ElCoM
ELECTRICAL COMPUTER MECHATRONICS

تقدم لجنة ElCoM الاكاديمية

ريبورتات لمختبر :

الفيزياء العامة العملية

Collection and Analysis of Data

****Data***

h(cm)	t(sec)			
	d = 1.5 mm	**d = 2.0 mm**	**d = 3.0 mm**	**d = 5.0 mm**
30.0	73.0	41.2	18.4	6.8
10.0	43.5	23.7	10.5	3.9
4.0	26.7	15.0	6.8	2.2
1.0	13.5	7.2	3.7	1.5

Table (1)

Using data in table (1) to fill table (2) below:

d(mm)	t(sec)			
	h = 30.0 cm	**h = 10.0 cm**	**h = 4.0 cm**	**h = cm**
5.0	6.8	3.9	2.2	1.5
3.0	18.4	10.5	6.8	3.7
2.0	41.2	23.7	15.0	7.2
1.5	73.0	43.5	26.7	13.5

Table (2)

For **h = 30.0 cm**, fill table (3) below:

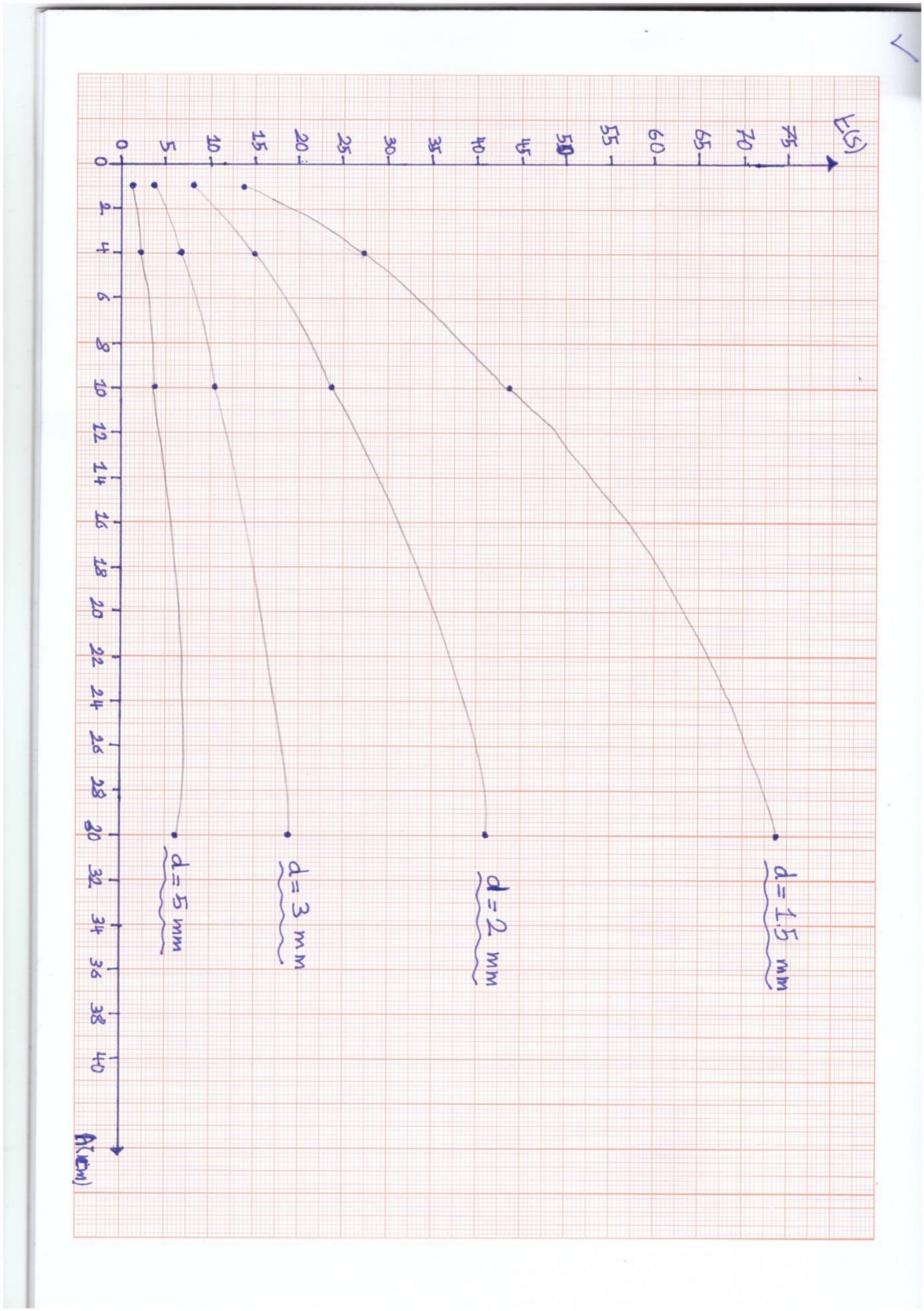
t (sec)	d (mm)	$1/d^2$ (mm^{-2})
6.8	5.0	0.04
18.4	3.0	0.11
41.2	2.0	0.25
73.0	1.5	0.44

