Date: ------------------------

Name: Doa'a abu rayan 10/10

Registration No: 1732420

Physics Section: 2

Partner's Name: ----------------

Registration No: ----------------

Instructor's Name: ملاك ماجد

PHYSICS LAB EXPERIMENT 1: COLLECTION AND ANALYSIS OF DATA

1. PURPOSE :

To know the relationship between (diameter of a hole (d) (h): depth of water in the container and the time needed to empty the container and draw the relation, also make the non linear relation to linear and inverse to positive.

II. DATA :

Table (1.1)

h (cm)	t in seconds			
	d = 1.5 mm	d= 2.0mm	d=3.0mm	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

Using data inTable (1.1) fill in Table (1.2) below:

Table (1.2)

d (mm)	t in seconds			
	h = 30.0 cm	h=10.0cm	h=4.0cm	h=1.0cm
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

for h = 30 cm , fill in Table 1.3 below:

Table(1.3)

t (s)	d (mm)	1/d² (mm⁻²)
6.8	5	0.04
18.4	3	0.11
41.2	2	0.25
73.0	1.5	0.44

for d = 2 mm fill in Table 1.4 below:

Table(1.4)

(t) (s)	log t	log h	(h) (cm)
41.2	1.614	1.477	30
23.7	1.374	1	10
15	1.176	0.602	4
7.2	0.857	0	1

III. ANALYSIS OF DATA :

Graph your results. **Independent** variables will be the diameter of 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 **1/d²** for h = 30 cm

D. plot **log t** versus **log h** for d = 2 mm.

IV. 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?

It passes through the origin (t=0 if h=0)

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

It's inverse relation and non linear.

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

$t = m \frac{1}{d^2} + b$ (m → slope)

$* m = \frac{73 - 6.8}{.44 - .04} = 165.5 \approx 166 (s \cdot mm^2)$

$* t = 166 * \frac{1}{d^2} + b$ (b=0)

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

$t(4) \rightarrow 166 * \frac{1}{(4)^2} \Rightarrow 10.375$ sec

$t(8) \rightarrow 166 * \frac{1}{(8)^2} \Rightarrow 2.593$ sec

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

$Log(t) = m\, Log(h) + b$

$10^{log(t)} = 10^{m\, Log(h) + b}$

$10^{log(t)} = 10^{log\, h^m} * 10^b$

$t = h^{.5} * 10^{.85}$

$* t = h^m * 10^b$

$* b = .85$

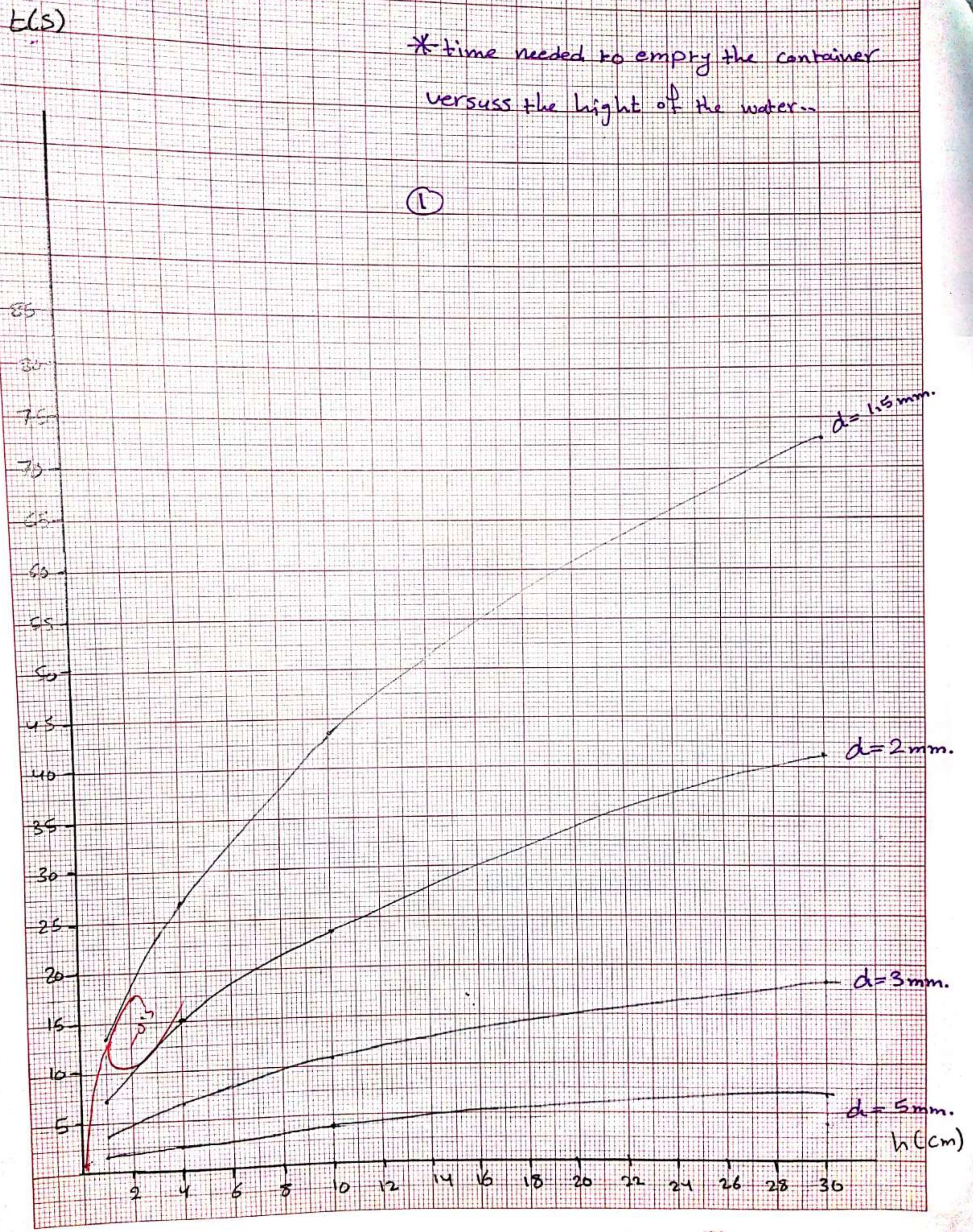
$* m = \frac{(1.6 - 1.37)}{(1.47 - 1)} = .49 \approx .5$

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

$t(25) = (25)^{(.5)} * 10^{.85} = 35.39$ sec

$t(80) = (80)^{.5} * 10^{.85} = 63.32$ sec.

* time needed to empty the container versuss the hight of the water..



