University of San Carlos
Department of Chemical Engineering

CHE 3214L Chemical Engineering Laboratory Investigations 1

Experiment Plan

(Form CHE 3214L-1)

Prepared and submitted by:

Gibson Jake C. Canama | Monica Claire L. Delco | Rhoel A. Talandron

Experiment : **Fluid in Pipes 2: Flow Regime and Pressure Drop**

Objectives of the Experiment

1) Determine the flow regime of a liquid at a given set of flow parameters
2) Determine the effect of mass flowrate to the pressure drop of a liquid for a given pipe
3) Compare the obtained experiment values to the calculated, simulator values.

Methodological Framework

Objective 1: Determine the flow regime of a liquid at a given set of flow parameters.

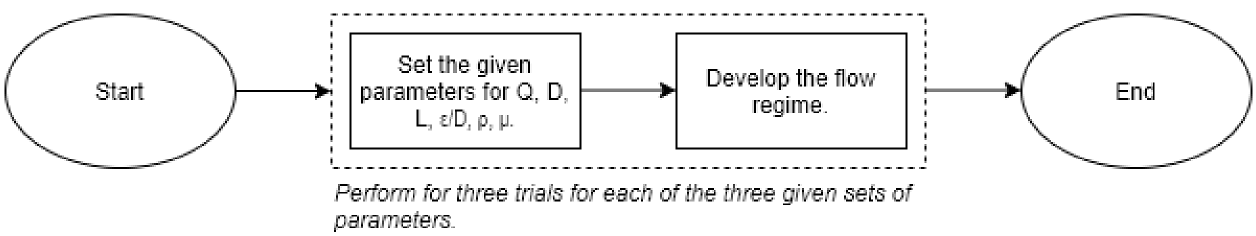


Figure 1. Methodological Framework for Objective 1

Objective 2: Determine the effect of mass flowrate to the pressure drop of a liquid for a given pipe.

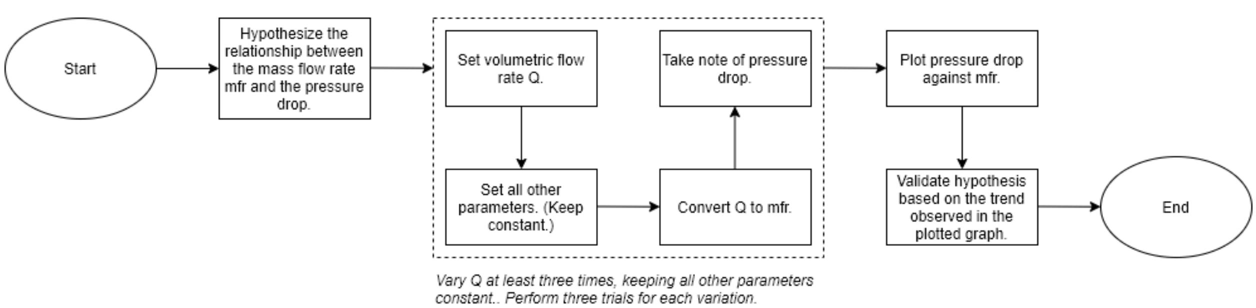


Figure 2. Methodological Framework for Objective 2

Objective 3: Compared the obtained experiment values to the calculated, simulator values.

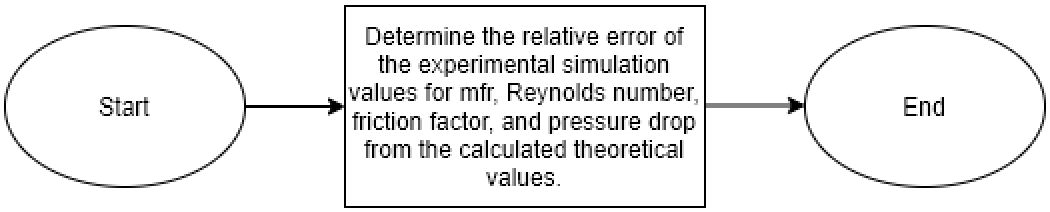


Figure 3. Methodological Framework for Objective 3

Materials, Measuring Apparatus & Equipment

Material	Quantity
Liquid	Density Range: $500\frac{kg}{m^3} - 1500\frac{kg}{m^3}$ Viscosity Range: $1000\ Pa.s - 1.5\ Pa.s$
Equipment	**Specifications**
Pipe	Diameter Range: $1cm - 50cm$ Unknown Material Length Range: $0m - 100m$