Table (3)

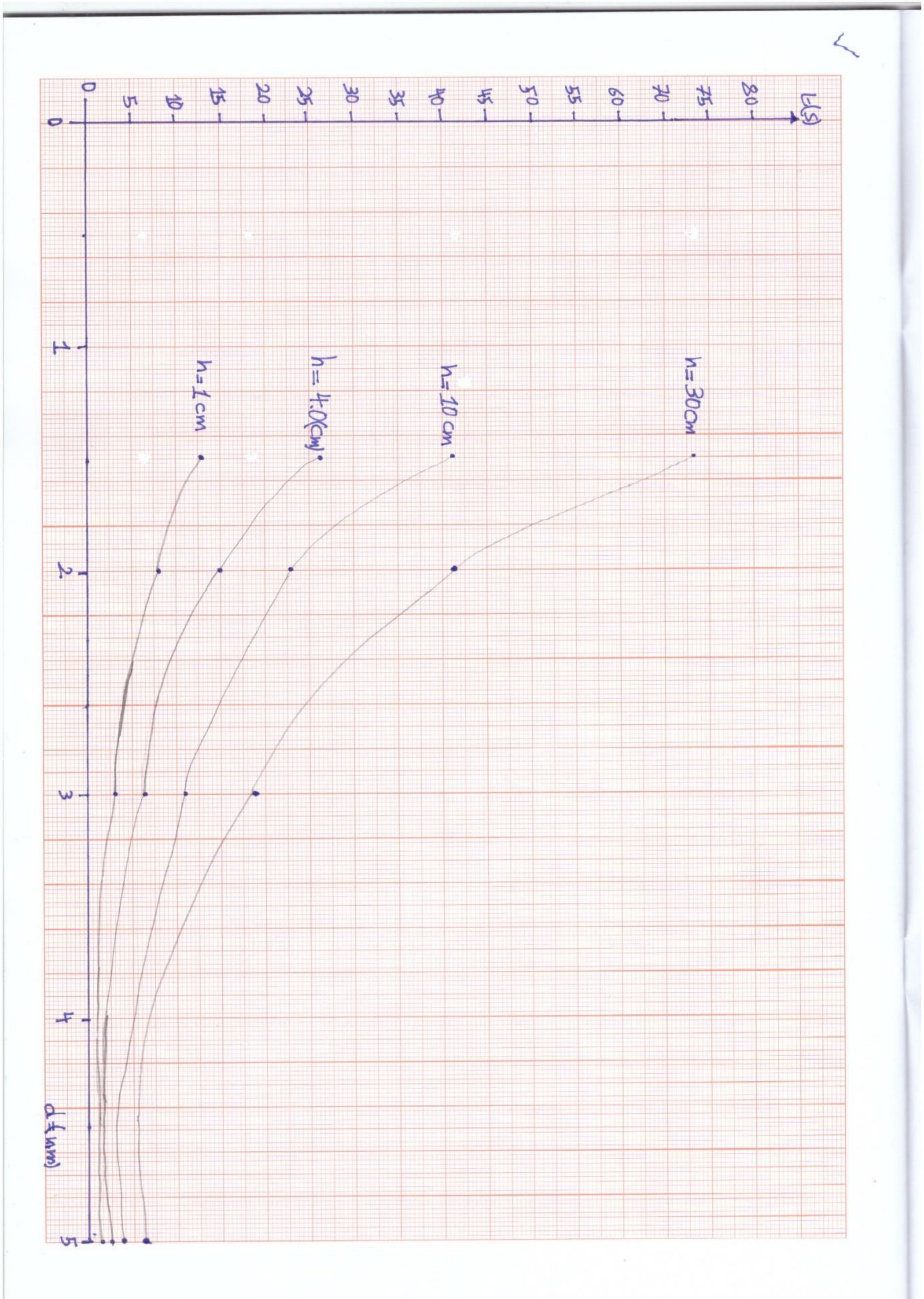
For **d = 2.0 mm**, fill table (4) below:

