Table 1.1

	t (s)			
h (cm) h	d = 1.5 mm	d = 2.0 mm	d = 3.0 mm	d = 5.0 mm
h 30.0	t 73.0	41.2 t	18.4	6.80
10.0	43.5	23.7	10.5	3.90
4.0	26.7	15.0	6.80	2.20
1.0	13.5	7.20	3.70	1.50

III. DATA

1. Use the data in Table 1.1 to fill in Table 1.2

Table 1.2

	t (s)			
d (mm)	h = 1.0 cm	h = 4.0 cm	h = 10.0 cm	h = 30.0 cm
1.5	13.5	26.7	43.5	73.0
2.0	7.20	15.0	23.7	41.2
3.0	3.70	6.80	10.5	18.4
5.0	1.50	2.20	3.90	6.80

2. For h = 30 cm, use Tables 1.1 and 1.2 and fill in Table 1.3.

Table 1.3

t (s)	d (mm)	$1/d^2$ (mm^{-2})
73.0	1.5	0.4
41.2	2.0	0.25
18.4	3.0	0.1
6.80	5.0	0.04

3. For d = 2.0 mm, fill in Table 1.4 below:

Table 1.4

t (s)	h (cm)	$Log_{10}(t)$	$Log_{10}(h)$
41.2	30.0	1.6	1.47
23.7	10.0	1.37	1
15.0	4.0	1.17	0.6
7.20	1.0	0.85	0

V. Analysis of Data

1. Plot your results.

- Using a scale that utilizes at least 2/3 of the sheet of graph paper, plot on the *same graph paper* (using the same axes) the function $t(h)$ (*i.e.*, t *vs.* h) for each diameter (d) used. Connect the data points from each case with a smooth curve, and label each curve with the corresponding d.
- Similarly, on a second sheet of graph paper, plot the function $d(t)$ (*i.e.*, d *vs.* t) for each value of the height (h). Connect the points corresponding to each value of h with a smooth curve and label each curve with the appropriate value of h.
- Plot t versus $1/d^2$ for $h = 30$ cm.
- Plot $Log_{10}(t)$ versus $Log_{10}(h)$ for $d = 2$ mm.

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2. Use your graphs to answer the following questions:

   a. From your graph of (h) versus (t) for $d = 1.5$ mm, extrapolate the curve toward the origin. Does it pass through it? Would you expect it to do so? Explain.

   yes it will pass through origin. I expect it : There's no water in the container so there's no time to measure

   b. What type of relationship (direct or inverse) do you see between the time t and diameter d for a fixed value of h? Why?

   Inverse because when the time increase the diameter lesses

   c. From the graph of t versus $1/d^2$, determine the *empirical relationship* between time t and hole diameter d for $h = 30$ cm.

   $y = mx + b$

   $t = \frac{m}{d^2}$

   $t = \frac{m}{4} = 149$

d. From the previous relation, calculate the time needed to empty the container if the diameter of the hole is 4 mm.

$t = \frac{m}{(4)^2}$ $t = \frac{0.5}{4^2}$ see 1 part i

e. From the $Log_{10}(t)$ versus $Log_{10}(h)$ graph, find the empirical relationship between the time t and height h for $d = 2$ mm.

$y = mx + b$

$Log(t) = Slope \times Log(h) + b$

$t = (h^m)(10^b)$

f. From the previous relation, obtained in the previous step, calculate the time needed to empty the container if the height of water was 25 cm.