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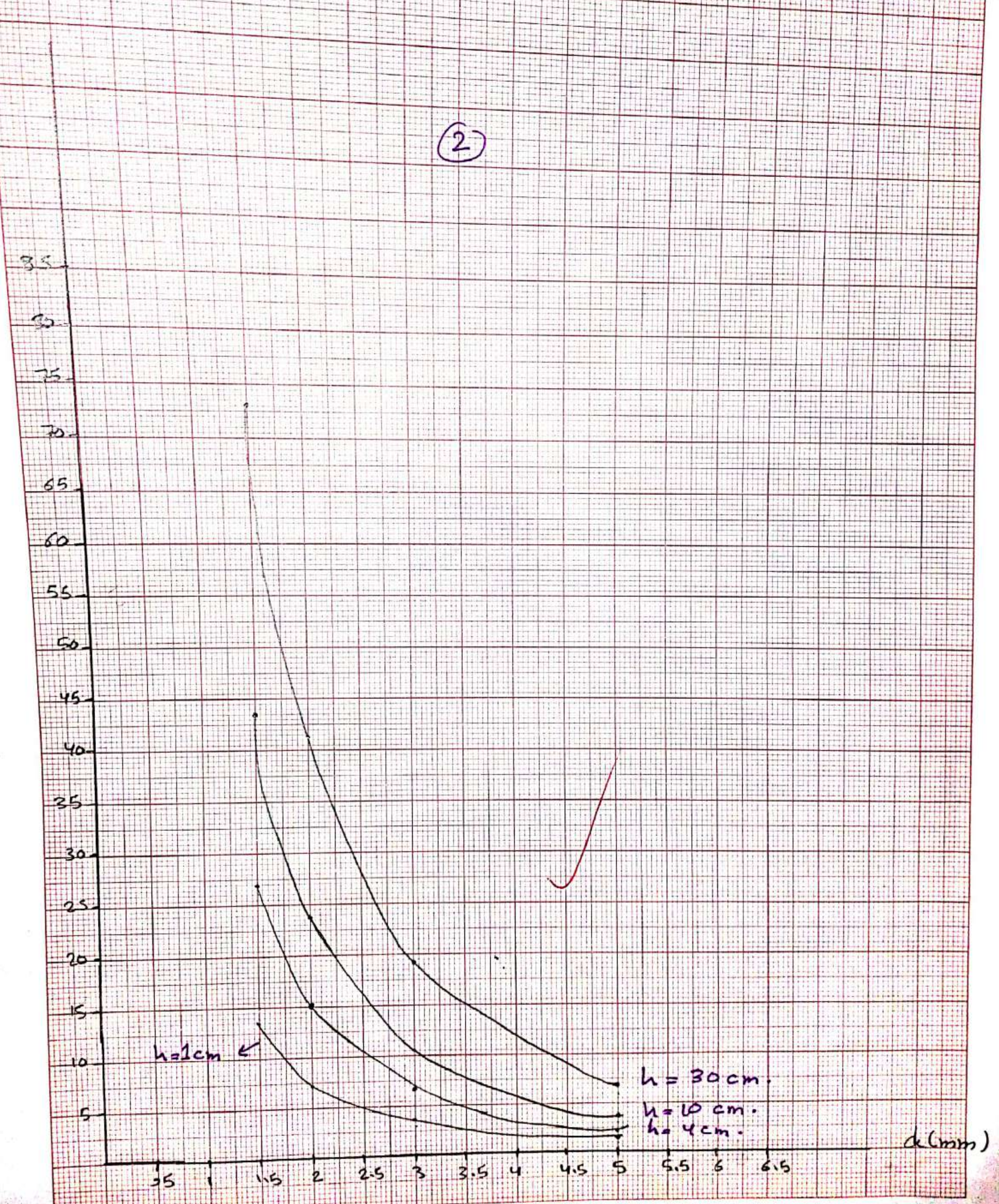
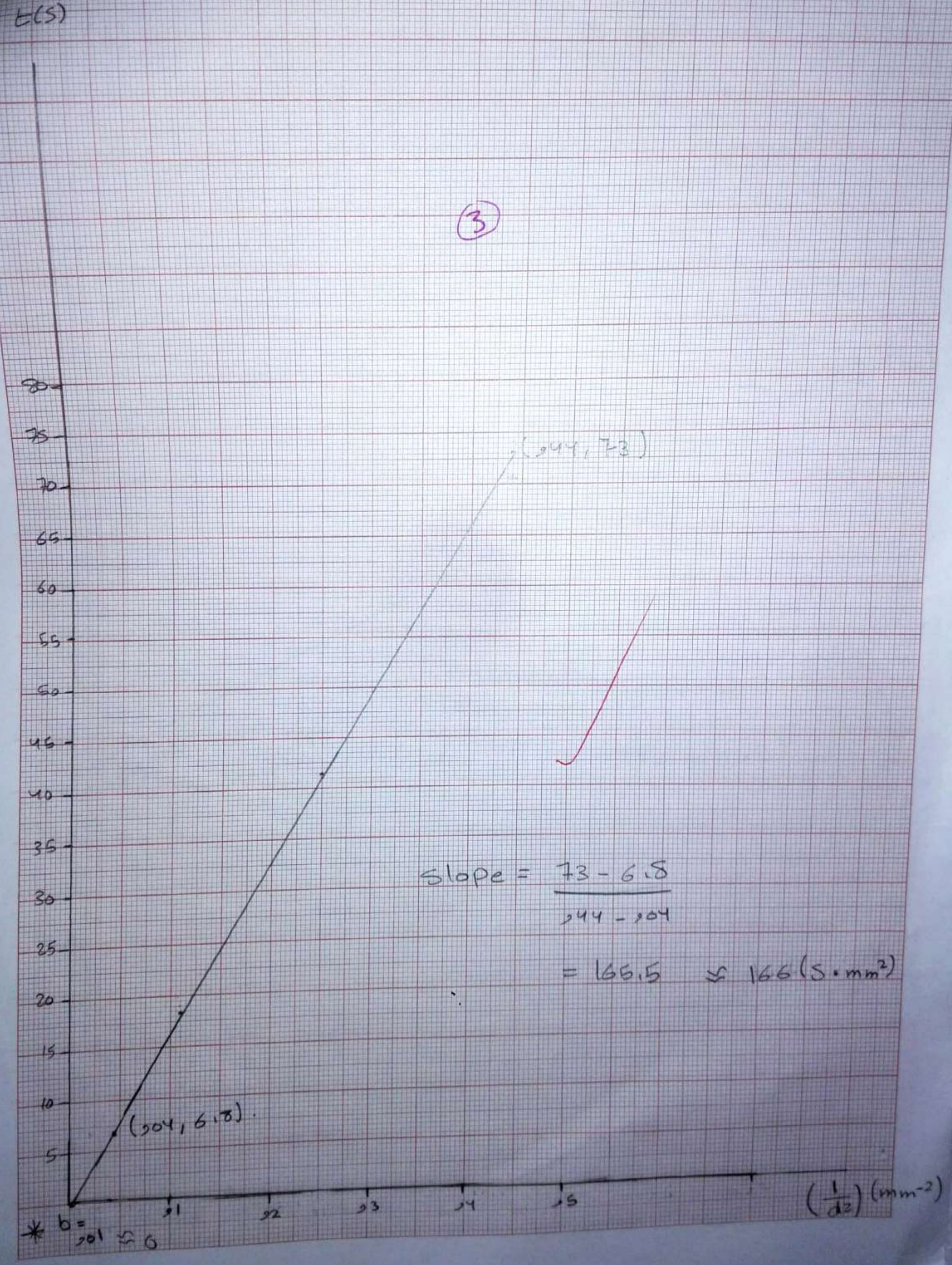
* The time (t) versus diameter (d) for each (h).

