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Team 2A

28/30

ENGR 4420 - Engineering Measurements
LOG SHEET REPORT
Fall 2023

LAB SECTION:___1______________ Team Number: ___2a____ Lab No. ____3______
NAME(S): (list members alphabetically)
__Julie Romano_______________________________________ EEEN
__Luis Hernandez_____________________________________ EEEN
__Jaquelinne Azua_____________________________________ EEEN

DATE PERFORMED:___10/02/2023_______ DATE SUBMITTED:____11/18/2023___

TEST PERFORMED: The team used a water tank with an orifice on the bottom. The team filled up that tank with water and slowly proceeded to drain the water back into the sink recording every measurement of the new water level every 5 seconds. Various data metrics were recorded and used for further calculations.

TYPE OF TEST/OBJECTIVE: The overall objective was to apply Torricelli principle along with Bernoulli's equation to the discharge of a tank and calculate various parameters such as volumetric flow rate.

EQUIPMENT USED:

PRIMARY EQUIPMENT:

- Water tank (on the hydration bench)
- Beakers
- Two wooden planks
- Rulers
- Stopwatch
- Spouts
- A tube used to drain the water.

SUPPORT EQUIPMENT:

- Dell desktop computer to do calculations.
- Scales to weight beaker and water.

EQUIPMENT SETTINGS:

To complete this lab, we had to fill the tank with water and measure its height. Then began to drain the tank, record the distance the stream travels. Making sure to record the stream falls over the distance recorded. Time how long it takes for stream to fill a container. Finally weigh the mass of water.

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EQUIPMENT CONFIGURATION AND SET UP

Figure 1 (a & b): Image of the equipment used in Lab3. a) Hydration bench with tanks and pumps b) and beaker on the scale

The image above is the test configuration for lab 3. Various physical parameters were measured such as the dimensions of the tank and orifice. The procedure for this lab is the following:

- Fill Tank to desired height.
- Open Orifice
- Record horizontal water distance and collect water in a beaker.
- Record the time it takes to drop the water height by 5 cm.
- Record water weight

SAFETY MEASURES:

All team members wore safety glasses to protect our eyes from any water splashing on us. The space was also clear to do measurements for the project.

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FINDINGS and OBSERVATIONS: Background ? -1

This experiment was conducted on 10/02/2023 at TAMUCC campus. The conditions in the room were 30.02 inHg for pressure and 72 degrees Fahrenheit. The next section details the various collected and calculated data parameters for this experiment. Several teams combined their efforts since this was a very involved lab and many hands were needed for the various parts. However, each team did their own calculations and reports. (Elizabeth, Michael, and Brandon, and Nicole were from the other half). Four team members of one team joined with Luis, Julie, and Jaquelinne from this team.

A team member would allow the flow apparatus to start filling the tank like in **Fig. 1a** so that it was at a constant height starting at 0.45 m. Another team member would use a beaker like the beaker in **Fig. 1b** and collect the water while a timer was used to time how long it took to fill the beaker. This time was recorded. Another team member would record how far the stream of water would release from the bottom of the tank. Another team member would take the beaker of water and record the mass of the collected water on the scale. The team would start to decrease the height of the water in the tank in increments of 0.05 m. All values associated with the change would be recorded. These values can be seen in **Table 2** while **Table 1** has the give parameters of this experiment. These values are in comparison to the theoretical values seen in **Table 3**. From these calculations, the team created the following graphs: Graph of Theoretical Water Column Height and Horizontal Water Projectile, Graph of Experimental Water Column Height and Horizontal Water Projectile, and Graph of Water Column Height and Experimental Water Mass Flow Rate.

DATA TABLE and GRAPH

The data in Table 1 includes the data which was measured and recorded by the students for lab 3. Graphs in figures 2 to 8 were created from equations seen in the equation section.