t (sec)	h (cm)	Log t	Log h
41.2	30.0	1.61	1.47
23.7	10.0	1.37	1.00
15.0	4.0	1.17	0.60
7.2	1.0	0.85	0.00

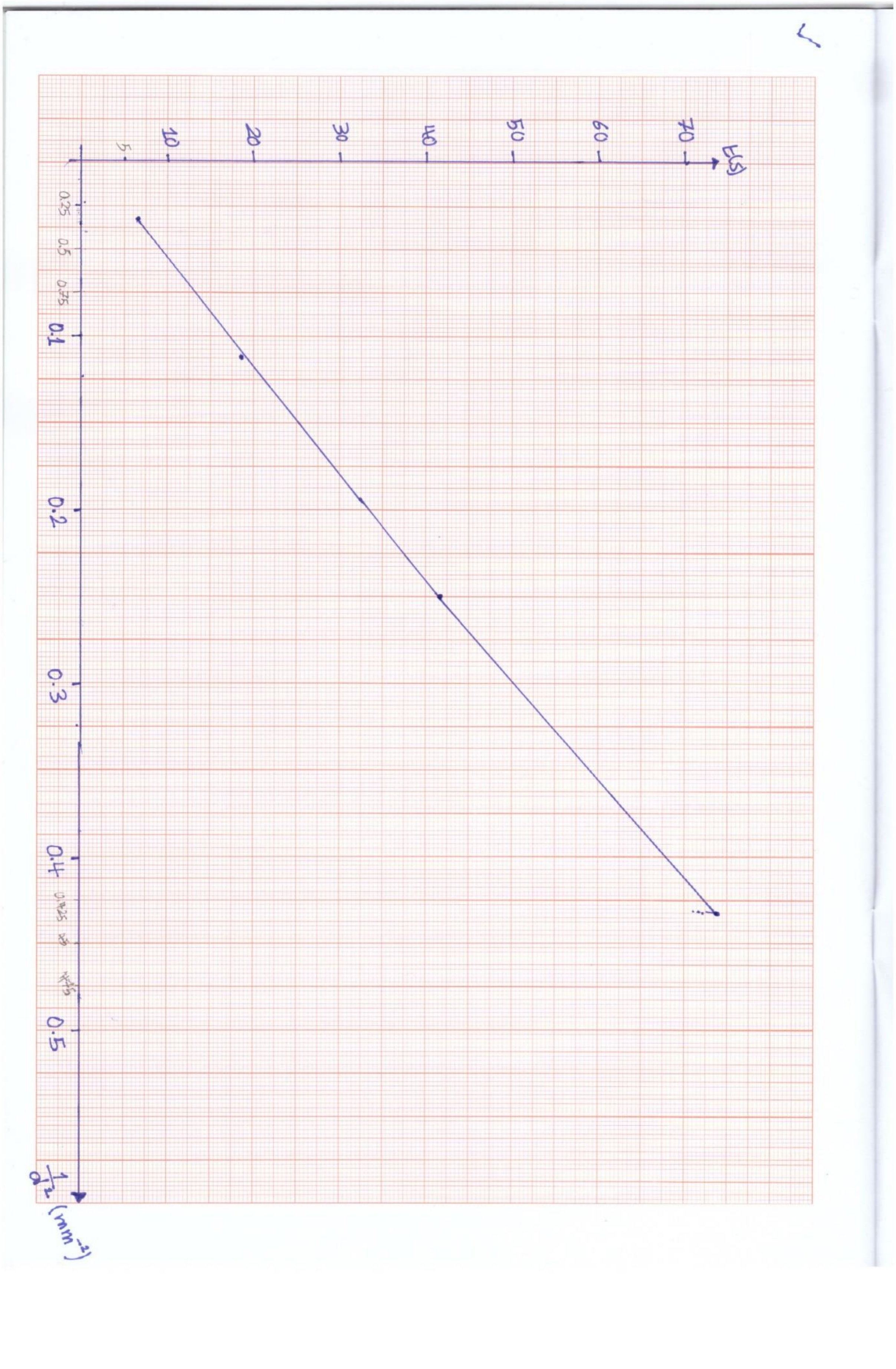
Table (4)