(2)



* (t) versus (1/d²) for h = 30 cm.

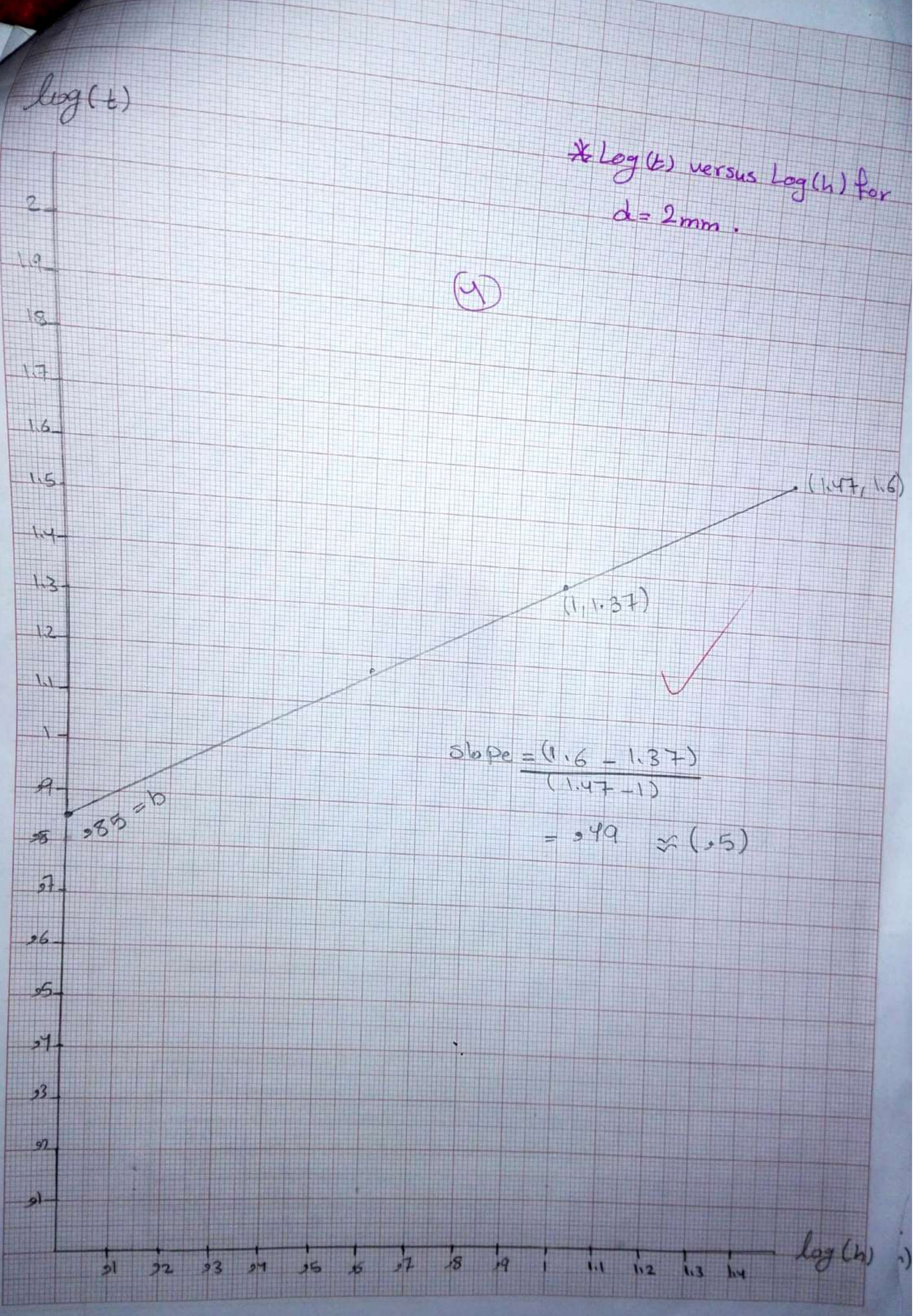
(3)



$$\text{slope} = \frac{73 - 6.8}{.44 - .04}$$

$$= 165.5 \cong 166 \ (s \cdot mm^2)$$

* b = .01 ≅ 0


log(t)
* Log(t) versus Log(h) for
d = 2mm.
(4)
(1.47, 1.6)
(1, 1.37)
slope = (1.6 − 1.37) / (1.47 − 1)
= .49 ≈ (.5)
.85 = b
log(h)

17327

- Farah Emad Alseifan 1530270
- Haya Maher Naser 1630892
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- Amal Kanaan 1732716

LAB REPORT FOR EXPERIMENT 2

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Date: 10/2/2019

Partner's Name:

Registration No: 1732420

Registration No:

Physics Section: 2

Instructor's Name: [illegible]

PHYSICS LAB EXPERIMENT 2 : MEASUREMENTS AND UNCERTAINTIES

I. PURPOSE :

We will make some elementary measurment of length and mass and : from our measurments we will derive other quantities such that (volume, density). To estimate the inaccuracy or the error in each measurment.