Given:		
Density:	999000	g/m^3
Diameter of tube:	0.175	m
Height of Orifice:	0.0508	m
Diameter of Orifice:	0.00335	m
Empty Beaker Weight:	2.6	oz
Acceleration due to Gravity	9.81	m^2/s

Table 1: Measured given parameters.

Experimental Data									
Trial	Height (m)	Horizontal Projectile (m)	Captured Mass (g)	Time (s)	Mass flow rate (g/s)	Projectile Motion Exit Velocity (m/s)	Projectile Motion Volumetric Flow (m^3/s)	Mass Flow Rate Exit Velocity (m/s)	Mass Flow Rate Volumetric Flow (m^3/s)
1	0.45	0.50	42.52	5.23	8.13	0.0946	0.055	0.92	8.14E-06
2	0.40	0.48	65.20	8.99	7.25	0.0534	0.031	0.82	7.26E-06
3	0.35	0.44	87.88	12.63	6.96	0.0346	0.020	0.79	6.97E-06
4	0.30	0.42	59.53	9.34	6.37	0.0444	0.026	0.72	6.38E-06
5	0.25	0.37	70.87	12.52	5.66	0.0292	0.017	0.64	5.67E-06

6	0.20	0.34	85.05	16.38	5.19	0.0205	0.012	0.59	5.20E-06
7	0.15	0.28	93.55	22.42	4.17	0.0125	0.007	0.47	4.18E-06
8	0.10	0.23	93.55	28.22	3.32	0.0080	0.005	0.38	3.32E-06

Table 2: Collected Experiment data.

Theoretical Data						
Trial	Height (m)	Projectile Time (s)	Horizontal Projectile (m)	Projectile Velocity (m/s)	Mass Flow Rate (g/s)	Volumetric Flow Rate (m^3/s)
1	0.5	0.032	0.096	2.96	26.09	2.47E-05
2	0.4	0.032	0.091	2.79	24.59	2.31E-05
3	0.4	0.032	0.085	2.61	22.99	2.14E-05
4	0.3	0.032	0.078	2.42	21.27	1.95E-05
5	0.3	0.032	0.072	2.20	19.40	1.74E-05
6	0.2	0.032	0.064	1.97	17.33	1.51E-05
7	0.2	0.032	0.055	1.70	14.97	1.23E-05
8	0.1	0.032	0.045	1.38	12.17	8.66E-06

Table 3: Calculated Theoretical Data.

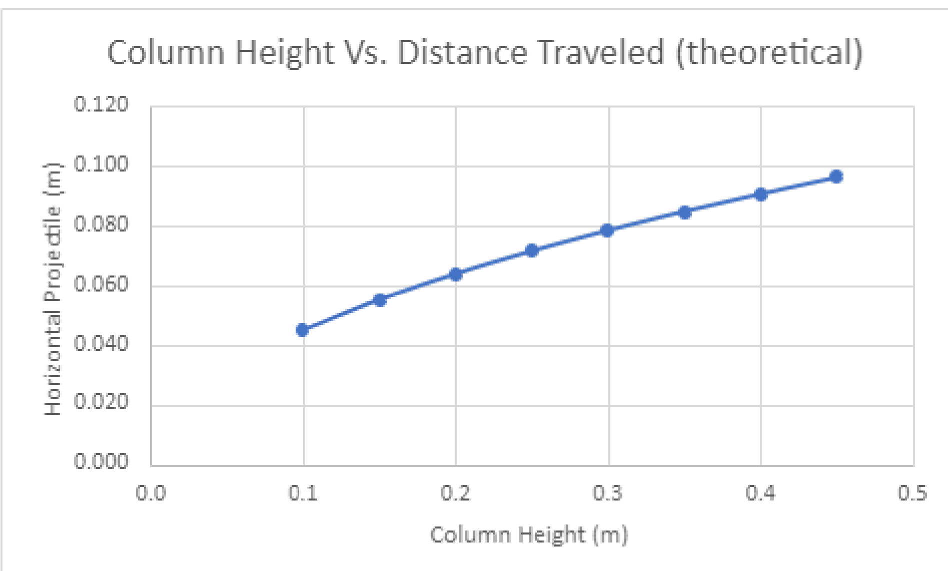

Figure 2: Graph of Theoretical Water Column Height and Horizontal Water Projectile.