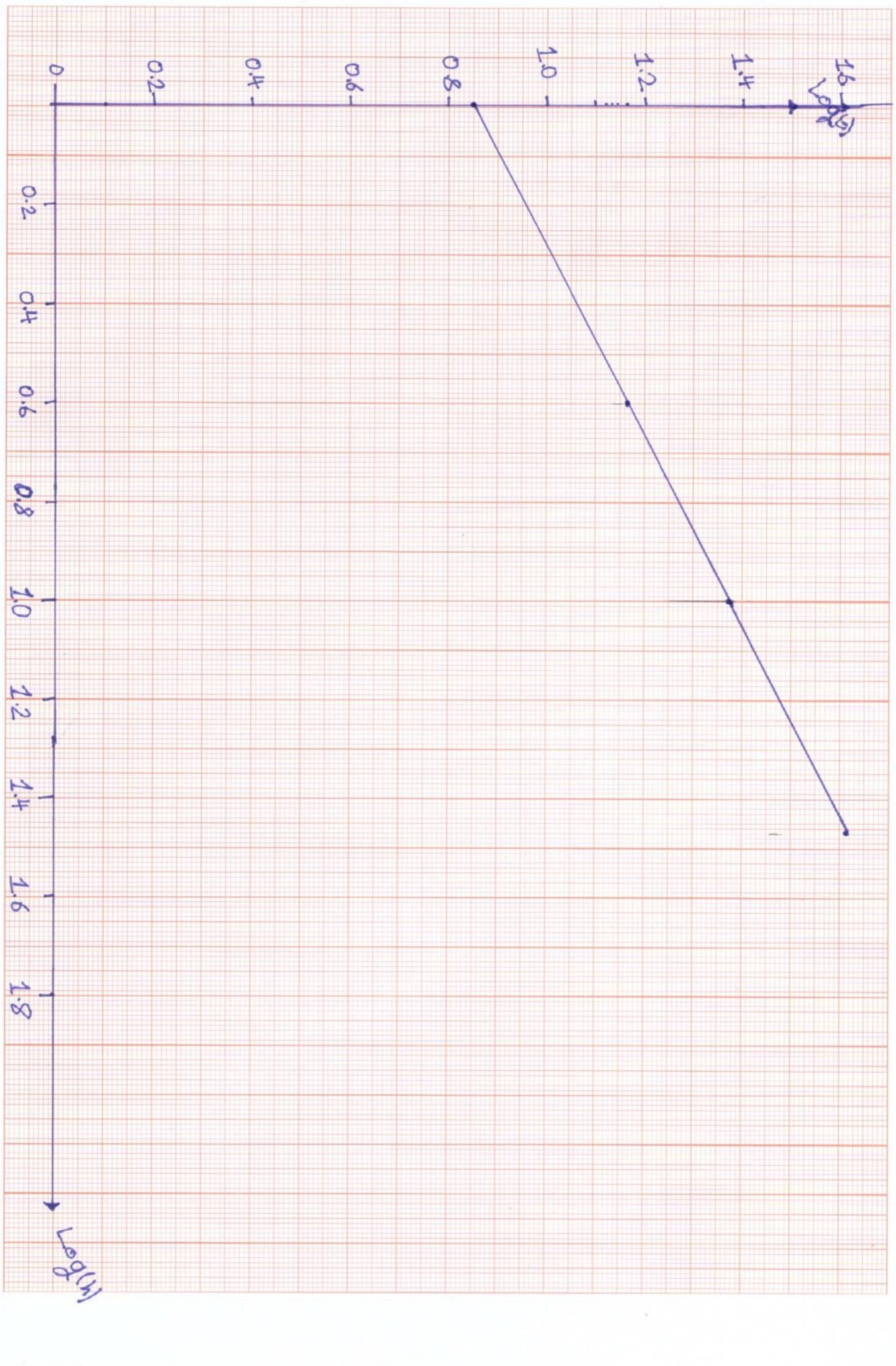
A



B



C



D

Analysis of Data:

Graph your results. **Independent** variables will be the diameter of the hole and depth of water in the container. Time is the **dependent** variable and will depend on the previous two independent variables.

- ***A.*** Plot the time (**t**) versus the depth (**h**) for each diameter (**d**) used. Do four graphs on one sheet, using the same set of axes, connecting points in a smooth curve for each and labeling them d_1, d_2, d_3 and d_4.
- ***B.*** On a second sheet of graph paper, plot the time (**t**) versus diameter (**d**) for each value of depth (**h**). Connect the points in a smooth curve and label the curves h_1, h_2, h_3 and h_4.
- ***C.*** Plot **t** versus $\mathbf{1/d^2}$ for h = 30.0 cm.
- ***D.*** Plot **log t** versus **log h** for d = 2 mm.

Conclusions

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

   Yes, I do, because from the graph we can see that the relation between (H)&(T) is direct relationship which means that if we extended the the curve towards the origin (water height becomes equal to zero) so the output of the time would also be a zero.

2. What type of relationship do you see between the **time** and **diameter**? Is it direct or inverse?
   Inverse relationship.

3. From **t** versus **$1/d^2$** graph, find the empirical relationship between time (t) and hole diameter (d) for **h = 30 cm**.

