OBJECTIVE ⇒ 1) To determine the venturimeter constants (K & N) from plotting of Q_a vs H_m on log-log graph paper.

2) To determine the coefficient of discharge C_d of venturimeter and to plot C_d vs. R_e on semi log graph paper.

THEORY ⇒ A venturimeter is used to measure the flow-rate in a pipeline quite accurately. Theoretical discharge through a venturimeter is expressed as $Q_1 = A_1 A_2 \sqrt{(2gh)} / (A_1^2 - A_2^2)$ where A_1 and A_2 are cross-sectional areas of pipeline and venturimeter throat respectively and h is differential head across sections 1 & 2 (in figure) in terms of flowing liquid. If head h is measured by a differential manometer with a heavier liquid of sp. gr. S_m (than flowing liquid of sp. gr. S) then $h = H_m (S_m/S - 1)$. But, actual discharge Q_a is smaller than theoretical discharge Q_T and is given by $Q_a = C_d Q_T$ where discharge coefficient C_d depends on roughness etc. and is always lesser than unity. for all practical purposes expression $Q_a = C_d A_1 A_2 \sqrt{2g\{H_m(S_m/S -1)\}} / \sqrt{(A_1^2 - A_2^2)}$ is reduced to $Q_a = K(H_m)^N$ where $K = C_d A_1 A_2 \sqrt{2g\{S_m/S - 1\}} / \sqrt{A_1^2 - A_2^2}$ and $n = 1/2$. So the venturimeter is to be calibrated means its constant K & N are to be determined experimentally. Now, the discharge equation $Q_a = K(H_m)^N$, in its logarithm takes the form of: $\log Q_n = N \log H_m + \log K$. When plotted Q_a vs H_m repreasents a straight line on a log-log graph paper and K & N can be determined from it. Reynold's No. is given by $Re = V_2 D_2 / \nu$ subscript 2 repreasent throat section.

- APPARATUS & INSTRUMENTS ⇒ Pipe line assembly with venturimeter fitted with mercury-manometer, volume tank, stop watch etc.

- PROCEDURE ⇒ Delivery valve was fully opened. For the first set of observations, control valve was so regulated that maximum flow was allowed in the pipeline and level difference H_m in the venturimeter manometer reached maximum. Manometer reading was noted. Water coming out of the pipe was stored in a collecting tank during time interval t which was noted through a stop watch. Height of the collected water H was noted through a piezometer tube fitted to the to the tank. The volume of collected water V was then obtained from the product of H and the ~~area~~ multiplied by the area (A) of tank. Actual discharge through the orifice Q_a could then be calculated from $Q_a = V/t$. For the next set flow in pipeline was decreased by control-valve and corresponding readings at tanks stop watch and manometer were noted. The procedure was repeated for obtaining, at least eight sets of observation.

~~Qs~~

Date ....

Signature ....