Task Plan

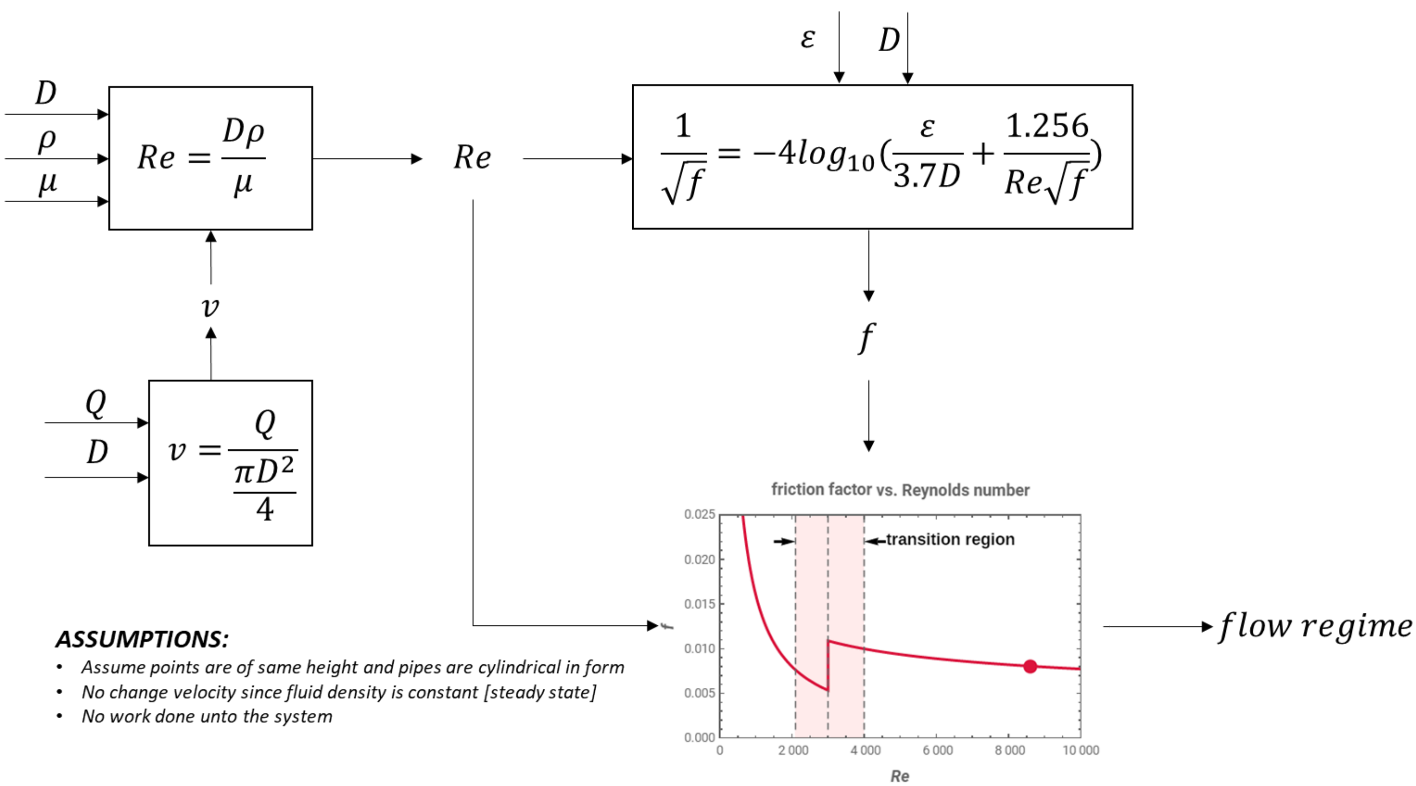
Time	Task	Person Responsible
1:30-3:00	Pre-Laboratory Virtual Questioning	Canama Delco Talandron
3:00 – 3:10	Open Virtual Laboratory Link > Frictional Pressure Drop in Pipe Simulator Taking note of the Conditions for RUN 1* Selection of Pipe Diameter Selection of Pipe Length Selection of Relative Roughness, $\frac{\varepsilon}{D}$ Selection of Fluid Density and Viscosity Selection of Volumetric Flow Rate Reading and Recording of Mass Flow Rate, Reynold's Number, Friction Factor, and Pressure Drop from Simulator Calculate the Mass Flow Rate, Reynold's Number, Friction Factor, and Pressure Drop using Given Data Resetting the Simulation Set-up for Next Pipe Diameter Run	Canama Delco Talandron (Note: Each member shall do the procedures **individually and simultaneously**)
3:10 – 3.20	Repetition of Procedures for RUN 2*	Canama Delco Talandron