II. DATA AND DATA ANALYSIS :

A. Measurement of π

Record your data in Table (2.1) below:

Table (2.1)

Trial No	d (cm)	$\lvert d-\bar{d}\rvert$ (cm)	c (cm)	$\lvert c-\bar{c}\rvert$ (cm)
1	3.71	.01	11.85	.04
2	3.73	.01	11.75	.06
3	3.72	0	11.9	.09
4	3.725	.005	11.8	.01
5	3.725	.005	11.75	.06
Average	$\bar{d}$ = 3.72 cm		$\bar{c}$ = 11.81 cm	
Error	$\Delta\bar{d} = \pm$ 3.54 $\times 10^{-3}$ cm		$\Delta\bar{c} = \pm$ .629 cm	

Name:
ID:

1. Calculate the error, $\Delta \bar{d}$, in measuring the diameter of the disk, and, $\Delta \bar{c}$, in measuring the circumference and enter the values calculated in Table 2.1
Example for one calculation ($\Delta \bar{d}$) or ($\Delta \bar{c}$):

$$\Delta \bar{d} = \sqrt{\frac{\Sigma (D_i - \bar{d})^2}{n(n-1)}} = \sqrt{\frac{(.01)^2 + (.01)^2 + (0)^2 + (.005)^2 + (.005)^2}{4 * 5}}$$

$\Delta \bar{d} = 3.54 * 10^{-3}$ cm

$$\Delta \bar{c} = \sqrt{\frac{\Sigma (c_i - \bar{c})^2}{N(N-1)}} = .029 \text{ cm}$$

2. Using your average measured values of $\bar{d}$ and $\bar{c}$, calculate $\bar{\pi}$.

$\bar{d} = 3.72$ cm / $\bar{c} = 11.81$ cm

$$\bar{\pi} = \frac{\bar{c}}{\bar{d}} = \frac{11.81}{3.72} = 3.175$$

3. Calculate the error, $\Delta\bar{\pi}$, in the measured value, $\bar{\pi}$.

Note: $\Delta\bar{\pi} = \bar{\pi}\,[(\Delta \bar{d} / \bar{d})^2 + (\Delta \bar{c} / \bar{c})^2]^{½}$ **(2.1)**

$$\Delta \bar{\pi} = 3.175 * \sqrt{\left(\frac{3.54}{3.72}\right)^2 + \left(\frac{.029}{11.81}\right)^2}$$

$= .097$

4. Which error contributes most to $\bar{\pi}$? (give a quantitative answer)

The error in measuring circumference contributes most to $\bar{\pi}$ because $\frac{\Delta \bar{c}}{\bar{c}} = 2.456 * 10^{-3} > \frac{\Delta \bar{d}}{\bar{d}} = 9.516 * 10^{-4}$

5. Does the measured average value of $\bar{\pi}$ agree with the accepted value of $\bar{\pi}$ (3.14159) within the calculated experimental error.

$$\% \text{ Error} = \left| \frac{\bar{\pi} - \pi}{\pi} \right| * 100\%$$

*use $\pi = 3.14152$

$$= \left| \frac{3.141512 - 3.175}{3.141512} \right| * 100\%$$

$= .0106\%$

it's accepted because $< 20\%$

Record your results in Table (2.2) below.

Table (2.2)

Trial No	h (cm)	$\lvert h-\bar{h}\rvert$(cm)	d (cm)	$\lvert d-\bar{d}\rvert$(cm)
1	9.9	0	.501	.001
2	9.91	.01	.504	.002
3	9.92	.02	.503	.001
4	9.89	.01	.5	.002
5	9.88	.02	.502	0
Average	$\bar{h}$= 9.9 cm		$\bar{d}$ = .502 cm	
Error	$\Delta\bar{h} = \pm$ 7.071*10⁻³ cm		$\Delta\bar{d} = \pm$ 7.07*10⁻⁴ cm	
mass	m = 16.66 g		Δ m = $\pm$ .01 g	

1. Calculate the error, $\Delta\bar{h}$, in the average measured length and enter the result in Table (2.2).

$$\Delta\bar{h} = \sqrt{\frac{\Sigma(h_i-\bar{h})^2}{N(N-1)}} = \sqrt{\frac{(0)^2+(.01)^2+(.02)^2+(.01)^2+(.02)^2}{5*4}}$$
$$= 7.071 * 10^{-3} \text{ cm}$$

2. Calculate the error, $\Delta\bar{d}$, in the average measured diameter and enter the result in Table (2.2).

$$= \sqrt{\frac{\Sigma(D_i-\bar{D})^2}{N(N-1)}} = \sqrt{\frac{(.001)^2+(.002)^2+(.002)^2+(.001)^2+(0)^2}{4*5}}$$
$$= 7.071 * 10^{-4} \text{ cm}$$

3. Take Δm to be half the smallest division of the balance used .

$\Delta m = .01$ g

4. Using your average measured values of $\bar{h}$, $\bar{d}$, π determined in **part A** , and the measured value of mass m, calculate $\bar{\rho}$.

$$\bar{\rho} = \frac{4m}{\pi h d^2} \Rightarrow \frac{4 * 16.66}{3.175 * 9.9 * (.502)^2}$$

$$= 8.4129 \text{ g/cm}^3$$

5. Calculate the error, $\Delta\bar{\rho}$, in the average value for the measured density, $\bar{\rho}$.

Note: $$\Delta\bar{\rho}=\bar{\rho}\left[\left(\frac{\Delta m}{m}\right)^2+\left(\frac{\Delta\bar{h}}{\bar{h}}\right)^2+\left(\frac{2\Delta\bar{d}}{\bar{d}}\right)^2+\left(\frac{\Delta\bar{\pi}}{\bar{\pi}}\right)^2\right]^{\frac{1}{2}} \quad (2.2)$$

and use for $\bar{\pi}$ and $\Delta\bar{\pi}$, the values determined in **part A.**

$= 8.4129 * \sqrt{\left(\frac{.01}{16.66}\right)^2+\left(\frac{7.071*10^{-3}}{9.9}\right)^2+\left(\frac{2*7.071*10^{-4}}{.502}\right)^2+\left(\frac{.097}{3.175}\right)^2}$

$\Delta\bar{\rho} = .258\ g/cm^3$

6. Which error in m, $\bar{h},\bar{d}$, or $\bar{\pi}$ contributes most to $\bar{\rho}$?
(give a quantitative answer)

$\frac{\Delta m}{m} = 6.002*10^{-4}$, $\frac{\Delta\bar{h}}{\bar{h}} = 7.14*10^{-4}$

$\frac{2\Delta\bar{d}}{\bar{d}} = 2.217*10^{-3}$ / $\frac{\Delta\bar{\pi}}{\bar{\pi}} = .03055$

∴ $\Delta\bar{\pi}$ is the most contributes to $\bar{\rho}$ because it's the largest.

7. Using your calculations in (6), which error in m, $\bar{h},\bar{d}$, or $\bar{\pi}$ contributes the least to $\bar{\rho}$?

Δm is the least contributes on $\bar{\rho}$ because it's the smallest.