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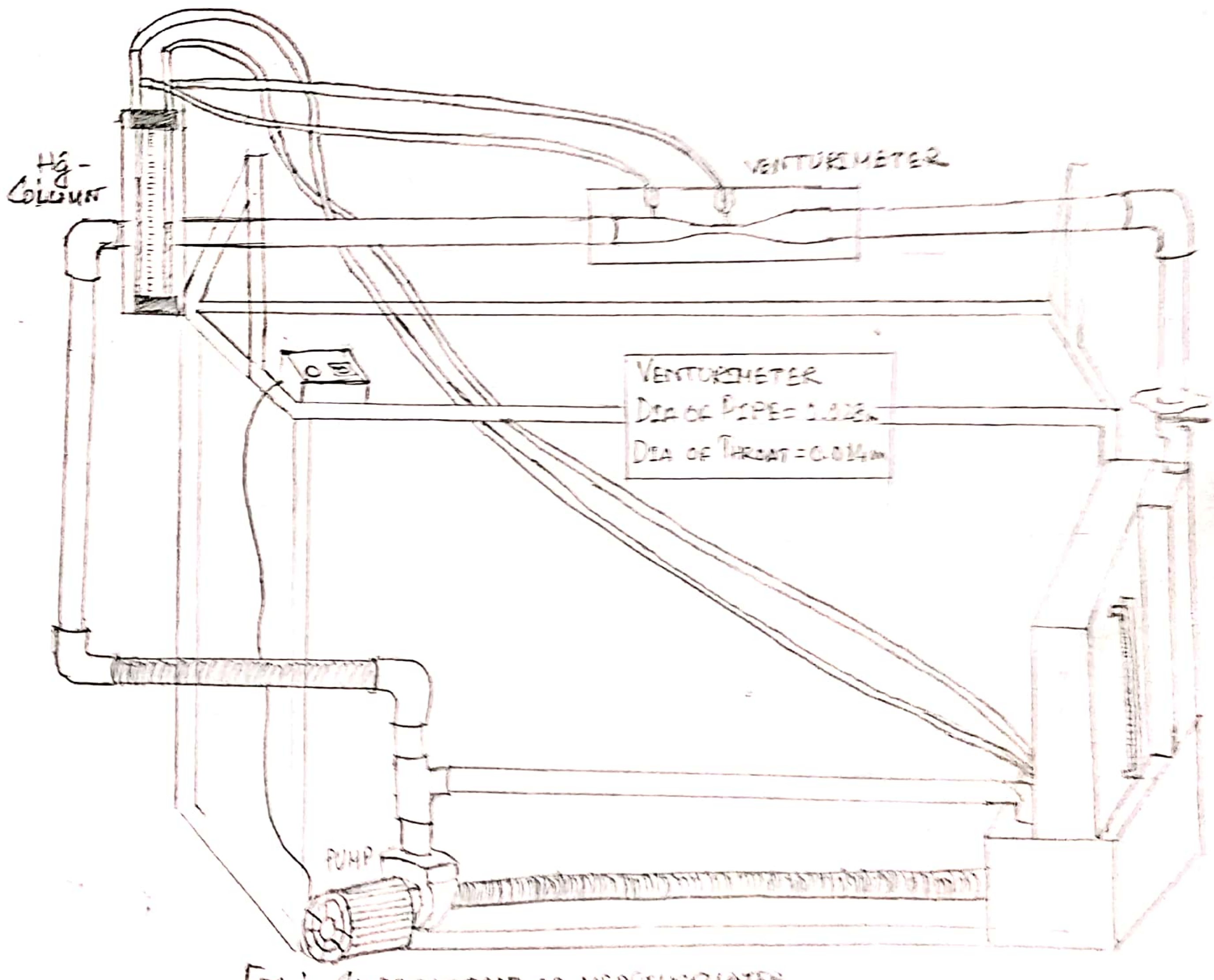

FIG: CALIBRATION OF VENTURIMETER

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OBSERVATION ⇒

Dia of pipe = 0.028 m

Dia of throat = 0.014 m

Density of water (ρ) = 1000 Kg/m^3

Density of Mercury (ρ_m) = 13600 Kg/m^3

Length of tank (L) = 38.1 cm

Bredth of tank (B) = 19.8 cm

$\therefore A = L \times B = 754.38\ cm^2$

TABLE - I

Observation No.	Manometer Reading (in cm)		Tank Reading (in cm)		time (t) (sec)
	LHS. (a)	RHS. (b)	Initial (h_i)	Final (h_f)	
1	20.3	22.5	5.5	15.1	20
2	20	22.9	5.1	16.4	20
3	19	23.2	6.	23	20
4	18.2	24.7	5.8	23.1	20
5	17.9	24.8	6.2	24.4	20
6	17.6	25.2	5.9	24.7	20
7	17.1	25.5	6	25.8	20
8	16.9	25.9	6	26.8	20

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TABLE - II

OBSERVATION NO.	Manometer deflection $H_m = (h_2 - h_1)$ cm	$H = (h_f - h_i)$ in cm	$Q_a = V/t = (A \times H)/t$ (in cm^3/s)	$Q_t = A_1 A_2 \times \sqrt{2gh} / \sqrt{(A_1^2 - A_2^2)}$	$C_d = Q_a/Q_t$	$R = V_2 D_2 / \nu$
1	2.2	9.6	362.1			
2	2.9	11.3	426.2247			
3	4.2	17	641.223			
4	6.5	17.3	652.5387			
5	6.9	18.2	686.4858			
6	7.6	18.8	709.1172			
7	8.4	19.8	746.8362			
8	9	20.8	784.5552			