		(Note: Each member shall do the procedures **individually and simultaneously**)
3:20 – 3:30	Repetition of Procedures for RUN 3*	Canama Delco Talandron (Note: Each member shall do the procedures **individually and simultaneously**)
3:30 – 4:00	Collection of Raw Data; Documentation Procedures; Plotting of Simulator and Calculated Data	Canama Delco Talandron
4:00 – 4:15	Analysis and Processing of Observed Mechanisms and Data Values from the Simulator	
4:15 – 4:30	Wrap-up of Discussions	

***The Selection of the Different Runs will be given by the Instructor herself.**

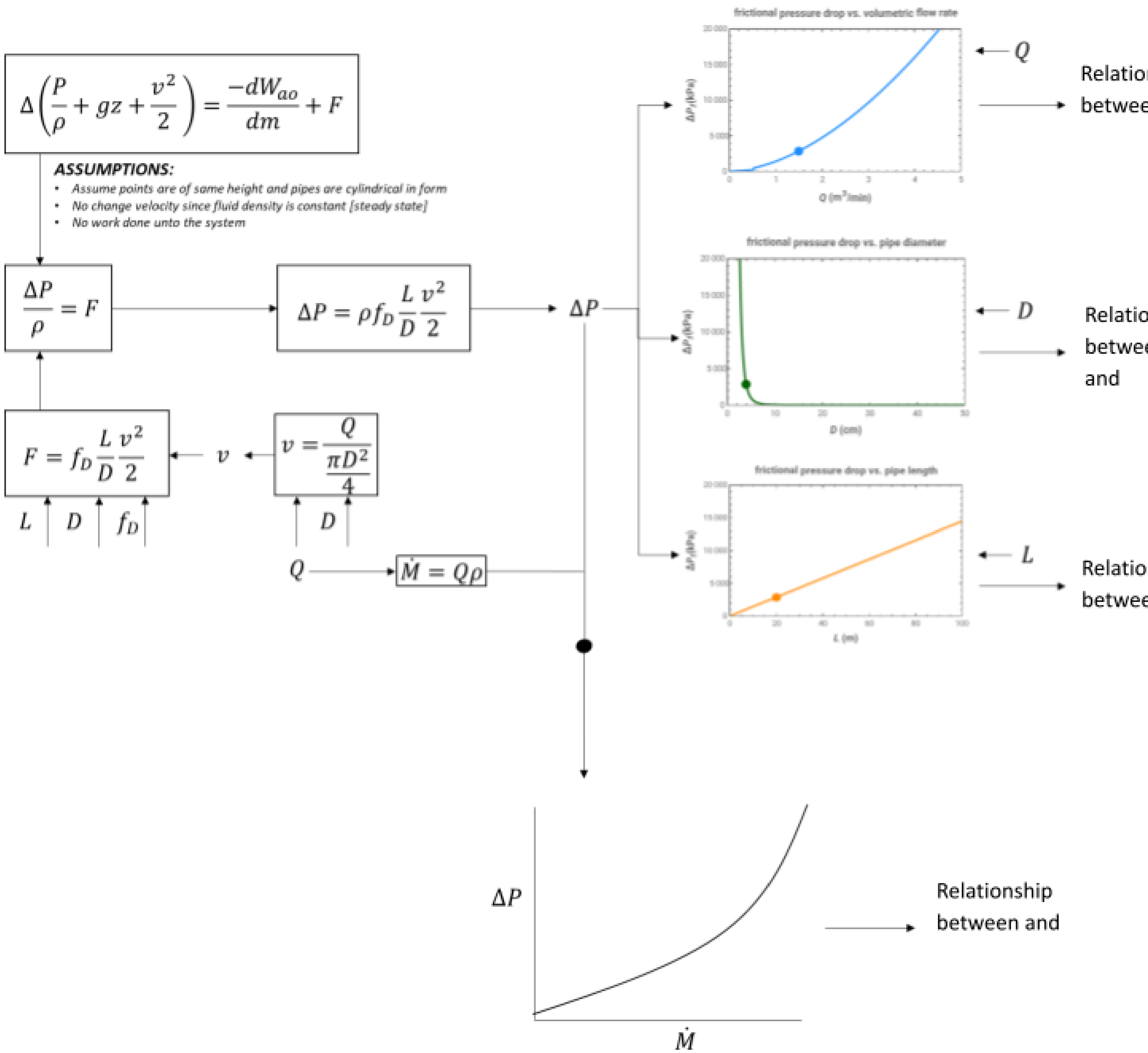
Information Flow Diagram

Objective 1: Determine the flow regime of a liquid at a given set of flow parameters.



ASSUMPTIONS:

- *Assume points are of same height and pipes are cylindrical in form*
- *No change velocity since fluid density is constant [steady state]*
- *No work done unto the system*