8. Compare the measured value of $\bar{\rho}\pm\Delta\bar{\rho}$ with the accepted value of ρ.

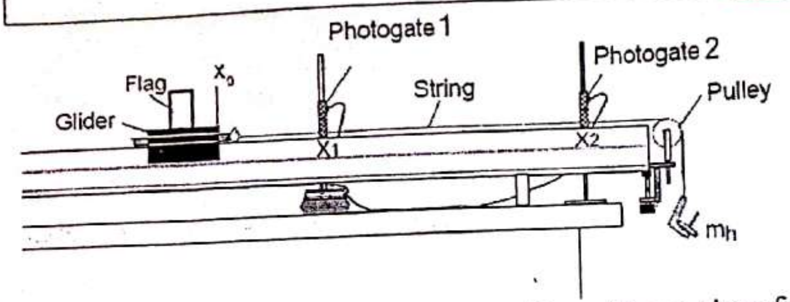
$\%\ errors = \frac{|\rho_{acc}-\rho_{exp}|}{\rho_{acc}} * 100\%$

$= \frac{|8.6 - 8.4129|}{8.6} * 100\%$

$= 1.9789\%$ yes it's accepted because < 20%.

Name: Amal Kanaan Partner: 10/10

ID#: 1732716 ID#: .... Section: 2



In figure **M**: mass of glider
m_a: added mass on glider
m_h: hanging mass
The theoretical equation of motion for this system is:
$$m_h g = (M + m_a + m_h)a$$

Purpose: To investigate Newton's second law: How a given force accelerates different masses and how different forces accelerate a given mass.

Part (I): Acceleration and added mass with constant driving force.

Fill in table (1) with data from your experiment. Make a graph for m_a versus 1/a. Then answer the following questions.

Glider's mass = 0.1 kg			
Air pressure #	Added mass m_a (kg)	Acceleration a (m/s²)	1/a $(m/s^2)^{-1}$
4	0	3.27	0.31
5	0.020	2.88	0.35
6	0.050	2.45	0.41
7	0.100	1.96	0.51

a) What is your conclusion about the way in which the acceleration depends on the magnitude of the added mass? When we increase the magnitude of added mass the acceleration decrease (inverse and Linear relation)

b) Find the slope of your (m_a-1/a) graph.

slope = $\frac{\Delta m_a}{\Delta a^{-1}} = \frac{.05 - 0.02}{.41 - .35} = 0.5$ N

What does the slope represent? the driving force ($m_h g$)

c) Determine the value of the **glider mass(M)** from the (m_a-1/a)graph. And compare it with the real value.

y = slop X + y intercept ⇒ $m_a = \frac{0.5}{a} + y$ ⇒ when $m_a = 0$, $0 = 0.5 * 0.31 + y$, y intersept = − 0.155

* slope = $m_h g$ ⇒ $m_h = 0.5 / 9.81$ ⇒ $m_h = 0.0509$ kg * |y-intercept| = M + m_h, M = .1041 kg

* P.e = $\left|\frac{M_{acc} - M}{M_{acc}}\right| * 100\% = \left|\frac{.01 - 0.1041}{0.01}\right| * 100\% = 4.1\%$

Part (II): Acceleration and driving force with constant total mass.

Fill in table (2) with data from your experiment. Then, draw a graph for $m_h g$ versus a.

Air pressure	m_a (g)	m_h (g)	$m_h g$ (dyne)	a (cm/s²)
7	100	50	49000	196
6	50	100	98000	392
5	20	130	127400	509.6
4	0	150	147000	588

a) What is your conclusion about the way in which the acceleration depends on the magnitude of the hanging mass?

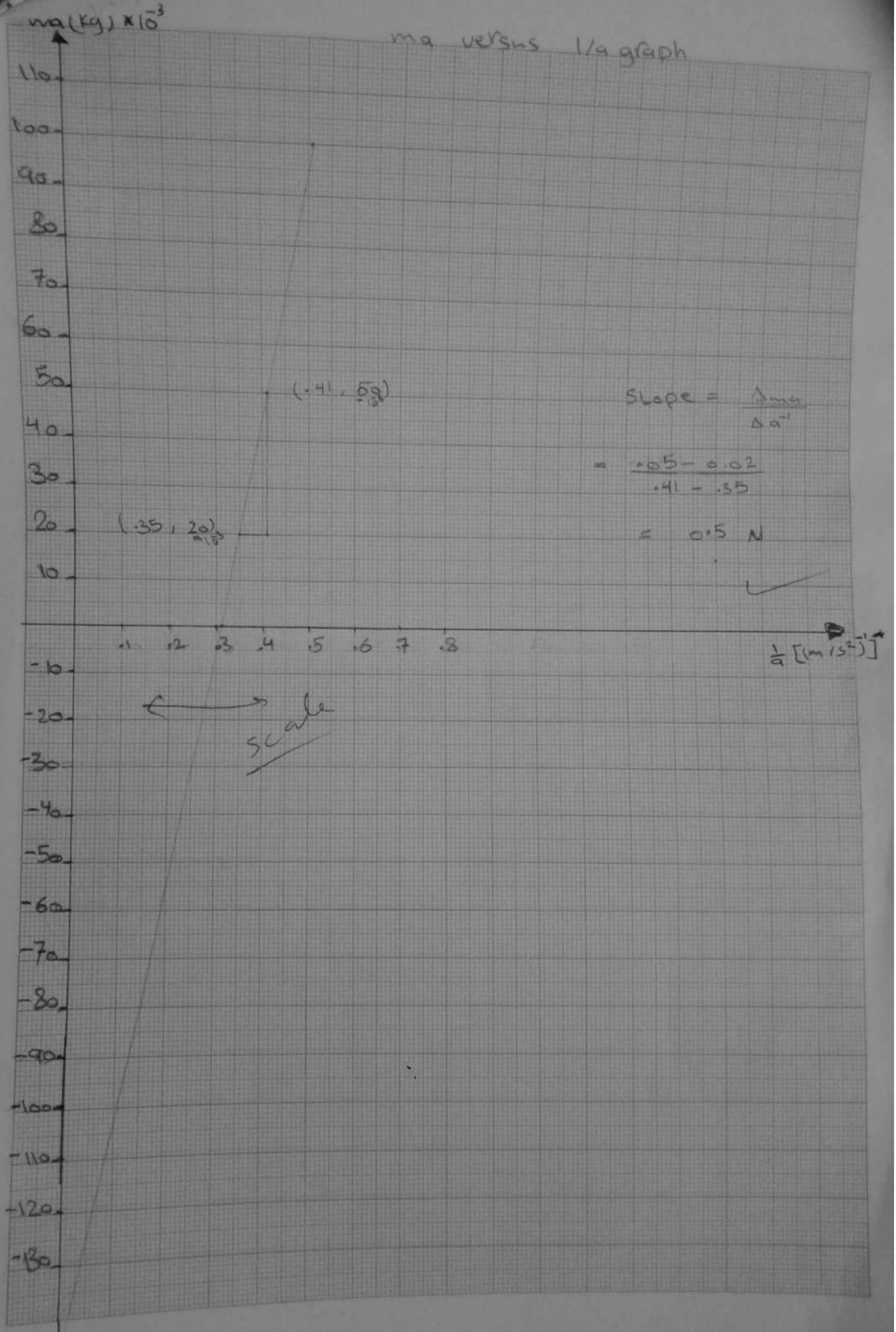
the relation is direct and Linear, when we increase the magnitude of the hanging mass the acceleration increase