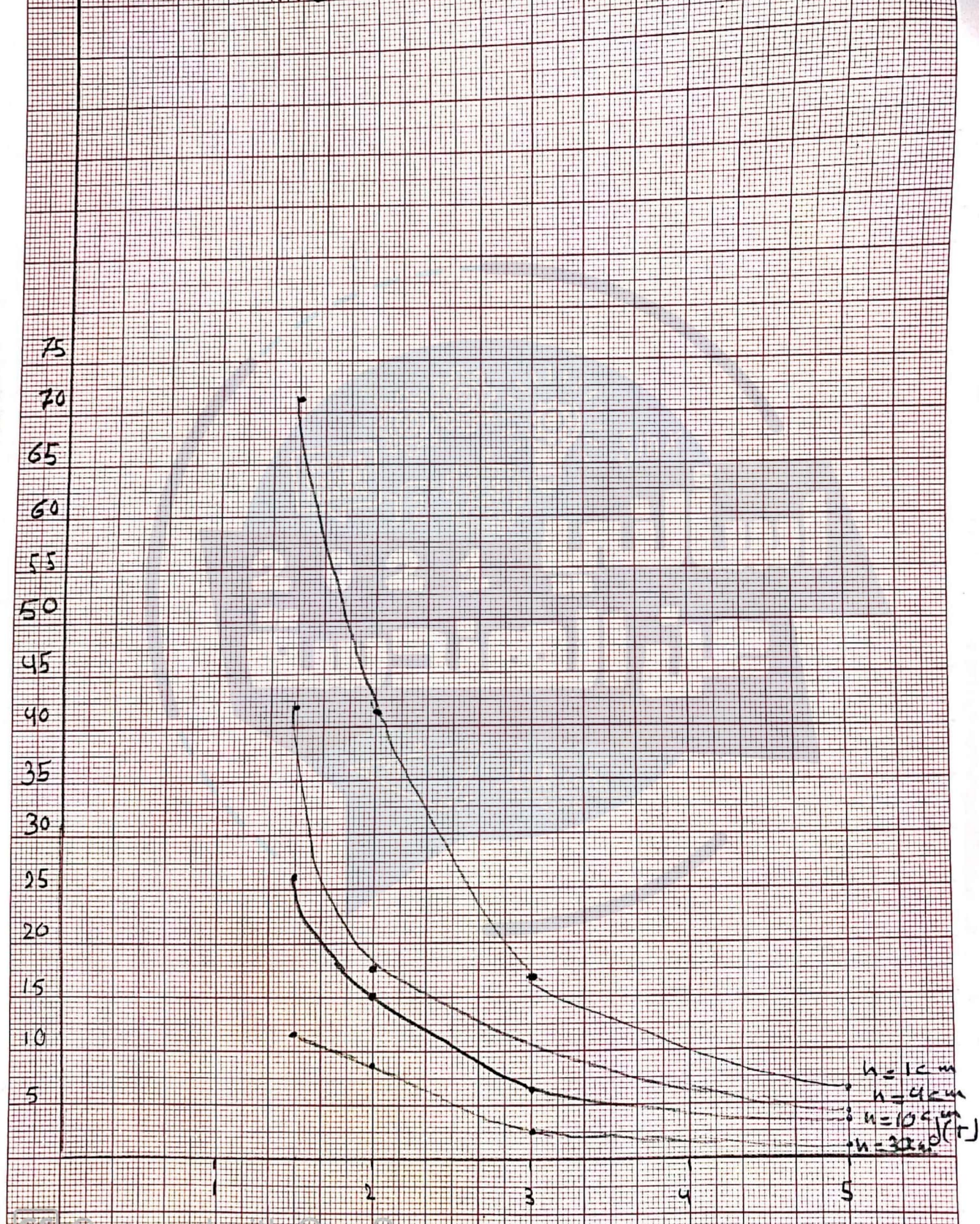
$y = mx + b$

$Log_{10} t = m\, Log_{10} h + b \Rightarrow t = 10^b h^m$ 1 point

g. What is meant by an empirical relationship?