- **Graph** The equation is $Q_a = K(H_m)^N$
  $\log Q_a = \log K + N \log H_m$

TABLE - III

Sl. No.	H_m	$\log H_m$	Q_a	$\log Q_a$
1	2.2	0.342	362.1	2.55
2	2.9	0.462	426.2247	2.62
3	4.2	0.623	641.223	2.80
4	6.5	0.812	652.5387	2.81
5	6.9	0.838	686.4858	2.83
6	7.6	0.88	709.1172	2.85
7	8.4	0.924	746.8362	2.87
8	9	0.954	784.5552	2.89

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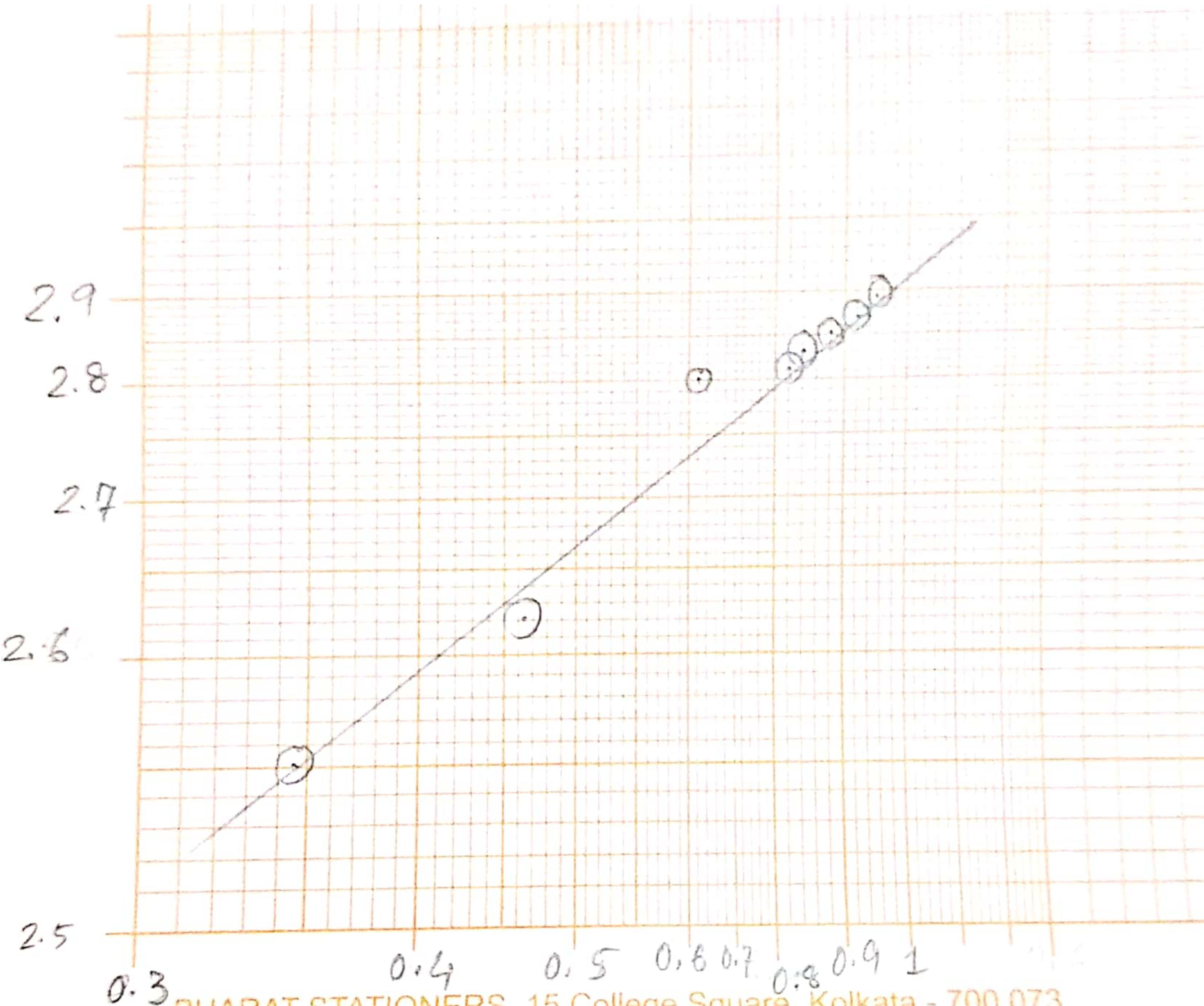

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