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# تقارير لاب الهيدرو

زكي بطارسة

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Name : Zaki Sami Batarsch | ID:1732428 | Exp:6 Specific En... Sec [1] Mon .[1-4]

| Data | | Show the equations, Subsitutions and result in this table | | |
|---|---|---|---|---|
| b = 75 mm | Q = 455 L/min | $h_c$ (Theo)(m) | $V_c$ (Theo) m/sec | $E_{min}$ (Theo) m |
| H (mm) before Sluice | HC (mm) After Sluice gate | $h_c = \left(\frac{q^2}{g}\right)^{1/3}$ | $V_c = \sqrt{g\, h_c}$ | $E_{min} = \frac{2}{3} h_c$ |
| 215 | 76 | $= \left(\frac{((0.00758)/0.075)^2}{9.81}\right)^{1/3}$ | | |
| 170 | 53 | $= \boxed{0.10\ m}$ | $\boxed{0.990\ m/s}$ | $= \boxed{0.067\ m}$ |
| 120 | 47 | | | |

Q ($m^3$/sec) = $7.58 * 10^{-3}$ = 0.00758

Before Sluice Gate [h>hc]

| H(m) | V(m/sec) | E(m) | Fr | Flow type |
|---|---|---|---|---|
| 0.215 | 0.47 | 0.22 | 0.32 | Subcrtical |
| 0.170 | 0.59 | 0.19 | 0.45 | Subcritical |
| 0.120 | 0.84 | 0.16 | 0.77 | Subcritical |

After Sluice Gate. [h<hc]

| H(m) | V (m/sec) | E (m) | Fr | Flow type |
|---|---|---|---|---|
| 0.076 | 1.33 | 0.17 | 1.54 | Supercritical |
| 0.053 | 1.91 | 0.24 | 2.65 | Supercritical |
| 0.047 | 2.15 | 0.28 | 3.166 | Supercritial |

Sample of Calculation @ H = 210 mm

| V (m/s) | E (m) | Fr & Flow type. |
|---|---|---|
| $V = \frac{Q}{A[b*h]}$ | $E = h + \frac{V^2}{2g}$ | $Fr = \frac{V}{\sqrt{g\,h}}$ |
| $= \frac{0.00758}{(0.075*0.21)}$ | $= 0.21 + \frac{0.48^2}{2*9.81}$ | $= \frac{0.48}{\sqrt{9.8*0.21}}$ |
| $= \boxed{0.48\ m/s}$ | $\boxed{= 0.22}$ | $= 0.334 < 1$ Subcritial |

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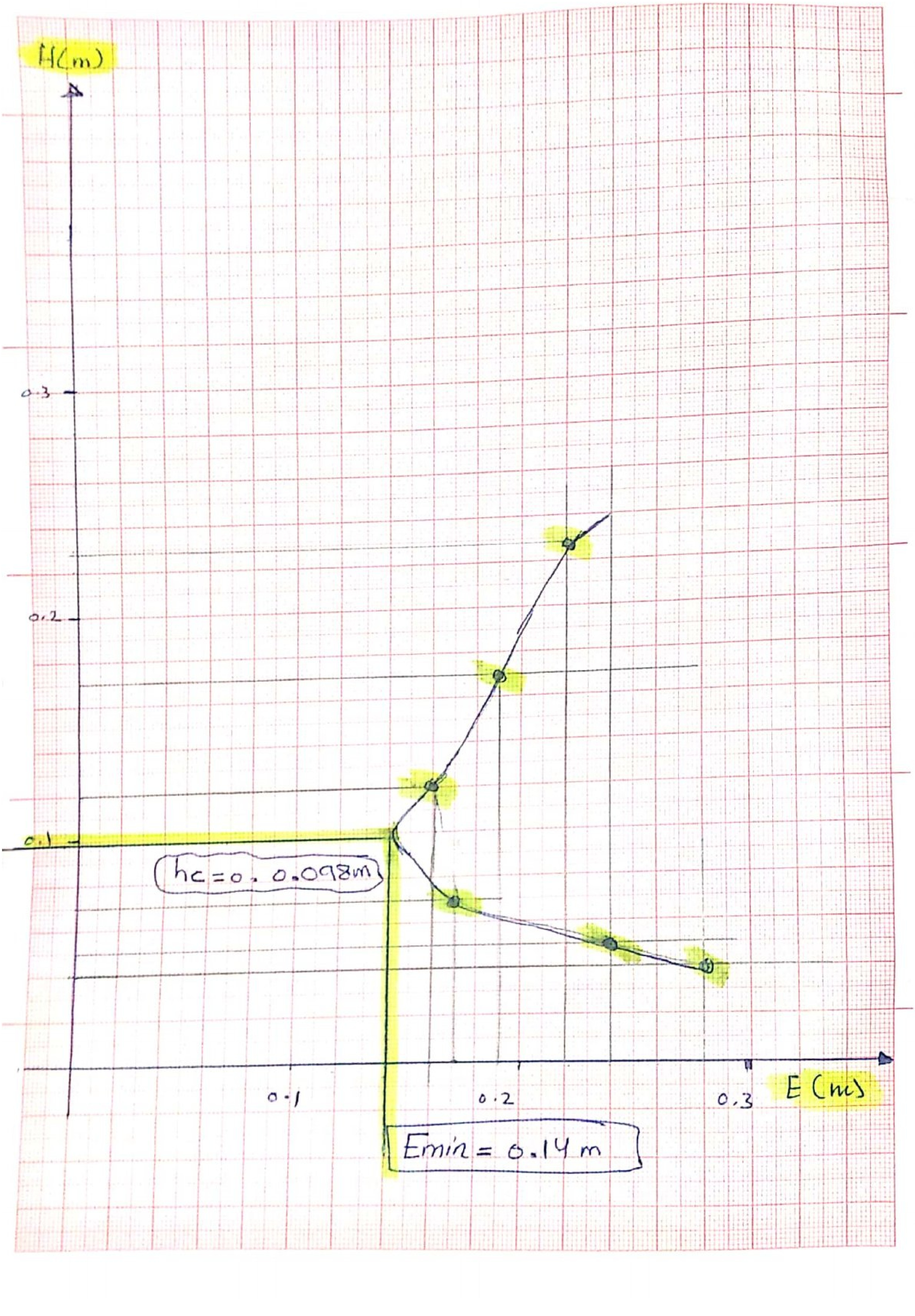


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| Emin (expermital) | hc (exprimital) |
|---|---|
| 0.14 m | 0.098 m |

## (6.4) Discussion

hc theo > hc expr.

0.1 m     0.098 m

Emin theo. > Emin Exp

0.16 m.     0.14 m.

Accepted

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ID : 1732428 | Name : Zaki Sami Batarseh | Sec (1) .
EXP (2) orifice and Jet flow. | Monday .

Diameter of orifice = 6mm = $\boxed{0.006\ m}$ $\quad Cd < 1$

| Trial | H (cm) | V (Lt) | Time (sec) | H (m) | $Q_{act}$ ($m^3/s$) | $H^{0.5}$ |
|---|---|---|---|---|---|---|
| # 1 | 30 | 5 | 135 | 0.3 | $3.704 \times 10^{-5}$ | 0.548 |
| # 2 | 40 | 5 | 111 | 0.4 | $4.505 \times 10^{-5}$ | 0.632 |

According to Second trial find :-

A - Theoritical flow rate ($m^3/s$) $\boxed{Q_{th} = \frac{\pi}{4} D^2 \sqrt{2g H_{(m)}}}$

$$Q_{th} = \frac{\pi}{4} (0.006)^2 * \sqrt{2 * 9.81 * 0.4} = \boxed{7.920 \times 10^{-5}\ m^3/s}$$

B. Coefficient of discharge (cd) $\boxed{Cd = \frac{Q_a}{Q_{th}} = \frac{V^{*10^{-3}} / t}{Q_{th}}}$

$$Cd = \frac{4.505 \times 10^{-5}}{7.92 \times 10^{-5}} = \boxed{0.5688} < 1 \text{ ok.}$$

C. Cofficecent of Velocity (Cv) if the flowjet is traveling horizantal X = 350mm , Y = 83mm It's Valid or not?

$$Cv = \frac{X}{2\sqrt{yH}} \qquad Cv = \frac{350}{2\sqrt{83 * 400}} = \boxed{0.960}$$

< 1 Valid

D. cofficient of Contract Area (Cc) It's Valid or Not?

$\boxed{Cc = \frac{Cd}{Cv}}$

$$Cc = \frac{0.5688}{0.960} = \boxed{0.5925}$$

It's Valid

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a : y intercept    b : Slope = 0.5

Log(H).