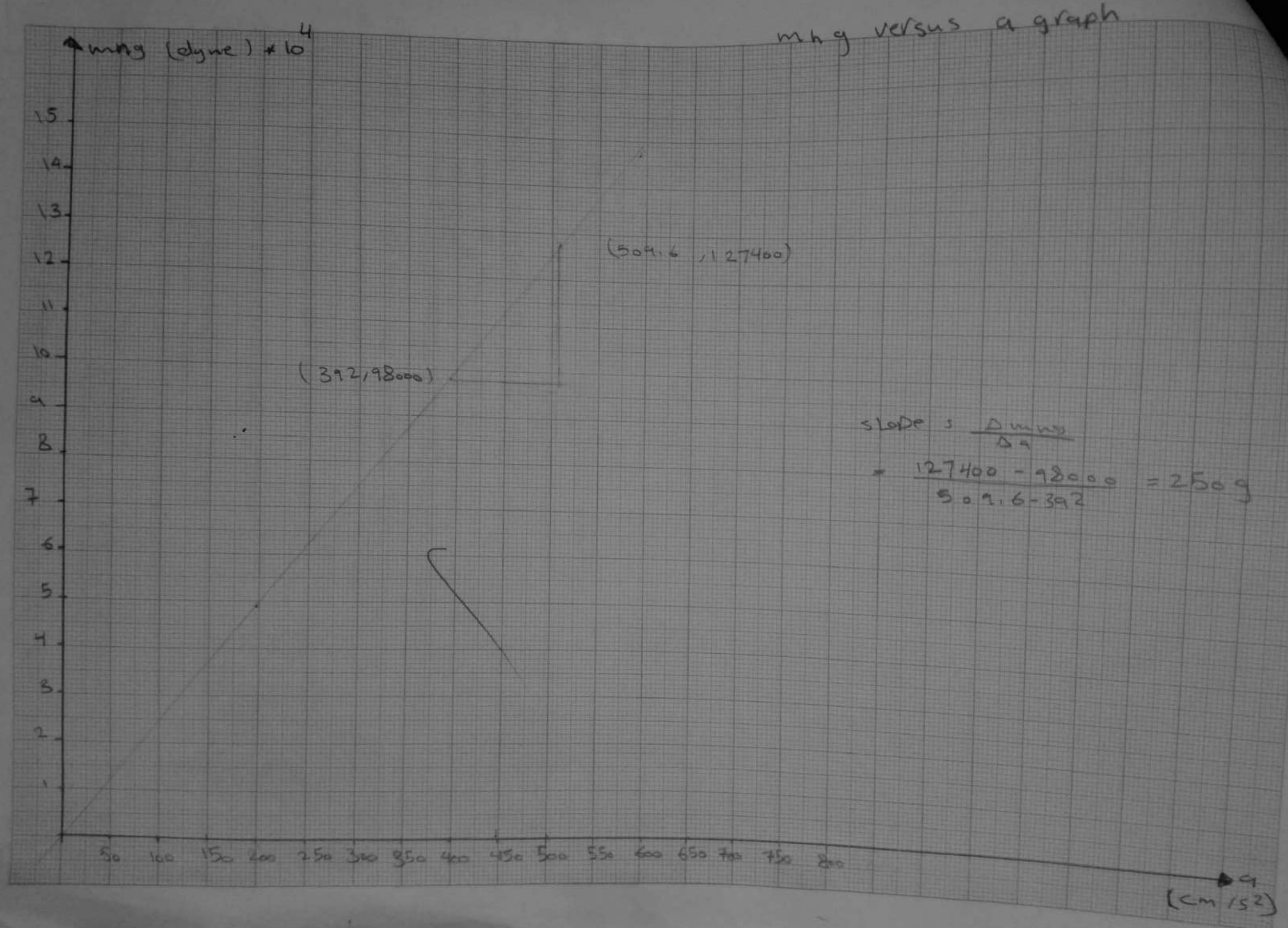
b) Find the **slope** of your $m_h g$ versus *a* graph. What does the slope represent?

slope = $\frac{\Delta m_h g}{\Delta a} = \frac{127400 - 98000}{509.6 - 392} = 250$ g, represent the total (M + m_a + m_h)

c) Do you expect that the curve should pass through the origin? **Explain** your answer.

yes I do, when there is no hanging mass the acceleration will be zero (0,0) (a, $m_h g$)


ma(kg) × 10⁻³
ma versus 1/a graph
(.41, 50) ×10⁻³
(.35, 20) ×10⁻³
Slope = Δma / Δa⁻¹
= (.05 − 0.02) / (.41 − .35)
= 0.5 N
1/a [(m/s²)⁻¹]
scale


mhg versus a graph
mhg (dyne) * 10^4
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800
a (cm/s²)
(509.6 ,127400)
(392,98000)
slope = Δmhg / Δa
= (127400 - 98000) / (509.6-392) = 250 g

Feghaa

4. Record the experimentally measured value of the resultant of the three forces in step two of the procedure (magnitude and direction).

* 150 + 180 = 330

* 50 + 100 + 50 + 10 = 210

5. Determine the resultant of the three forces in step two of the procedure graphically using the polygon method. Compare it with the measured value.

scale : 1 cm = 20 g. , |R| = 9.8 cm = 196 g. , θR = 360 − 28 = 332

$$\text{Percent error} = \left|\frac{E_2 - E_1}{(E_2+E_1)/2}\right| \times 100\% = \left|\frac{196 - 210}{(196+210)/2}\right| \times 100\% = 6.8\ \%$$

θ = 7? (P.E) = ?

6. Again, use the method of components to determine the resultant for the three forces in step two of the procedure. Compare with experimental findings.