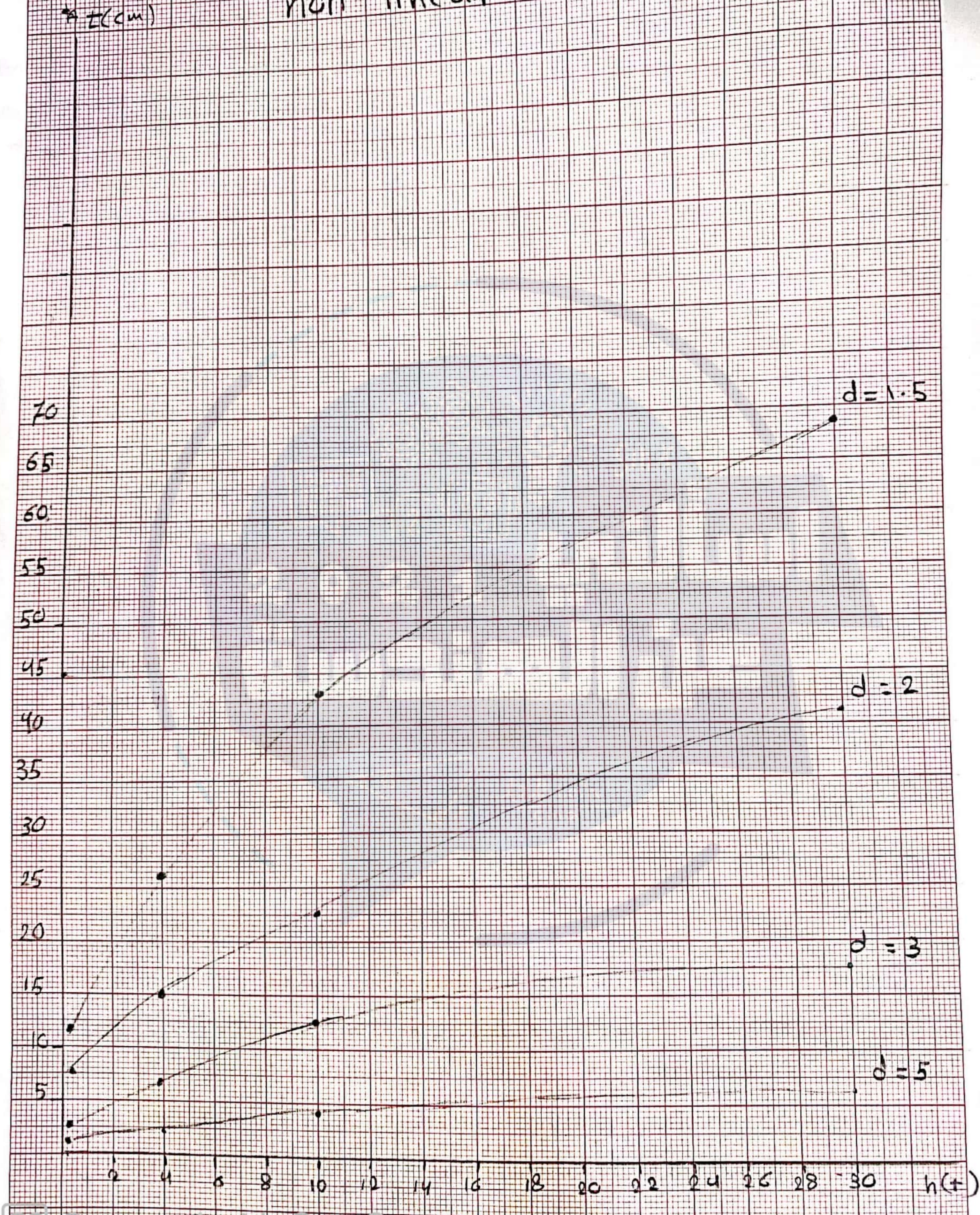
t(s) versus d(t)