-0.1  -0.2  -0.3  -0.4  -0.5  -0.6

-1

Slope Should = 0.5

-2

$$Error = \left| \frac{0.68 - 0.5}{0.5} \right| * 100\%$$

36% Not accepted.

| Log(H) | Log(Qa) |
|---|---|
| -0.523 | -4.431 |
| -0.398 | -4.346 |

-3

$$cd = \frac{Slope * 10^{-4}}{\frac{\pi}{4} d^2 (2*9.81)^{0.5}} = \frac{10^{-4} * 0.68}{\frac{\pi}{4}(0.0016)^2(24)^{0.5}} = \boxed{= 0.543}$$

Valid < 1

-4

a = -3.99
≈ -4

-5

$$Slope = \frac{-4.346 + 4.431}{-0.398 + 0.523} = \boxed{0.68}$$

Log(Qa)

$Qa * 10^{-5}$

(0.632, 4.505)

(0.548, 3.704)

| $\sqrt{H}$ | $Qa*10^{-5}$ |
|---|---|
| 0.548 | 3.704 |
| 0.632 | 4.505 |

4

3

$$Slope = \frac{\Delta y}{\Delta x} = \frac{(3.704 - 4.505) * 10^{-5}}{(0.548 - 0.632)}$$

2

$$= \boxed{9.5 * 10^{-5}}$$

* It's Valid because < 1

1

$$cd = \frac{9.5 * 10^{-5}}{(\frac{\pi}{4})(0.006)^2(2*9.81)^{0.5}} = \boxed{0.7614}$$

0.1  0.2  0.3  0.4  0.5  0.6  0.7

$\sqrt{H}$

$$cd = \frac{Slope}{\frac{\pi}{4} d^2 (2g)^{0.5}} \Rightarrow * \; Slope = Cd = \frac{\Delta y}{\Delta x}$$

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3. True or false

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1) True

2) True

3) True

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| | Experiment 6<br>Center of Pressure | |
|---|---|---|
| ID: 1732428 | Name: Zaki Sami Batarseh | SEC.1 |

# 1. Data and Calculations: Notes: - All unit in hydraulic lab convert it to large unit for example (g to kg) and so on.

| $\gamma (N/m^3) = \rho * g$ | b(mm) | d(mm) | R1(mm) | R2(mm) | R3(mm) |
|---|---|---|---|---|---|
| 9810 | 75 | 100 | 100 | 200 | 200 |
| | (m) → 0.075 | 0.1 | 0.1 | 0.2 | 0.2 |

*Convert to larger.

## 1.1 Totally Immersed

**Table1:** Determination of the calculated and experimental center of pressure on a plan surface totally immerged with water

| Mass (g) | Water depth y (mm) | $\bar{y}$ (mm) | $F_{theo.}$ (N) | $F_{exp.}$ (N) | $Y_{c.p\ calculated}$ (mm) | $Y_{c.p\ experimental}$ (mm) |
|---|---|---|---|---|---|---|
| 400 | 122 | 72 | 5.2974 | 0.2941 | 83.574 | 170.1 |
| 500 | 155 | 105 | 7.7254 | 0.540 | 112.937 | 182. |

**Show sample of calculation on each computation of mass 400g**

| $\bar{y}$ (mm) | $F_{theo.}$ (N) | $F_{exp.}$ (N) | $Y_{c.p\ calculated}$ (mm) | $Y_{c.p\ experimental}$ (mm) |
|---|---|---|---|---|
| $\bar{y} = y - \frac{d}{2}$<br>$\bar{y} = 122 - \frac{0.1}{2}$<br>$= 0.072$<br>$= 72 mm$ | $= \rho g \bar{y} A$<br>$= 9810 * 0.075 * 0.1 * 0.072$<br>$= 5.2974 N$ | $\frac{0.4 * 9.81 * 0.2}{0.2 \left[ \frac{0.122 * 0.1}{2} - \frac{0.1^2}{6} \right]}$<br>$0.122 - \frac{0.1}{2}$<br>$= \boxed{0.2941}$ | $72 + \frac{\frac{1}{12} * 75 * 100^3}{72 * 75 * 100}$<br>$= 83.574 m$ | $\frac{2(0.4)(0.2}{9.81(2 * 0.122 * 0.075 - 0.075(0.1)^2)}$<br>$- 0.2 + 0.122$<br>$= 170.1$ |

## 1.3 Partially Immersed

**Table2:** Determination of the calculated and experimental center of pressure on a plan surface partially immerged with water

| Mass (g) | Water depth y (mm) | $\bar{y}$ (mm) | $F_{theo.}$ (N) | $F_{exp.}$ (N) | $Y_{c.p\ theo.}$ (mm) | $Y_{c.p\ experimental}$ (mm) |
|---|---|---|---|---|---|---|
| 100 | 54 | 27 | 1.073 | 1.078 | 36 | 36.9 |
| 200 | 78 | 39 | 2.2382 | 2.255 | 52 | 53.3 |

**Show sample of calculation on each computation of mass 100g**

| $\bar{y}$ (mm) | $F_{theo.}$ (N) | $F_{exp.}$ (N) | $Y_{c.p\ calculated}$ (mm) | $Y_{c.p\ experimental}$ (mm) |
|---|---|---|---|---|
| $\bar{y} = \frac{y}{2}$<br>$= \frac{54}{2}$<br>$= 27 m$ | $0.5 * 9810 * 0.075 * 0.054^2$<br>$\boxed{= 1.073 N}$ | $\frac{0.1 * 9.81 * 0.2}{0.2 - \frac{0.054}{3}}$<br>$\boxed{= 1.078} N$ | $\frac{2}{3}(54)$<br>$= 36$ | $\frac{2(0.1)0.2}{9.81 * 0.075 * 0.054^2}$<br>$- 0.2 + 0.054$<br>$= 36.9$ |