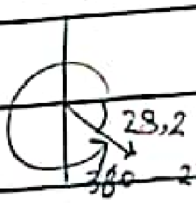
* $\Sigma x = 100\cos 45 + 200\cos 30 - 150\cos 60 = 168.9157589$

* $\Sigma y = 200\sin 30 - (15\sin 60 + 100\sin 45) = -100.6144887$

* $|R| = \sqrt{(\Sigma x)^2 + (\Sigma y)^2} = \sqrt{(168.9)^2 + (-100.6)^2} = 196.6108058$

* $\theta_R \Rightarrow \tan\theta = \frac{\Sigma y}{\Sigma x} \Rightarrow \tan\theta = \frac{-100.6\ldots}{168.9\ldots} \Rightarrow \theta = \tan^{-1}\frac{-100.6\ldots}{168.9\ldots}$

θ = −28.2



(يقع تحت محور السينات بمقدار زاوية 28.2)

360 − 28.2 = 331.8   332 ≈ (331.8 تساوي)

* $\text{Percent error} = \left|\frac{E_2 - E_1}{(E_2+E_1)/2}\right| \times 100\% = \left|\frac{210 - 196.6}{(210+196.6)/2}\right| \times 100\% = 6.6\%$

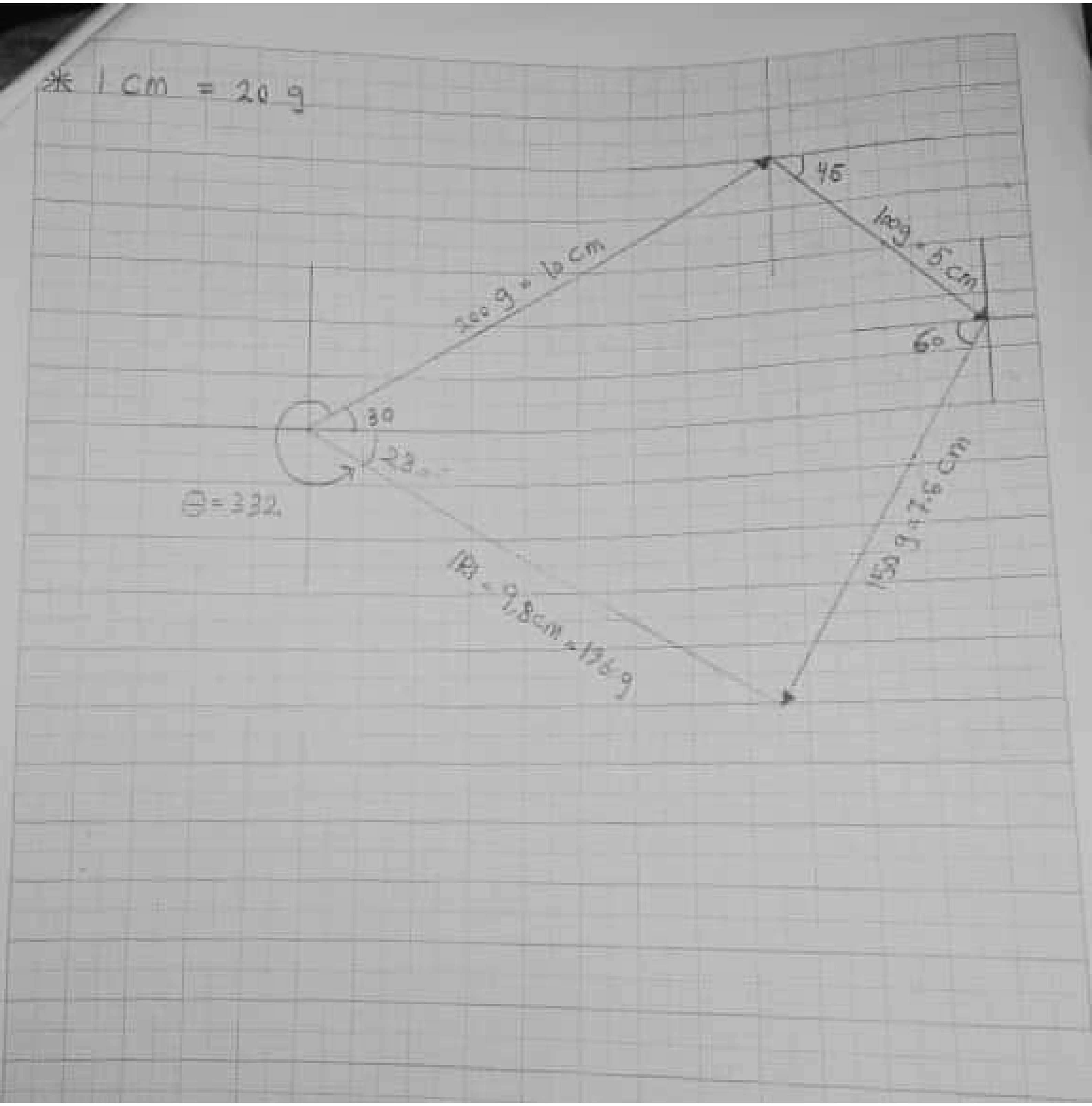
(P.E) = ??

7. State the major source(s) of inaccuracy in the experimental results?

1- errors in reading the scale.

2- the force table maybe not horizontal.

3- Friction between the strig and the pully.


※ 1 cm = 20 g
200 g = 10 cm
45
100 g = 5 cm
60
150 g = 7.6 cm
30
θ = 332
= 9,8cm = 196 g

LAB REPORT FOR EXPERIMENT 3

Date: 19/ 2/2019

Name:-- Baraah yousef Al-qanbar 9/10 Partner's Name: Heba Al-mansi

Registration No: 1832864 Registration No: 1738013

Physics Section: 10 Instructor's Name: غادة

PHYSICS LAB EXPERIMENT 3: VECTORS (FORCE TABLE)

I. PURPOSE :

To calculate the magnitude & direction of the resultant force by ways: ① force table ② Graphically ③ by the method of components.

II. DATA AND DATA ANALYSIS :

1- Record the **experimentally** measured value of the resultant of the two forces in step one of the procedure (magnitude and direction).

$\vec{F_1} = 1N, \theta = 40°$, $\vec{F_2} = 1.5N, \theta = 140°$

$\vec{F_R} = 1,68\ N, \theta R = 282° - 180 = 102°$

2- Determine the resultant of the two forces in step one of the procedure **graphically**. How does it compare with the measured value?

$\vec{F_R} = 1,68N \quad \theta R = 282° - 180 = 102°$

-0.5

3- Again determine the resultant of the two forces in step one by the method **of components**. How does it compare with the measured value?