Δ(P/ρ + gz + v²/2) = −dW_ao/dm + F
ASSUMPTIONS:
Assume points are of same height and pipes are cylindrical in form
No change velocity since fluid density is constant [steady state]
No work done unto the system
ΔP/ρ = F
ΔP = ρ f_D (L/D)(v²/2)
F = f_D (L/D)(v²/2)
v = Q/(πD²/4)
L
D
f_D
Q
Ṁ = Qρ
ΔP
frictional pressure drop vs. volumetric flow rate
Q (m³/min)
frictional pressure drop vs. pipe diameter
D (cm)
frictional pressure drop vs. pipe length
L (m)
Relation
betwee
Relatio
betwee
and
Relatio
betwee
Relationship
between and
Ṁ

Objective 2: Determine the effect of mass flowrate to the pressure drop of a liquid for a given pipe

Objective 3: Compare the Obtained Experiment Values to the Calculated, Simulator Values

$$\Delta P$$

$$\Delta P_{expt}$$

$$\delta = \frac{\left|\Delta P - \Delta P_{expt}\right|}{\Delta P} \times 100\%$$

$$\delta$$

Legend:

$g = Acceleration\ due\ to\ Gravity \left(\frac{m}{s^2}\right) = 9.81 \frac{m}{s^2}$