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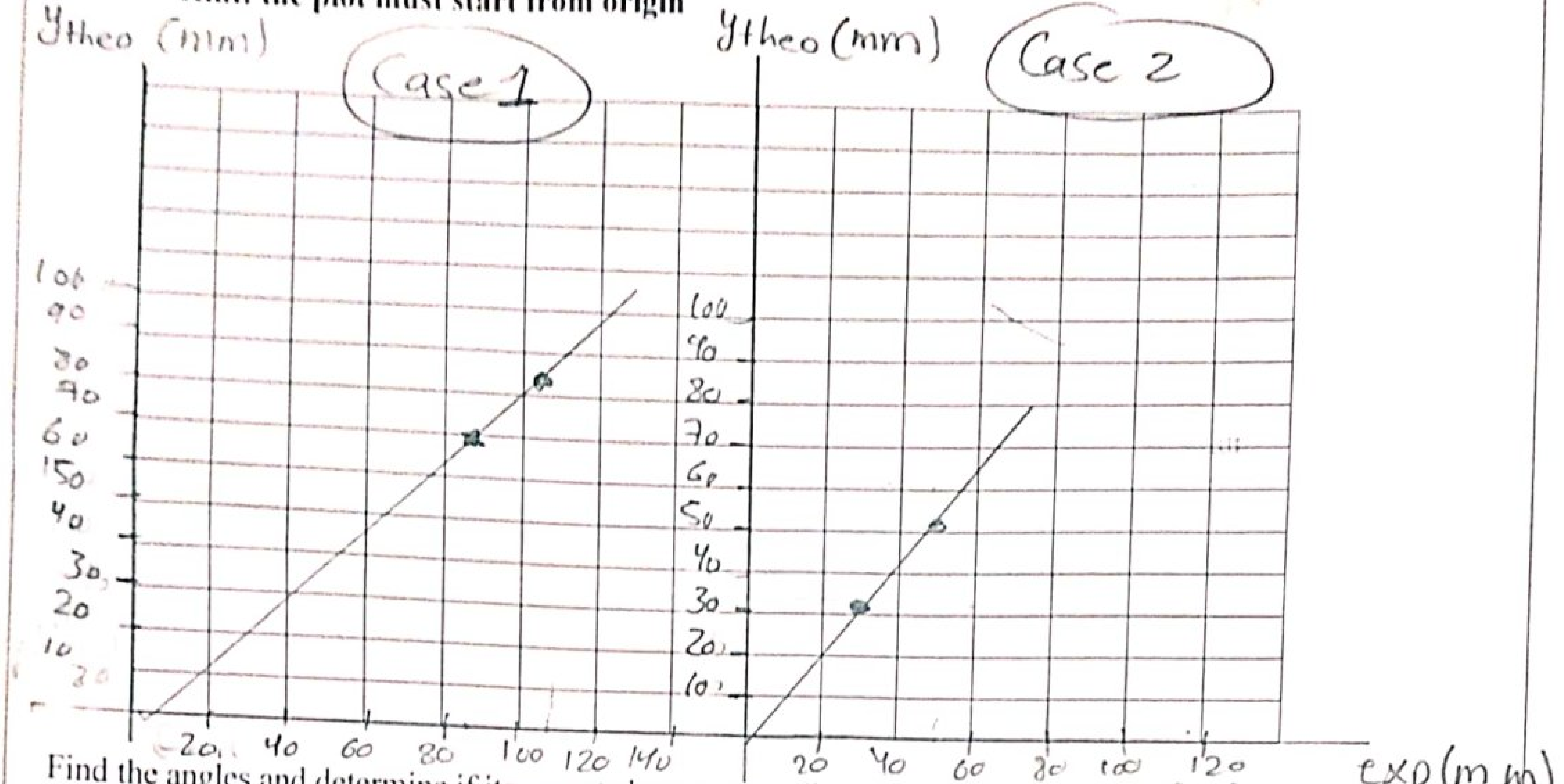
**2. Plot the results:**

Draw $Y_{cp\ theo}$ VS. $Y_{cp\ experimental}$ for **Totally** and **Partially** immersed in the same figure.

***Hint: the plot must start from origin**




Find the angles and determine if its accepted or not according to the angles values. ($40^0$-$50^0$).

**Totally:** $\text{Slope} \overset{\tan^{-1}}{=} (\phi) = \frac{\Delta y}{\Delta x} = \phi = \tan^{-1}\left(\frac{83.574 - 112.137}{70 - 82}\right) = \boxed{67.77^\circ}$

Not accepted

**Partially:** $\text{Slope} \overset{\tan^{-1}}{=} (\phi) = \tan^{-1}\left(\frac{36 - 52}{36.9 - 53.3}\right) = \boxed{44.23^\circ \text{ Accepted}}$

سيتم ادراج اسئلة المناقشة والقراءات غدا ان شاءالله بموعد المختبر على خانة الواجبات

- العلاقة طردية ( water depth increase, Center of p increase )
- Centre of pressure is always deeper than Centre of Area. because the Pressure increase by depth.

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Experiment 4 [impact of water jet]

$D_{Nozzle} = 8$ mm

$A = \frac{\pi}{4}(0.008)^2 = 5.027 * 10^{-5}$

Table 1.1 Falt plate target [$\theta = 90°$]

$S = 3$ cm → $S = 0.03$ m

| Mass (g) | Volume (L) | Time (s) | Q ($m^3/s$) | $V_{Nozel}$ (m/s) | $V_0$ Nozzel (m/s) | Moment $\dot{m} * V_0$ | $F_{mesured}$ (N) | $F_{calculated}$ (N) |
|---|---|---|---|---|---|---|---|---|
| 100 | 5 | 22 | $2.27 * 10^{-4}$ | 4.52 | 4.46 | 1.012 | 0.981 | 1.012 |
| 200 | 5 | 15 | $3.33 * 10^{-4}$ | 6.63 | 6.58 | 2.19 | 1.962 | 2.19 |

Table 2.1: Cone Target [$\theta = 120°$]

| Mass (g) | Volume (L) | Time (s) | Q ($m^3/s$) | V (m/s) Nozzel | $V_0$ Nozzel (m/s) | Momet $\dot{m} * V_0$ | F (N) measured | $F_{calculated}$ (N) |
|---|---|---|---|---|---|---|---|---|
| 100 | 5 | 28 | $1.78 * 10^{-4}$ | 3.54 | 3.46 | 0.615 | 0.981 | 0.922 |
| 200 | 5 | 19 | $2.63 * 10^{-4}$ | 5.23 | 5.18 | 1.36 | 1.962 | 2.04 |

Sample of Calculation @ 100g of flat target ($\theta = 90°$)

$Q (m^3/s) = \frac{Volume}{time}$

$= \frac{5 * 10^{-3}}{22}$

$= 2.27 * 10^{-4}$

$V_{Nozzel}$ (m/s)

$V_n = \frac{Q}{A}$

$= \frac{2.27 * 10^{-4}}{\frac{\pi}{4}(0.008)^2} = 4.52$ m/s

$V_0$ Nozzel (m/s)

$V_0^2 = V_n^2 - 2gS$

$V_0 = \sqrt{V_n^2 - 2gS}$ = 4.46 m/s

$= \sqrt{4.52 - 2(9.81)(0.03)}$

Moment $m * V_0$

$m V_0 = \rho Q V_0$

$= 1000 * 2.27 * 10^{-4} * 4.46$

$= 1.012$ N.s

$F_{measured}$ (N)

$F_{mesued} = m * g$

$= \frac{100}{1000} * 9.81$

$= 0.981$ N

F Calculated.

$F_{calc} = \rho Q V_0 (1 - \cos\theta)$

$= M * V_0 * (1 - \cos(90))$

$= 1.012 * (1 - \cos(90))$

$= 1.012$

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## 4.4 Discussion

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Slope from ~~Chart~~ (graph)

$\theta = 90$ , Slope = 1

$\theta = 120$ , Slope = 3.

Slope from Chart (Calculated)

$\theta = 90 \quad \frac{\Delta y}{\Delta x} = \frac{(1.962 - 0.981)}{(2.19 - 1.012)} = \boxed{0.838}$ $\boxed{<1}$ plate

$\theta = 120 \quad , \frac{\Delta y}{\Delta x} = \frac{(1.962 - 0.981)}{(1.36 - 0.615)} = \boxed{1.3168} > 1$