$\vec{F_1} = 1\cos 40\ \hat{i} + 1\sin 40\ \hat{j} = 0.76\ \hat{i} + 0,64\ \hat{j}$

$\vec{F_2} = -1.5\cos 40\hat{i} + 1.5\sin 40\hat{j} = -1.15\hat{i} + .96\hat{j}$

$\vec{F_R} = -0.39\ \hat{i} + 1.6\hat{j} \Rightarrow |F_R| = \sqrt{(1.6)^2 + (-.39)^2} = 1.646\ N$ -0.5

$\theta_R = \tan^{-1} \frac{1.6}{-0.39} \Rightarrow 180 - 76 = 103.7°$ | % error $= \frac{1,68 - 1,64}{1,68} \times 100 = 2\%$

4. Record the **experimentally** measured value of the resultant of the three forces in step two of the procedure (magnitude and direction) .

$\vec{F_1} = .8N, \theta = 50^\circ, \vec{F_2} = 1.2N, \theta = 120^\circ, \vec{F_3} = 2N, \theta = 270^\circ$

$\vec{F_R} = .3N, \theta_R = 78 + 180 = 258^\circ$

5. Determine the resultant of the three forces in step two of the procedure **graphically** using the polygon method . Compare it with the measured value.

$\vec{F_R} = 0,36 N, \theta_R = 78 + 180 = 258^\circ$

0.5

6. Again, use the **method of components** to determine the resultant for the three forces in step two of the procedure. Compare with experimental findings.

$\vec{F_1} = .8 \cos 50 \hat{i} + .8 \sin 50 \hat{j} = 0.51 \hat{i} + 0.61 \hat{j}$

$\vec{F_2} = -1,2 \cos 60 \hat{i} + 1,2 \sin 60 \hat{j} = -0,6 \hat{i} + 1,03 \hat{i}$

$\vec{F_3} = 2 * -1 \hat{j} = -2$

$\vec{F_R} = (0.51 - 0,6)\hat{i} + (0,61 + 1,03 - 2)\hat{j} = -0,09\hat{i} - 0.36\hat{j}$

$|F_R| = \sqrt{(-0.09)^2 + (-0.36)^2} = 0,37 N$

$\theta = \tan^{-1}\left(\frac{0.36}{0,09}\right) \Rightarrow 76 + 180 = 255,9^\circ$

$\% \text{ error} = \frac{.3 - 0,37}{.3} * 100 = 23\%$

0.5

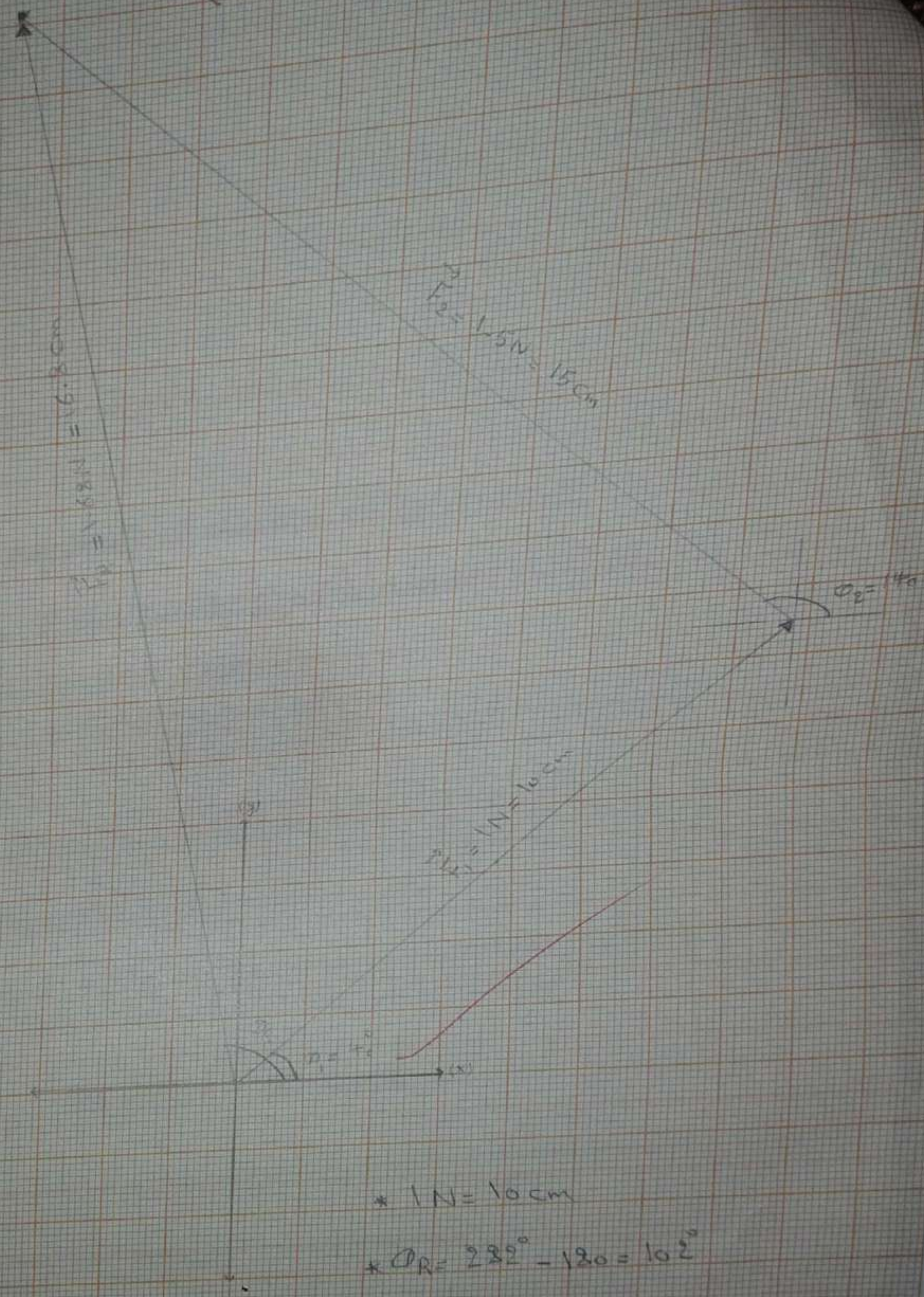
7. State the major source(s) of inaccuracy in the experimental results?

① The friction force between polly.

② The force table not horizontally.

③ the angle not accorde.

(two forces)



* 1N = 10 cm

* $\theta_R = 282^\circ - 180 = 102^\circ$

* $\vec{F}_R = 1.62N = 16.2$ cm

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