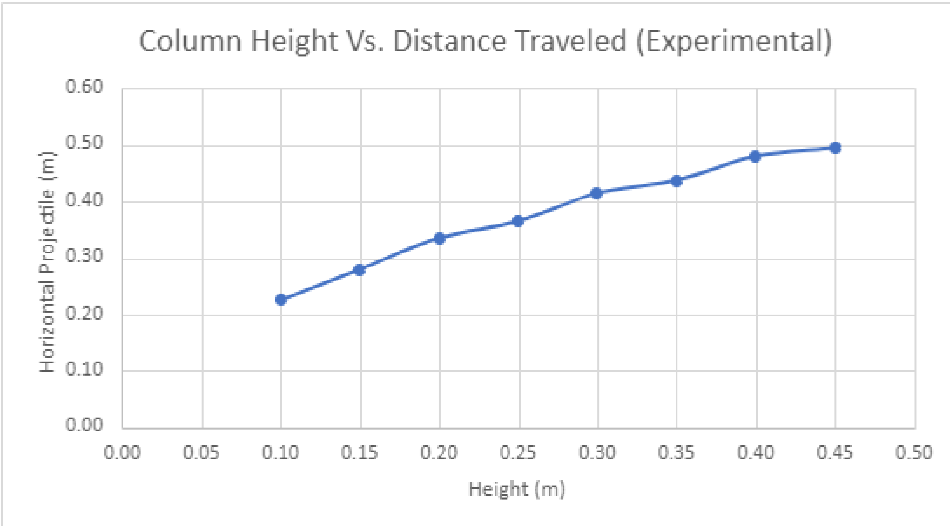

Figure 3: Graph of Experimental Water Column Height and Horizontal Water Projectile.