$\approx 1.5$ Cone

2. When the internal Angle = 280°, derive impact equation.

$F = m V_o (1 - \cos(\theta))$

$= m V_o (1 - \cos(80))$

$= \boxed{0.826 \; m V_o}$

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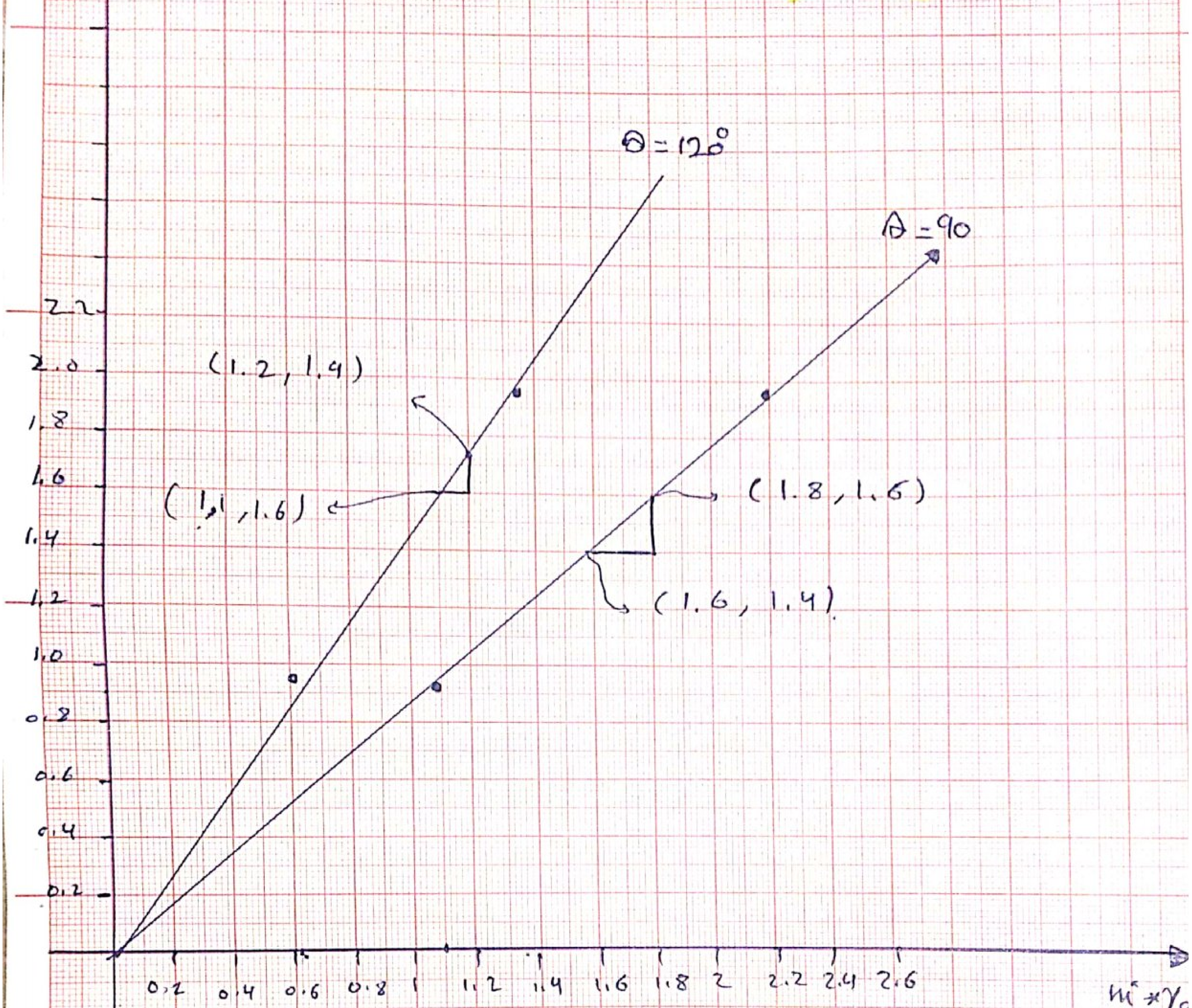


$$\text{Slope } \theta = 90^\circ = \frac{\Delta y}{\Delta x} = \frac{(1.6 - 1.4)}{(1.8 - 1.6)} = \frac{0.2}{0.2} = \boxed{1}$$

$$\text{Slope } \theta = 120^\circ = \frac{\Delta y}{\Delta x} = \frac{(1.9 - 1.6)}{(1.2 - 1.1)} = \frac{0.3}{0.1} = \boxed{3}$$

Zaki Sami Batarseh. [1732428] ⇒ Fluid friction in Pieps. and Losses from fitting

1.1 Loses due to friction [PVC] pipe $D = \frac{3}{4}$ in $= 0.01905$ m, $L = 1.25$ m, $A = 0.000285\ m^2$

| Volume ($m^3$) | Time (sec) | $h_L$ (m) | Q ($m^3$/sec) | V (m/ses) | Re | Flow type | fexp |
|---|---|---|---|---|---|---|---|
| 0.01 | 24 | 0.107 | $4.17 \times 10^{-4}$ | 1.46 | 27813 | Turbinent | 0.015 |
| 0.01 | 27 | 0.081 | $3.70 \times 10^{-4}$ | 1.29 | 24575 | Turbinent | 0.0145 |
| 0.01 | 29 | 0.075 | $3.45 \times 10^{-4}$ | 1.21 | 23051 | Turbent | 0.015 |

B) PVC picpe $D = \frac{1}{2}$ in $= 0.0127$ m ⇒ $L = 1.25$ m, $A = 0.000126676\ m^2$

| Volume $m^3$ | Time (sec) | $h_L$ (m) | Q $m^3$/Sec | V m/sec | Re | Flow type | fexp |
|---|---|---|---|---|---|---|---|
| 0.01 | 27 | 0.275 | $3.7 \times 10^{-4}$ | 2.92 | 37084 | Turbinet | $6.43 \times 10^{-3}$ |
| 0.01 | 30 | 0.234 | $3.33 \times 10^{-4}$ | 2.61 | 33147 | Turbinet | $9.99 \times 10^{-3}$ |
| 0.01 | 39 | 0.181 | $2.56 \times 10^{-4}$ | 2.02 | 25654 | Turbinent | $8.84 \times 10^{-3}$ |

c) PB Pipe $D = \frac{3}{4}$ in, $= 0.01905$ m, $L = 1.25$ m, $A = 0.000285\ m^2$

| Volume ($m^3$) | Time (sec) | $h_L$ (m) | Q ($m^3$/sec) | V (m/sec) | Re m | Flow type | fexp |
|---|---|---|---|---|---|---|---|
| 0.01 | 25 | 0.156 | $4 \times 10^{-4}$ | 1.40 | 26670 | Turbinent | 0.024 |
| 0.01 | 30 | 0.125 | $3.33 \times 10^{-4}$ | 1.17 | 22289 | Turbinet | 0.027 |
| 0.01 | 46 | 0.103 | $2.17 \times 10^{-4}$ | 0.76 | 14478 | Turbinet | 0.053 |

2. Losses due to fitting

$D = 3/4$ in, $A = 0.000285\ m^2$

| | Volume ($m^3$) | Time (sec) | $h_L$ (m) | Q ($m^3$/sec) | V (m/sec) | k |
|---|---|---|---|---|---|---|
| 90° Elbow | 0.01 | 25 | 0.08 | $4 \times 10^{-4}$ | 1.40 | 0.800 |

• sample of Calculations of each Computation PVC D=1/2 inch trial #1

| Q $m^3$/s | V m/s | Re | f | k for 90° |
|---|---|---|---|---|
| $Q = \frac{\text{Volume}}{\text{time}}$ | $V = \frac{Q}{A}$ | $Re = \frac{VD}{10^{-6}}$ | $f = \frac{h_L \cdot D \cdot 2g}{L\,(v)^2}$ | $k = \frac{h_L\, 2g}{v^2}$ |
| $= \frac{0.01}{27}$ | $V = \frac{3.7 \times 10^{-4}}{0.000126676}$ | $= \frac{2.92 \times 0.0127}{10^{-6}}$ | $= \frac{0.275 \times 0.0127 \times 2 \times 9.81}{1.25 \times 2.92^2}$ | $k = \frac{0.08 \times 2 \times 9.81}{(1.4)^2}$ |
| $= \boxed{3.7 \times 10^{-4}}$ | $= \boxed{2.92}$ | $\boxed{37084 >> 4000 \text{ Turbinent}}$ | $= \boxed{6.43 \times 10^{-3}}$ | $= \boxed{0.800}$ |