$Q = Volumetric\ Flowrate\ \left(\frac{m^3}{min}\right)$

$F = Friction\ Term$

$z = height\ (cm)$

$D = Pipe\ Inner\ Diameter\ (cm)$

$L = Pipe\ Length\ (m)$

$v = Velocity\ \left(\frac{m}{s}\right)$

$f_D = Darcy - Weisbach\ Friction\ Factor$

$\varepsilon = Surface\ Roughness$

$\rho = Density\ of\ fluid\ (kg/m^3)$

$\mu = Viscosity\ of\ Fluid\ (Pa.s)$

$Re = Reynold's\ Number$

$\Delta P_{expt} = Experimental\ Pressure\ Drop\ from\ Simulator\ (kPa)$

$\Delta P = Pressure\ Drop\ (kPa)$

$\delta = Relative\ Error\ (\%)$

$\dot{M} = Mass\ Flowrate\ (kg/min)$

Raw Data Sheets

CANAMA: Raw Data and Documentation

Table 1.1 Raw Data Set for Objective 1

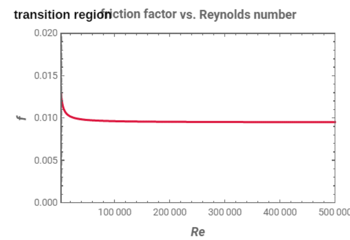
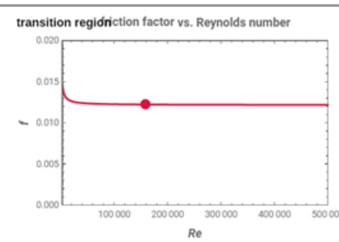
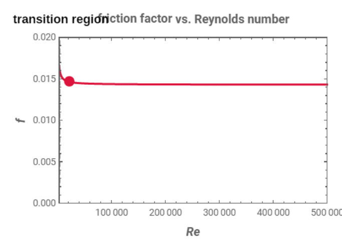
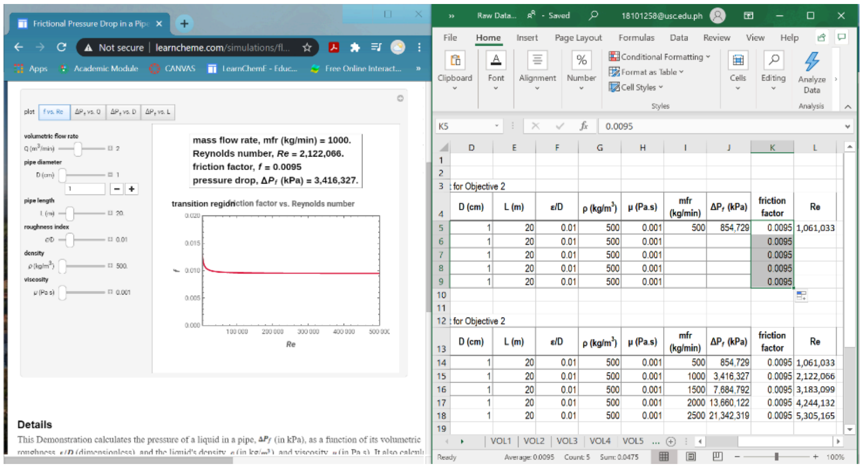
Run	Q (m^3/min)	D (cm)	L (m)	ε/D	ρ (kg/m^3)	μ (Pa.s)	Flow Regime (screenshot)
1	1	1	20	0.01	500	0.001	
2	2	2	40	0.02	750	0.01	
3	3	3	60	0.03	1000	0.1	

Table 1.2 Raw Data Set for Objective 2

Run	Q (m^3/min)	D (cm)	L (m)	ε/D	ρ (kg/m^3)	μ (Pa.s)	mfr (kg/min)	ΔP_f (kPa)
1	1	1	20	0.01	500	0.01	500	854,729
2	2						1000	3,416,327
3	3						1500	7,684,792
4	4						2000	13,660,122
5	5						2500	21,342,319

Observations:

As the parameters increases in its value, the closer it is towards the transition region. Further, the point in the graph shows where the condition is situated in the Moody chart. Thus, it can be inferred, based on the value of Re, that the flow of the pipe is at turbulent regime.



for Objective 2

D (cm)	L (m)	ε/D	ρ (kg/m³)	μ (Pa.s)	mfr (kg/min)	ΔP_f (kPa)	friction factor	Re
1	20	0.01	500	0.001	500	854,729	0.0095	1,061,033
1	20	0.01	500	0.001			0.0095	
1	20	0.01	500	0.001			0.0095	
1	20	0.01	500	0.001			0.0095	
1	20	0.01	500	0.001			0.0095	

for Objective 2

D (cm)	L (m)	ε/D	ρ (kg/m³)	μ (Pa.s)	mfr (kg/min)	ΔP_f (kPa)	friction factor	Re
1	20	0.01	500	0.001	500	854,729	0.0095	1,061,033
1	20	0.01	500	0.001	1000	3,416,327	0.0095	2,122,066
1	20	0.01	500	0.001	1500	7,684,792	0.0095	3,183,099
1	20	0.01	500	0.001	2000	13,660,122	0.0095	4,244,132
1	20	0.01	500	0.001	2500	21,342,319	0.0095	5,305,165