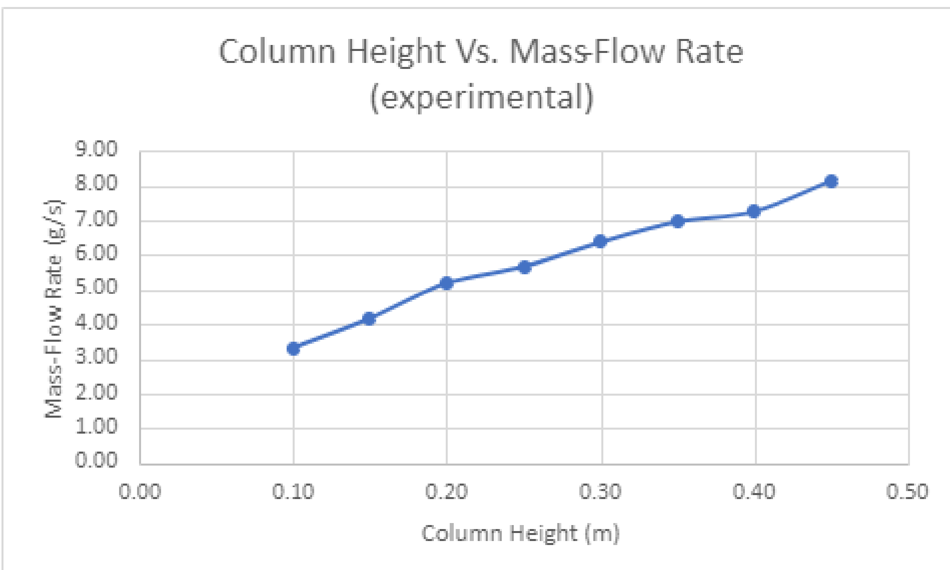

Figure 4: Graph of Water Column Height and Experimental Water Mass Flow Rate

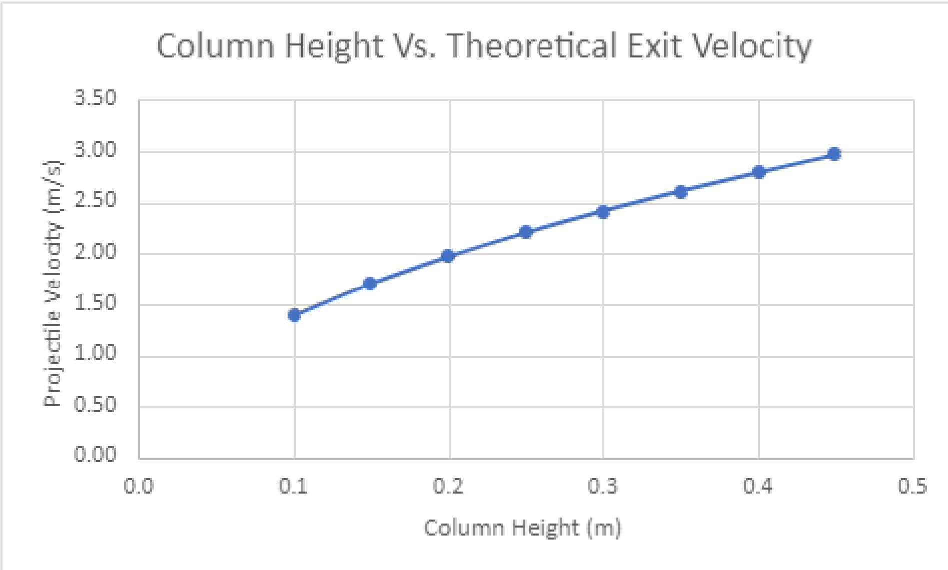

Figure 5: Graph of Water Column Height and Theoretical Exit Velocity

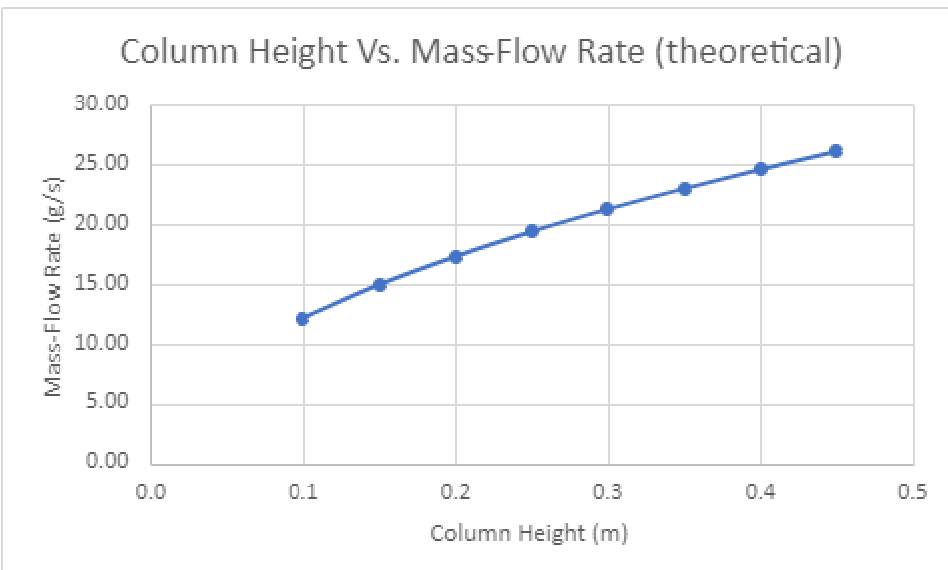