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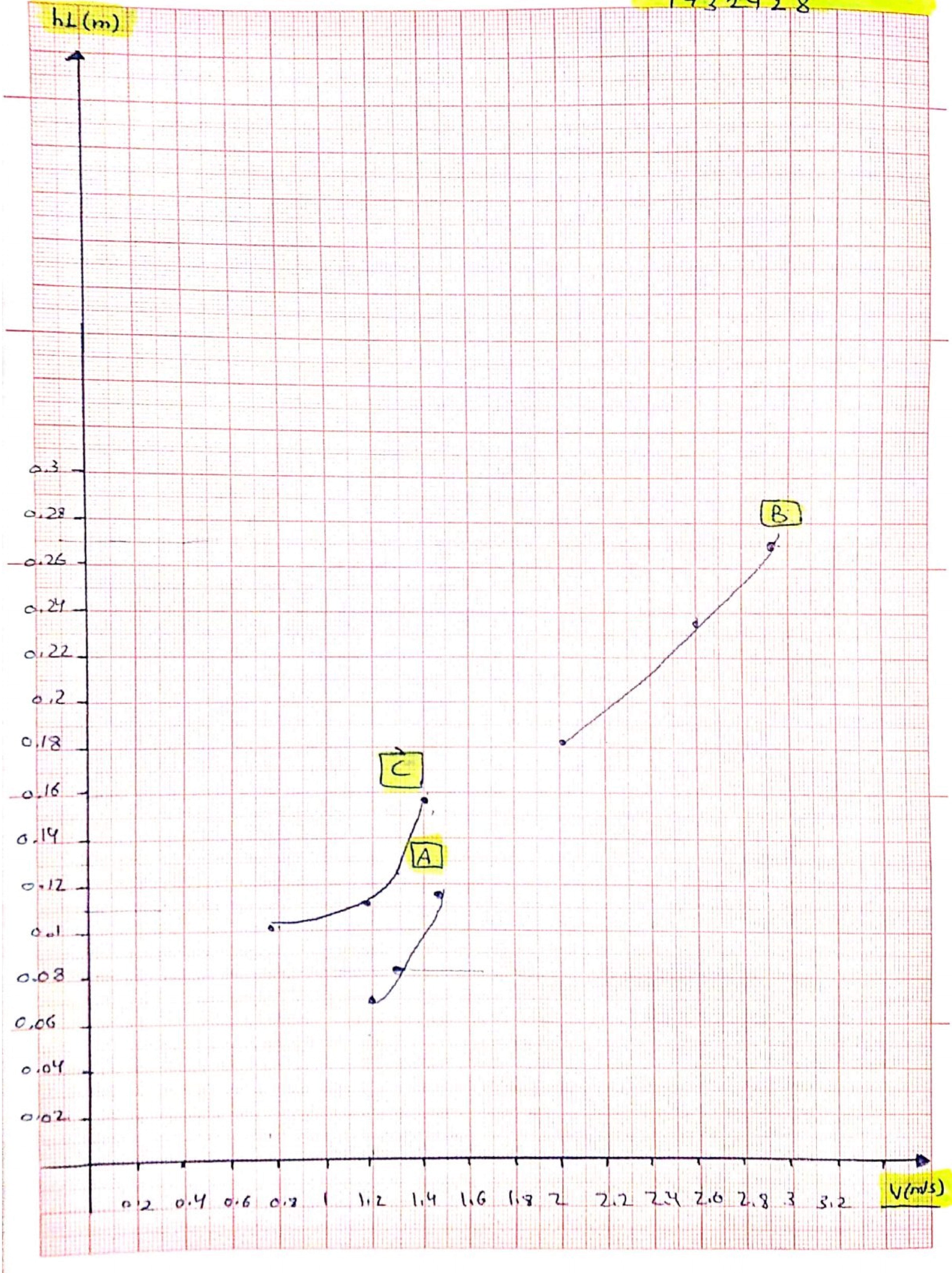


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## 4. Discussion

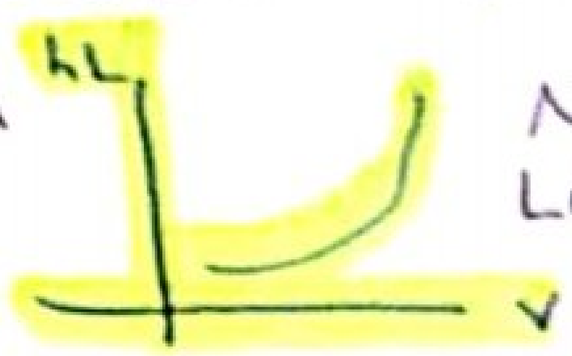
1) True

2) False

3) False

4) False

2) The Flow is Turbulent because the Relation between V & hL is aparobola




Not Linear According to the equation

$$f \cdot L \cdot V^2 = h_L \cdot D \cdot 2g$$

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[Experiment (6) Bernoulli's Theorm.]

Monday (Sec 2)

Data: $D_1 = 25\,mm$, $D_5 = 10\,mm$, $D8 = 25\,mm$ (Total head)

0.025 m, 0.01 m, 0.025 m

| Trail # | Volume (L.t) | Time (Sec) | reading (Cm) | Point 1 | Point 5 |
|---|---|---|---|---|---|
| 1 | 5 | 41 | HP | $h_1$ 46.9 | $h_5$ 28.9 |
| | | | Ht | 47.3 | 44.8 |
| 2 | 5 | 44 | HP | $h_1$ 27.9 | $h_5$ 13.3 |
| | | | Ht | 29.1 | 28.4 |

2. Calcutation.

$A_1 = \frac{\pi}{4} D_1^2 = \frac{\pi}{4} * (0.025)^2 = 4.909 * 10^{-4}\ m^2$

$A_5 = \frac{\pi}{4} D_5^2 = \frac{\pi}{4} * (0.01)^2 = 7.854 * 10\ m^2$

| Trial # | Qact $m^3/s$ | Qtheo $m^3/s$ | Cd | $V_5$ | $Re_5$ | $(h_1 - h_5)^{0.5}$ |
|---|---|---|---|---|---|---|
| 1 | $1.22*10^{-4}$ | $1.5*10^{-4}$ | 0.813 | 1.50 | 15500 | 0.424 |
| 2 | $1.14*10^{-4}$ | $1.35*10^{-4}$ | 0.840 | 1.451 | 14500 | 0.382 |

Show Sample of Calculations of each Computation of Trial 1

**Qact ($m^3/s$)**

$Qact = \frac{Volume}{Time (sec)}$

$= \frac{5*10^{-3}}{41}$

$= 1.22*10^{-4}$

**Qtheo ($m^3/s$)**

$Qtheo = A_5 \sqrt{\frac{2g(h_1 - h_5)}{1 - \left(\frac{A5}{A1}\right)^2}}$

$= 7.854*10^{-5} \sqrt{\frac{2(9.81)(46.9-28.9)}{1 - \left(\frac{7.854*10^{-5}}{4.909*10^{-4}}\right)^2}}$