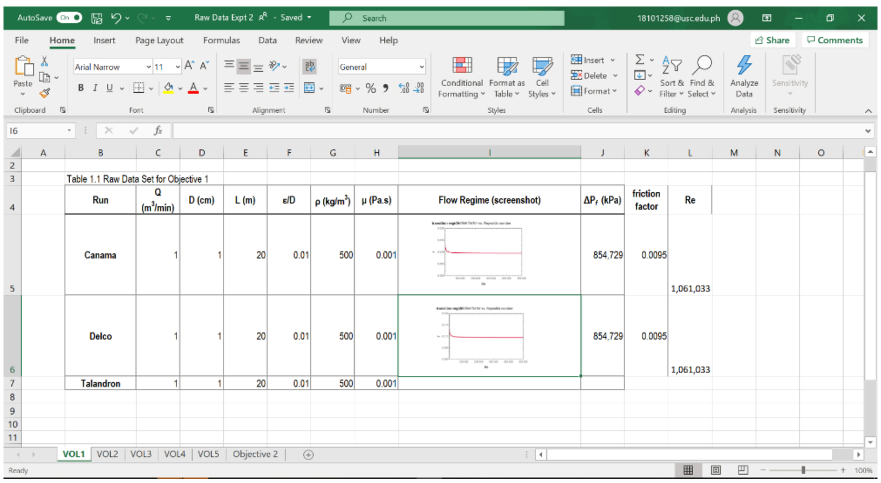
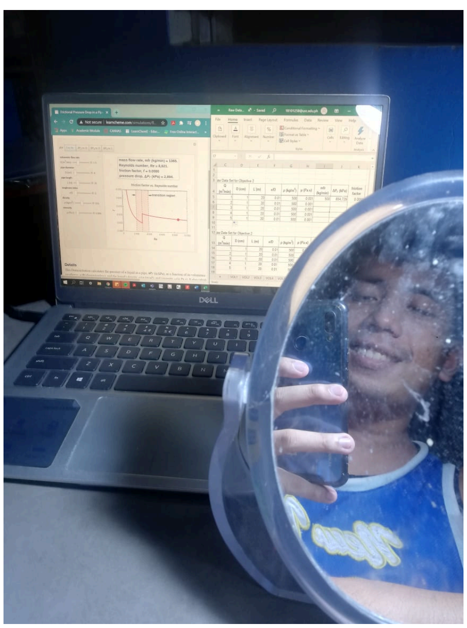


Table 1.1 Raw Data Set for Objective 1

Run	Q (m³/min)	D (cm)	L (m)	ε/D	ρ (kg/m³)	μ (Pa.s)	Flow Regime (screenshot)	ΔP_f (kPa)	friction factor	Re
Canama	1	1	20	0.01	500	0.001		854,729	0.0095	1,061,033
Delco	1	1	20	0.01	500	0.001		854,729	0.0095	1,061,033
Talandron	1	1	20	0.01	500	0.001				