inverse and non linear

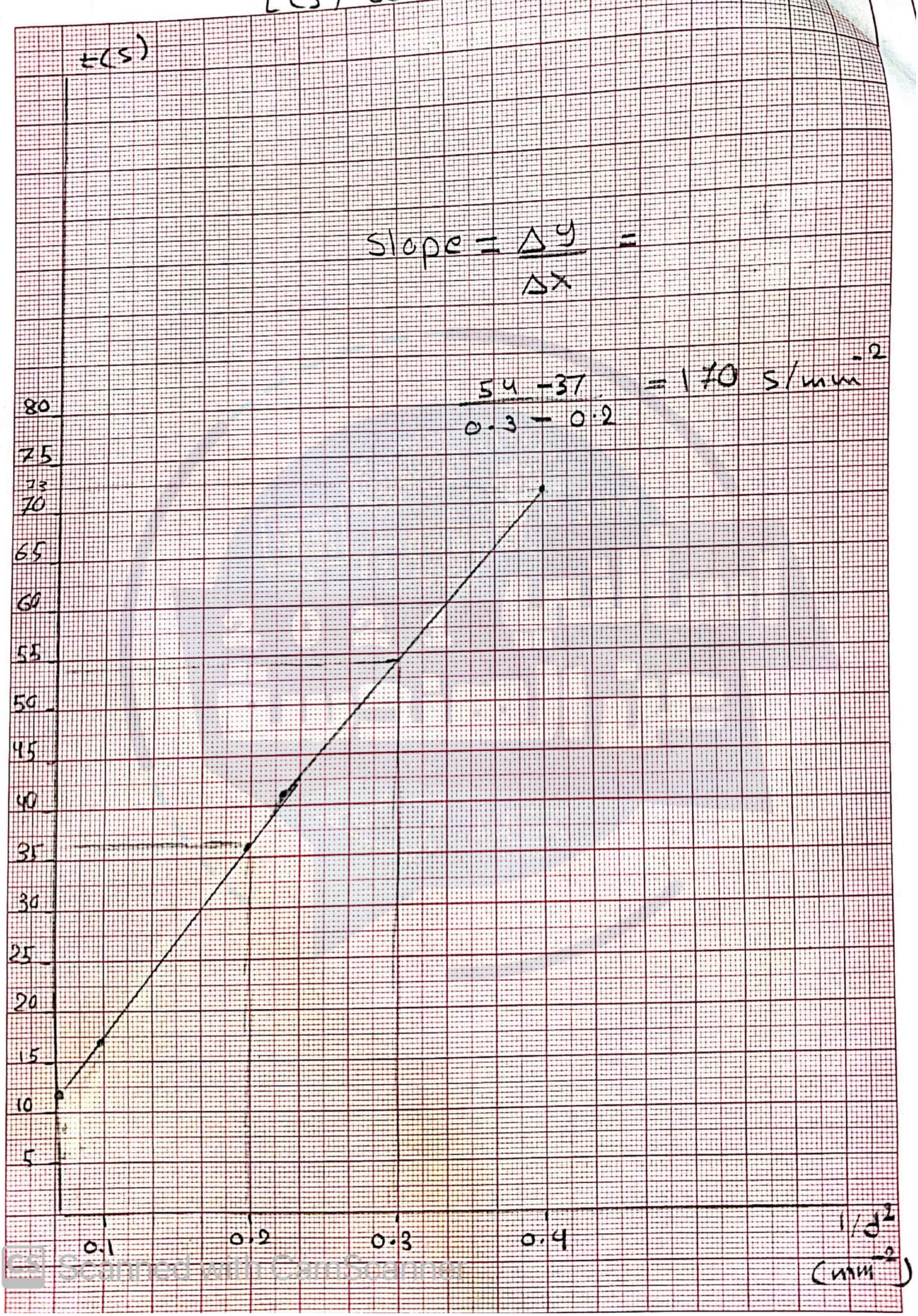


t(cm) versus h(+)

non linear and direct



t(s) versus $1/d^2$



Log(t) versus log(h)

logt

$$\text{Slop} = \frac{\Delta y}{\Delta x} =$$

(0.4, 1)
(1, 1.3)

$$\frac{1.3 - 1}{1 - 0.4} = 0.5$$