$= 1.5 * 10^{-3}\ m^3/s$

**Cd**

$\frac{Qact}{Qtheo} = \frac{1.22*10^{-4}}{1.5*10^{-4}}$

$= \boxed{0.813}$

**V5**

$V_5 = \frac{Qact}{A5}$

$= \frac{1.22*10^{-4}}{7.854*10^{-5}}$

$1.553 = m/s$

**Re5**

$Re_5 = \frac{V_5 D_5}{10^{-6}}$

$= \frac{1.553 * 0.01}{10^{-6}}$

$= \boxed{15500}$

**$(h_1 - h_5)^{0.5}$**

$\sqrt{(46.9 - 28.9) * 10^{-2}}$

$= 0.424\ m^{0.5}$

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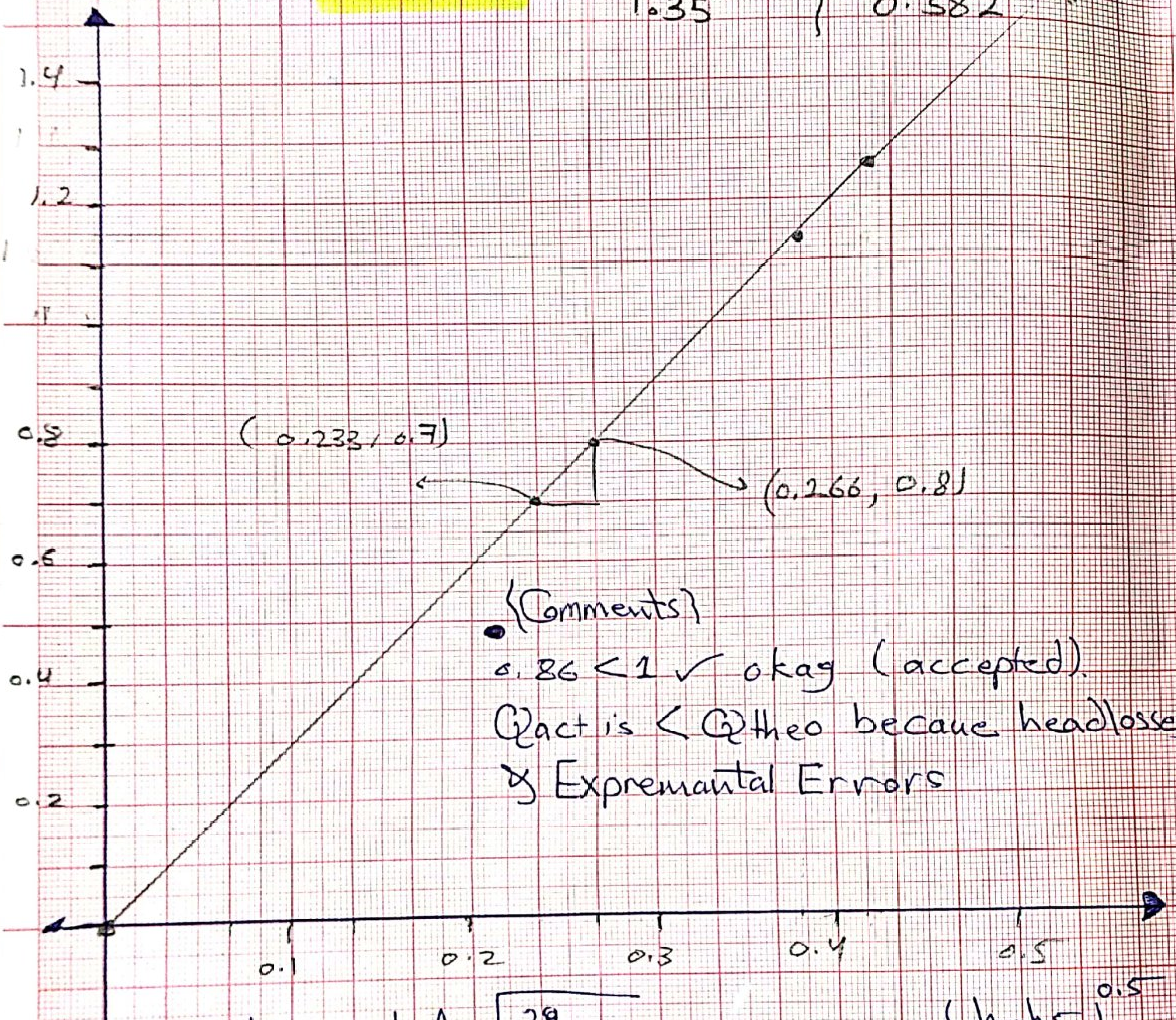
| $Q_{act} \times 10^{-4}$ | $(h_1 - h_5)^{0.5}$ |
|---|---|
| 1.5 | 0.424 |
| 1.35 | 0.382 |




{Comments}

- 0.86 < 1 ✓ okay (accepted).
- Qact is < Qtheo becaue headlosses & Expremantal Errors

$$\frac{\Delta y}{\Delta x} = k = C_d A_5 \sqrt{\frac{2g}{1 - \left(\frac{A_5}{A_1}\right)^2}}$$

$$\boxed{\begin{aligned} A_5 &= 7.854 \times 10^{-5} \\ A_1 &= 4.909 \times 10^{-4} \end{aligned}}$$

$$\text{Slope} = \frac{(0.8 - 0.7)}{(0.266 - 0.233) \times 10^{-4}} = 30303$$

$$C_d = \frac{Q_{act}}{Q_{the}} = \frac{30303}{\sqrt{\frac{2(9.81)(46.9-23.9)}{1 - \left(\frac{7.854 \times 10^{-5}}{4.909 \times 10^{-4}}\right)^2}}} = \boxed{0.86} < 1$$

It's accepted

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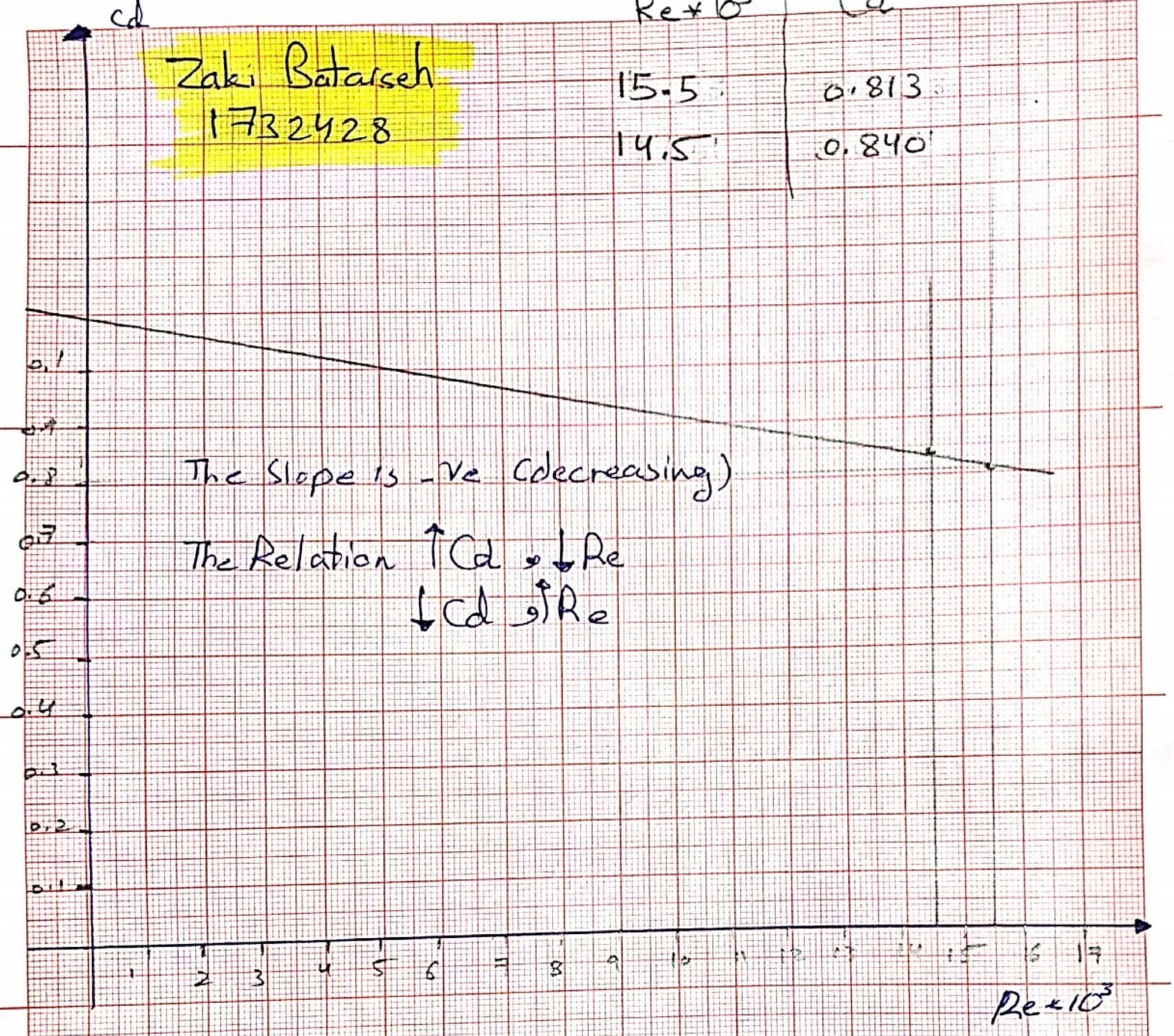
| $Re \times 10^3$ | Cd |
|---|---|
| 15.5 | 0.813 |
| 14.5 | 0.840 |



Name: Zaki Sami Batarseh / ID:1732428 / Exp(7) [Hydrulic JumP]

| Q (L/min) | Q ($m^3/s$) | $h_1$ (mm) | $h_2$ (mm) | Lj (cm) |
|---|---|---|---|---|
| 250 | 0.00417 | 50.0 | 86.0 | 56 |
| 150 | 0.00250 | 30.0 | 76.0 | 39 |
| 50 | 0.00083 | 6.0 | 73.0 | 20 |