DELCO: Raw Data and Documentation

Table 2.1 Raw Data Set for Objective 1

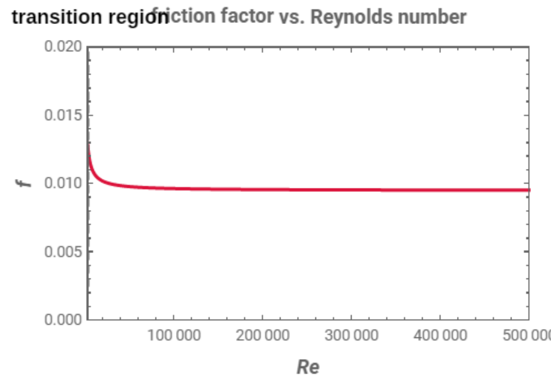
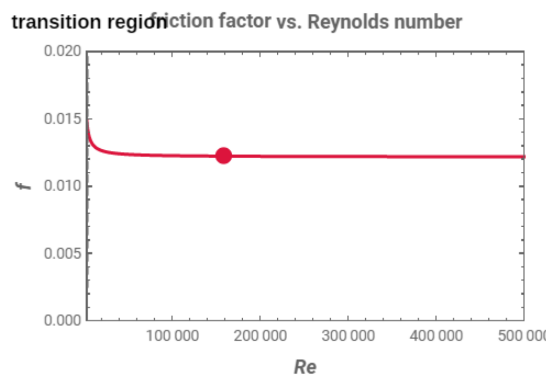
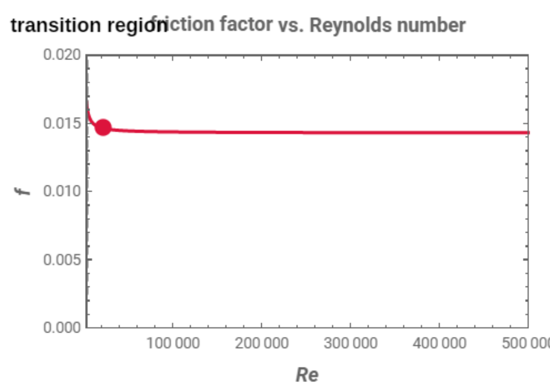
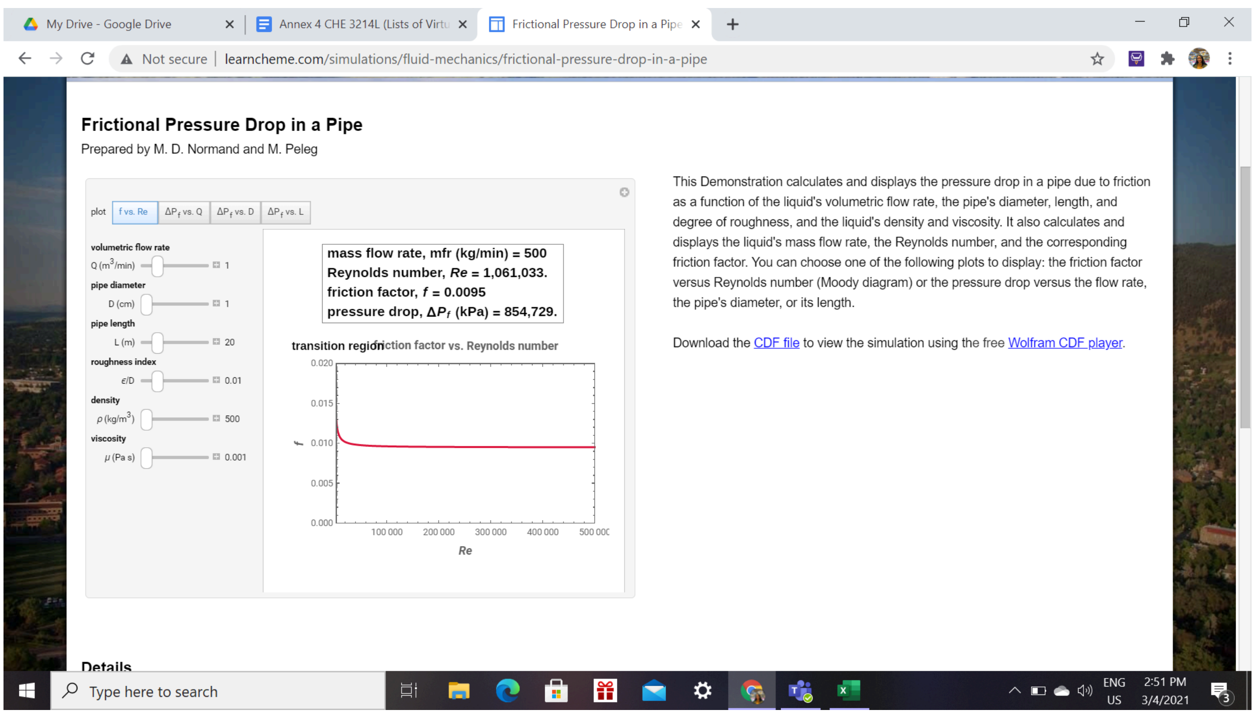
Run	Q (m^3/min)	D (cm)	L (m)	ε/D	ρ (kg/m^3)	μ (Pa.s)	Flow Regime (screenshot)
1	1	1	20	0.01	500	0.001	
2	2	2	40	0.02	750	0.01	
3	3	3	60	0.03	1000	0.1	

