required to a Hevin this condition.
   (iii) What is the power of the pump required assuming an overall efficiency of 65%.
   (iv) What is the centre - line relocity and the velocity gradient at pipe wall.

7. (a) Describe in detail hydrodynamically smooth and rough boundaries. **8**

   (b) A smooth pipe of 100 mm diameter and 1000 m long is carrying water at the rate of 10 lit/sec. If the kinematic viscosity of water is 0.015 stokes and the value of coefficient of friction is given by relation $f = \frac{0.0791}{(Re)^{1/4}}$ where Re is Reynolds number **12**

   Calculate :-
   (i) Loss of head
   (ii) Wall shear stress
   (iii) Centre-line velocity
   (iv) Velocity and shear stress at 20 mm from the pipe wall and
   (v) Thickness of laminar sublayer.