Calculations 2.1

| $h_1$ (m) | $h_1$ Theo (m) | $V_1$ (m/s) | $E_1$ Exp(m) | $Fr_1$ | Flow Type |
|---|---|---|---|---|---|
| 0.05 | 0.00225 | 1.112 | 0.113 | 1.59 | Supercrtical |
| 0.03 | 0.0283 | 1.111 | 0.093 | 2.08 | Supercrtical |
| 0.006 | 0.00464 | 1.844 | 0.179 | 7.600 | Supercritical |
| $h_2$ (m) | $h_2$ Theo (m) | $V_2$ (m/s) | $E_2$ Exp (m) | $Fr_2$ | Flow Type |
| 0.086 | 0.090 | 0.646 | 0.107 | 0.116 | Subcrtical |
| 0.076 | 0.0745 | 0.436 | 0.086 | 0.505 | Subcrtical |
| 0.073 | 0.0616 | 0.156 | 0.074 | 0.184 | Subcrtical |

| hj (m) | Lj (m) | Lj Theo (m) | ΔE Exp($h_L$) (m) | ΔE Theo ($h_L$) (m) |
|---|---|---|---|---|
| 0.036 | 0.56 | Undular jump | 0.006 | 0.00271 |
| 0.046 | 0.39 | $4.464h_2 = \boxed{0.384}$ | 0.007 | 0.011 |
| 0.067 | 0.2 | $6.18h_2 = \boxed{0.469}$ | 0.105 | 0.172 |

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## 2.1 Sample of Calculations, Show the Sample for trial no.1

| $h_1$ Theo(m) | $V_1$ (m/s) | $E_1$ Exp (m) | $Fr_1$ | Flow Type |
|---|---|---|---|---|
| $h_1 = \frac{h_2}{2}\left[\sqrt{1+8Fr_2^2}-1\right]$ <br> $= \frac{0.86}{2}\left[\sqrt{1+8(0.116)}\right]$ <br> $= 0.00225$ <br> $Fr_2 = \frac{V^2}{\sqrt{g*h_2}}$ | $V_1 = \frac{Q}{A_1} = \frac{Q}{bh_1}$ <br> $= \frac{0.00417}{0.075*0.05}$ <br> $= 1.112$ m/s | $E_1 = h_1 + \frac{V_1^2}{2g}$ <br> $0.05 + \frac{1.112^2}{2(9.81)}$ <br> $= 0.113$ m | $Fr_1 = \frac{V_1}{\sqrt{g h_1}}$ <br> $= \frac{1.112}{\sqrt{9.81*0.05}}$ <br> $= 1.59$ <br> Supercritical | Supercritical |

| $H_j$ (m) | $L_j$ (m) | $L_j$ Theo (m) | $\Delta E$ exp($h_L$) (m) | $\Delta E$ Theo. $h_L$ (m) |
|---|---|---|---|---|
| $H_j = h_2 - h_1$ <br> $0.086 - 0.05$ <br> $= 0.036$ | in Table <br> $\frac{56}{100}$ <br> $= 0.56$ m | From Table <br> Attached in the Channel | $E_1 - E_2$ <br> $0.113 - 0.107$ <br> $= 0.006$ | $\Delta E = \frac{(h_2 - h_1)^3}{4h_2 * h_1}$ <br> $\frac{(0.086 - 0.05)^3}{4*0.086*0.05}$ <br> $= 0.00271$ |

1) ( True ) 2) ( True )

3) ( True ) 4) ( True ) 5) ( False )

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# Exp (8) The Flow Beneat Sluice Gate. (An undershot weir).

## 8.1 Data and Calculations.

### 8.1.1 Data.

$b = 75\ mm = \boxed{0.075\ m}$

| $h_g = 15\ mm$ | | $h_g = 20\ mm$ | |
|---|---|---|---|
| Q (L/min) | $h_o$ (mm) | Q (L/min) | $h_o$ (mm) |
| 60 | 145 | 60 | 84 |
| 50 | 83 | 50 | 50 |

### 8.1.2 Calculations

| | $h_o$ (m) | Q ($m^3$/sec) | $Q_{theo}$ $m^3$/Sec | Cd | $h^{0.5}$ |
|---|---|---|---|---|---|
| hg = 15mm | 0.145 | $1*10^{-3}$ | $1.898*10^{-3}$ | 0.527 | 0.381 |
| | 0.083 | $8.33*10^{-4}$ | $1.436*10^{-3}$ | 0.580 | 0.288 |

| | $h_o$ (m) | Q ($m^3$/sec) | $Q_{theo}$ ($m^3$/Sec) | Cd | $h^{0.5}$ |
|---|---|---|---|---|---|
| hg = 20mm | 0.084 | $1*10^{-3}$ | $1.926*10^{-3}$ | 0.519 | 0.289 |
| | 0.05 | $8.33*10^{-4}$ | $1.486*10^{-3}$ | 0.560 | 0.224 |

| @ hg 15mm Sample of Calculations | Q ($m^3$/Sec) | $Q_{Theo}$ ($m^3$/Sec) | Cd |
|---|---|---|---|
| | $Q_{m^3(sec)} = \frac{50*10^{-3}}{60}$ | $Q_{The} = b h_g \sqrt{2gh_o}$ | $Cd = \frac{Q_{act}}{Q_{Theo}}$ |
| | | $= 0.075*0.015\sqrt{2*9.81*}$ $*\sqrt{0.145}$ | $= \frac{1*10^{-3}}{1.898*10^{-3}}$ |
| | $= \boxed{1*10^{-3}\ m^3/s}$ | $= \boxed{1.898*10^{-3}}$ | $\boxed{=0.527}$ |

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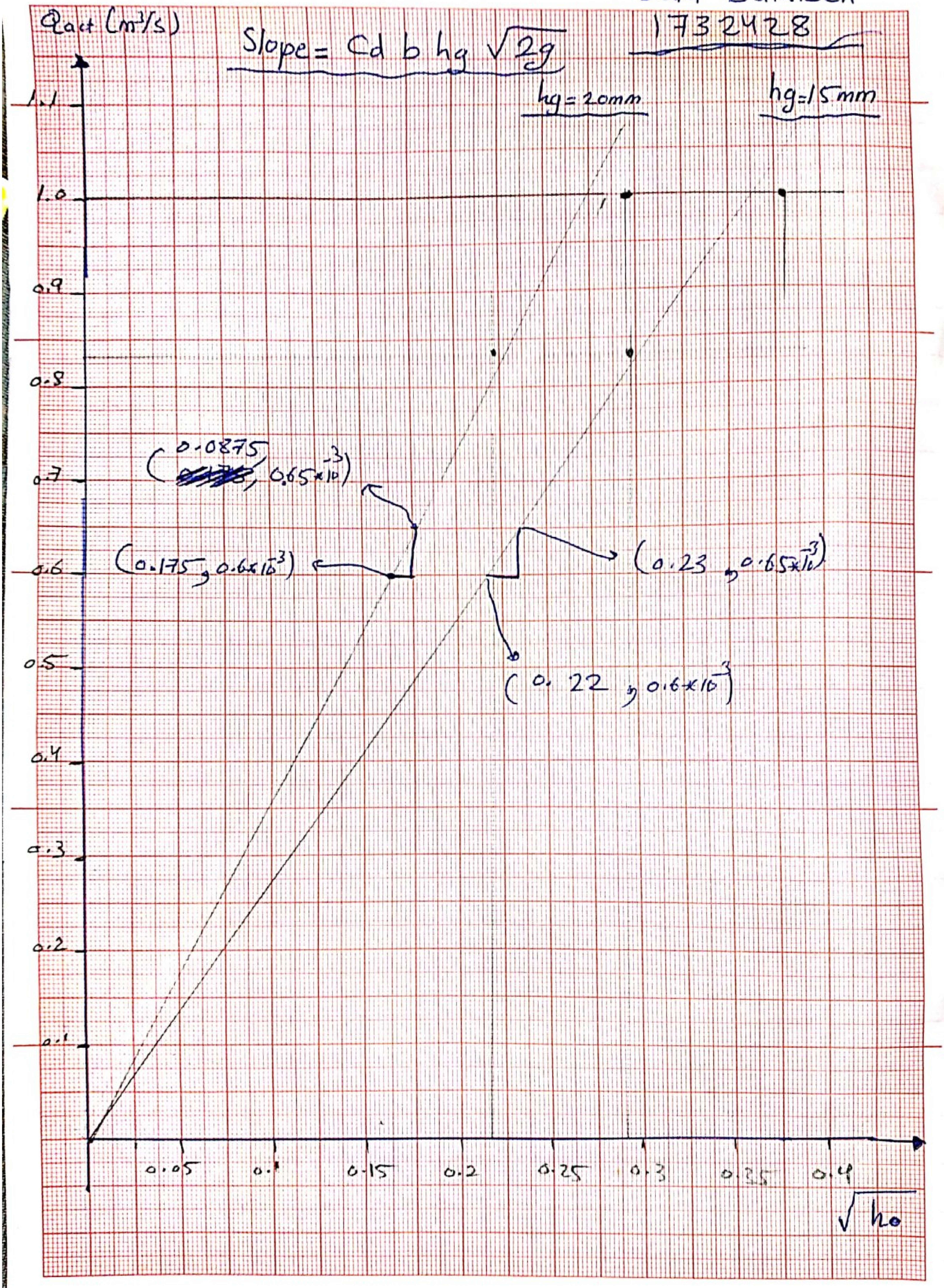