Figure 6: Graph of Water Column Height and Theoretical Mass Flow Rate

Wrong graphs -1

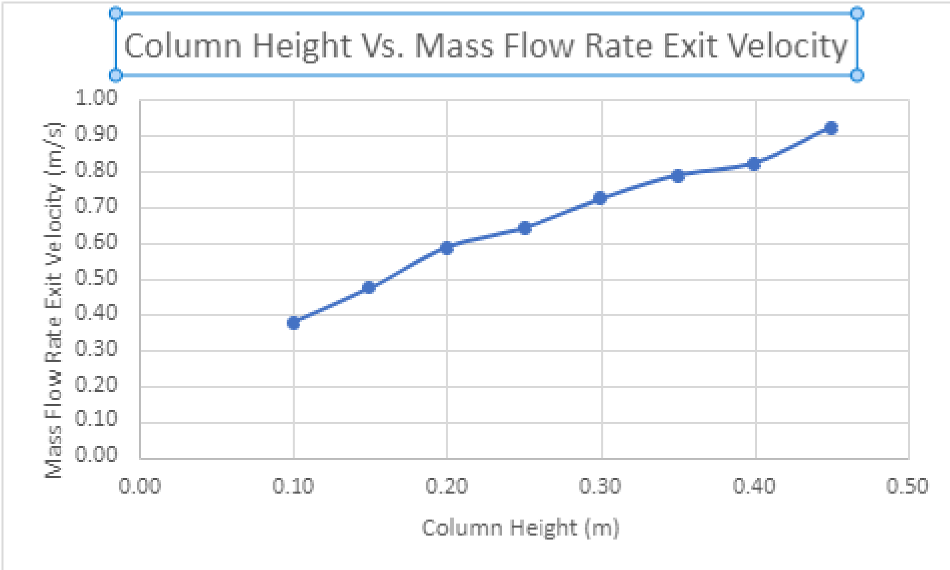

Figure 7: Water Column Height and Water Mass Flow Rate Exit Velocity

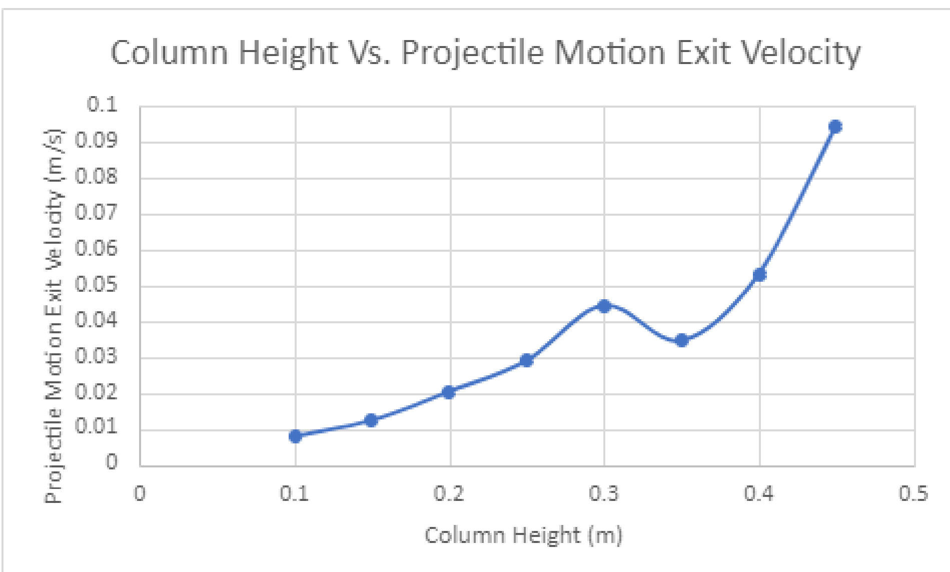

Figure 8: Water Column Height and Projectile Water Motion Exit Velocity.