$$Slope = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta t}{\Delta(\frac{1}{d^2})} = \frac{73 - 6.2}{0.44 - 0.04} = 165.5\ (s.mm^2)$$

Empirical Relationship (general equation) :

$$y = mx + b$$

y = t (y-axis)
m = 165.5 (slope)
x = $1/d^2$ (x-axis)
b = zero (y-intercept)

$$t(d) = 165.5\ \times \left(\frac{1}{d^2}\right)$$

4. From the previous relation, can you predict the time needed to empty the container if the diameter of the opening was **4 mm, 8mm**?

Of course, (نعوض في معادلة الـ Empirical Relation) :

t(4) = 10.34375 (sec)

t(8) = 2.5859375 (sec)

5. From the **log t** versus **log h** graph, find the empirical relationship between time (t) and depth (h) for **d = 2 mm**.

$$Slope = \frac{\Delta \log(t)}{\Delta \log(h)} = \frac{1.61 - 1.37}{1.47 - 1.00} = 0.51$$

$$The\ general\ equation\ of\ Empirical\ Realtion:$$

$$y = m\,x + b$$

y = log(t) [y-axis]

x = log(h) [x-axis]

m = 0.51 (slope)

b = 0.85 (y-intercept)

$$\log(t) = \log(h) \times 0.51 + 0.85$$

simplify:

$$\log(t) = \log(h^{0.51}) + 0.85$$
$$\log(t) - \log(h^{0.51}) = 0.85$$
$$\log\left(\frac{t}{h^{0.51}}\right) = 0.85$$

$$10^{\log\left(\frac{t}{h^{0.51}}\right)} = 10^{0.85}$$

$$\frac{t}{h^{0.51}} = 7$$

$$\boxed{\boldsymbol{t = h^{0.51}(7)}}$$

6. Can you predict the time needed to empty the container if the depth of water was **25 cm, 80 cm**?

Yes,
Time at h = 25cm is equal to 36.14 sec
Time at h = 80cm is equal to 65.41 sec

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