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| $h_g = 15$ mm | | $h_g = 20$ mm. | |
|---|---|---|---|
| Slope | cd | Slope | Cd |
| $\frac{\Delta Q}{\sqrt{h}}$ | $cd = \frac{slope}{b\,h_g\sqrt{2g}}$ | $\frac{\Delta Q}{\Delta\sqrt{h}}$ | $Cd = \frac{slope}{b\,h_g\sqrt{2g}}$ |
| $= \frac{(0.65-0.6)10^{-3}}{0.23-0.22}$ | $= \frac{0.005}{0.075\times0.015\sqrt{29.81}}$ | $= \frac{(0.65-0.6)10^{-3}}{0.175-0.0875}$ | $\frac{5.71*10^{-4}}{0.075*0.02\sqrt{2*9.81}}$ |
| $\boxed{=0.005}$ | $\boxed{=1.00}$ | $\boxed{=5.71*10^{-4}}$ | $\boxed{=0.085}$ |

True OR False

1) True

2) True

3) False

4) False.

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| Name: Zaki Sami Batarseh | Experiment (9) Secton (1) Monday |
|---|---|
| ID: 1732428 | The flow Through rectangular Sharp crested weir |

## 9.1.1 Data.

| b = 75 mm | |
|---|---|
| Q (L/min) | H (mm) |
| 43 | 26 |
| 30 | 19 |

## 9.1.2 Calculations

| H (m) | $Q_{act}$ ($m^3$/sec) | $Q_{theo}$ ($m^3$/s) | $C_d$ | Log H | Log $Q_{act}$ | $H^{3/2}$ |
|---|---|---|---|---|---|---|
| 0,026 | $7.167*10^{-4}$ | $9.284*10^{-4}$ | 0.772 | -1.585 | -3.144 | $4.192*10^{-3}$ |
| 0,019 | $5*10^{-4}$ | $5.8*10^{-4}$ | 0.862 | -1.721 | -3.301 | $2.619*10^{-3}$ |

## 9.2 Sample of Calculation @ H =

| $Q_{act}$ ($m^3$/sec) | $Q_{the}$ ($m^3$/Sec) | $C_d$. |
|---|---|---|
| $Q_{act}$ ($m^3$/se) $= \frac{Q_{(L/min)} * 10^{-3}}{60}$ | $Q_{theo} = \frac{2}{3} b \sqrt{2g}\, H^{3/2}$ | $C_d = \frac{Q_{act}}{Q_{theo}}$ |
| $= \frac{43 * 10^{-3}}{60}$ | $= \frac{2}{3} * 0.075 * \sqrt{2*9.81} * 4.192*10^{-3}$ | $= \frac{7.167*10^{-4}}{9.284*10^{-4}}$ |
| $= \boxed{7.167*10^{-4}}$ $m^3$/Sec | $= \boxed{9.284*10^{-4}}$ $m^3$/sec. | $= \boxed{0.772}$ |

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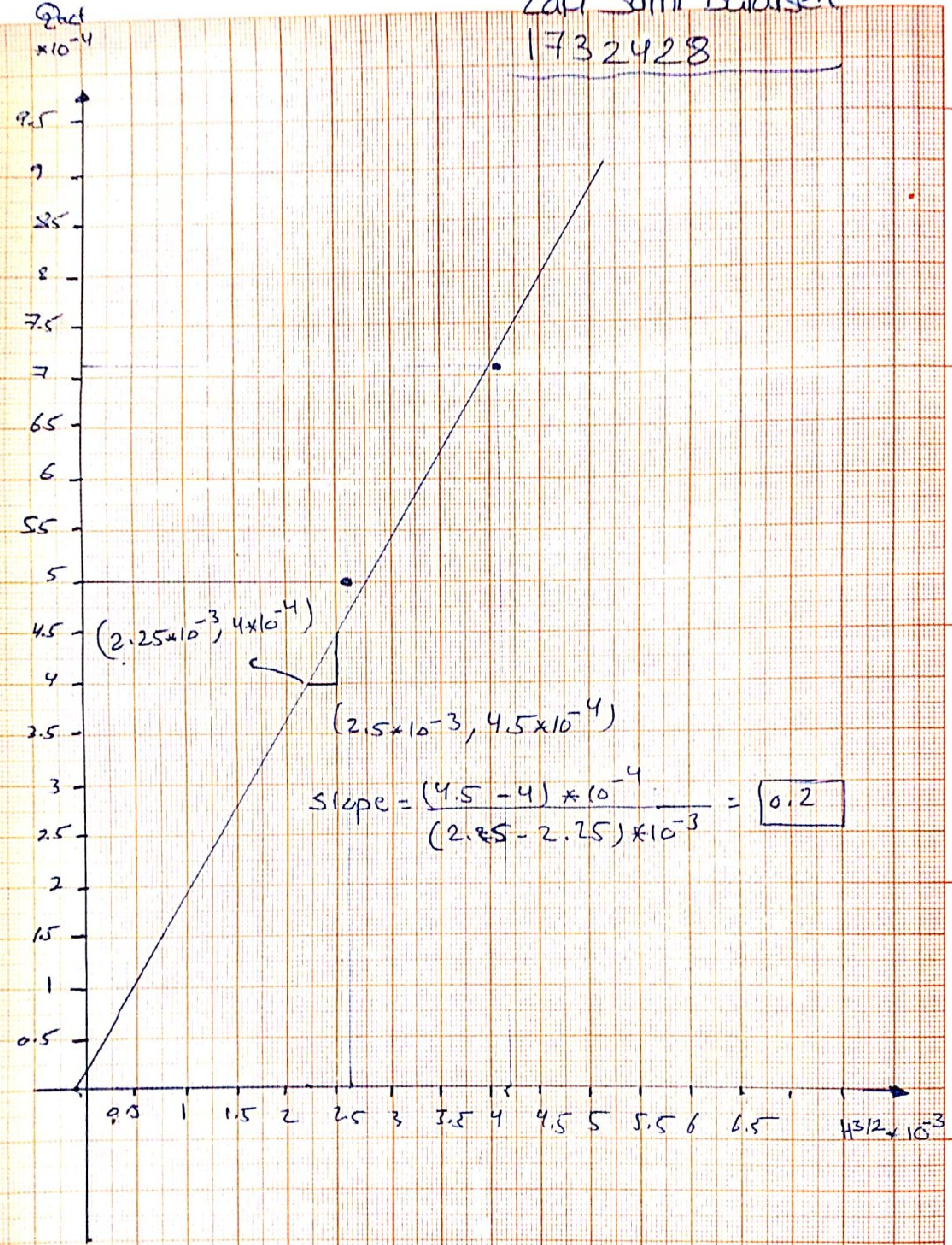


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| Slope | Cd |
|---|---|
| $\frac{\Delta y}{\Delta x} = \frac{(4.5-4)*10^{-4}}{(2.5-2.25)*10^{-3}}$ | $Slope = Cd\left(\frac{2}{3}*b*\sqrt{2g}\right)$ |
| $= \boxed{0.2}$ | $Cd = Slope / \frac{2}{3}*b*\sqrt{2g}$ |
| | $= 0.2 / \left(\frac{2}{3}*0.075*\sqrt{2*9.81}\right)$ |
| | $= \boxed{0.903}$ |

It's accepted It's very Close to table result &
It's Less than $< 1$

1) True

2) False

3) False.

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