SUMMARY:

The overall objective was to apply Torricelli principle along with Bernoulli's equation to the discharge of a tank and calculate various parameters. Overall, when comparing the theorical and experimental graph trend, they seem to have a similar graph shape. However, the values from theorical differed from experimental. The error could be in part from the lack of equation supplied by the laboratory manual as well as human error from either stopping the timer a little after the water reached an amount in the beaker. The recommendation from the students would include specific equations to calculate the desired charts.

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APPENDIX

References
Website: https://www.usgs.gov/special-topics/water-science-school/science/water-density#overview
Website: https://byjus.com/jee/acceleration-due-to-gravity/

"Lab 03 - ENGR4420_-_Torricelli Principle- Discharge of Tank Through an Orifice," ENGR 4420 – Engineering Lab Measurements, taught by Dr. Mazloum. Blackboard, Texas A&M University-Corpus Christi, 18 Nov 2023.

"The Leaking Bucket Lab's Theory and Procedure," ENGR 4420 – Engineering Lab Measurements, taught by Dr. Mazloum. Blackboard, Texas A&M University-Corpus Christi, 18 Nov 2023.

"Lab's Explanation Video - The Leaking Bucket," ENGR 4420 – Engineering Lab Measurements, taught by Dr. Mazloum. Blackboard, Texas A&M University-Corpus Christi, 18 Nov 2023.

"The Leaking Bucket's Virtual LAB," ENGR 4420 – Engineering Lab Measurements, taught by Dr. Mazloum. Blackboard, Texas A&M University-Corpus Christi, 18 Nov 2023.

Team Tasks:

Luis Hernandez: Conducted the experiment. Contributor to the report in various sections. Generated tables and graphs.
Julie Romano: Conducted the experiment. Contributor to the report in various sections. Collected data for the report.
Jaquelinne Azua: Conducted the experiment.

CALCULATION SHEET:

These equations were used in our Excel sheet to calculate with various parameters and the data collected.

$$Area\ of\ Orifice\ (AO) = \pi \cdot \left(\frac{DiameterOrifice}{2}\right)^2$$

$$Mass\ Flow\ Rate\ \left(\frac{g}{s}\right) = \frac{Capured\ Mass\ (g)}{Time\ (s)}$$

$$\Pr o\,jectile\ Motion\ Exit\ Velocity\ \left(\frac{m}{s}\right) = \frac{Horizontal\ \Pr o\,jectile\ (m)}{Time\ (s)}$$

$$\Pr o\,jectile\ Motion\ Volumetricic\ Flow\ \left(\frac{m^3}{s}\right) = \Pr o\,jectile\ Motion\ Exit\ Velocity \cdot \sqrt{\frac{1.07}{\pi}}$$

$$Mass\ Flow\ Rate\ Exit\ Velocity\ \left(\frac{m}{s}\right) = \frac{Mass\ Flow\ Rate}{Density\ of\ Water\ \cdot Diameter\ of\ Tube}$$

$$Mass\ Flow\ Rate\ Volumetric\ Flow\ \left(\frac{m^3}{s}\right) = Mass\ Flow\ Rate\ Exit\ Velocity\ \cdot Diameter\ of\ Tube$$

$$\Pr o\ jectile\ Time\ (s) = \frac{\sqrt{2 \cdot Height\ Orifice}}{9.81}$$

$$Horizontal\ \Pr o\ jectile\ (m) = \Pr o\ jectile\ Time\ \cdot \sqrt{2 \cdot 9.81 \cdot (Height - Height\ of\ Orifice)}$$

$$\Pr o\ jectile\ Velocity\ \left(\frac{m}{s}\right) = \frac{Horizontal\ \Pr o\ jectile}{\Pr o\ jectile\ Time}$$

$$Volumetric\ Flow\ Rate\ \left(\frac{m^3}{s}\right) = Diameter\ of\ Orifice\ \cdot \sqrt{2 \cdot 9.81 \cdot (Height\ - Height\ of\ Orifice)}$$

NOTES:

N/A

Presentation

N/A