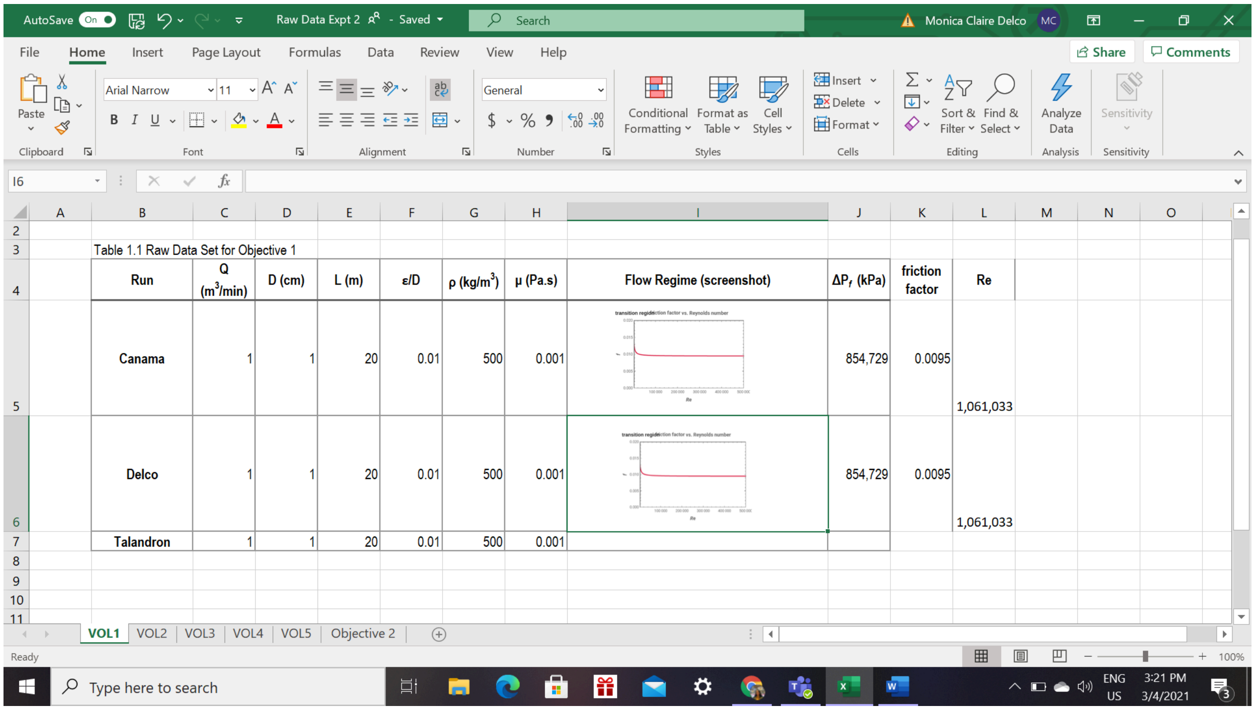
Table 2.2 Raw Data Set for Objective 2

Run	Q (m^3/min)	D (cm)	L (m)	ε/D	ρ (kg/m^3)	μ (Pa.s)	mfr (kg/min)	ΔP (kPa)
1	1						500	854,729
2	2						1000	3,416,327
3	3	1	20	0.01	500	0.001	1500	7,684,792
4	4						2000	13,660,122
5	5						2500	21,342,319

Observations:

Frictional pressure drop increases as mfr increases.





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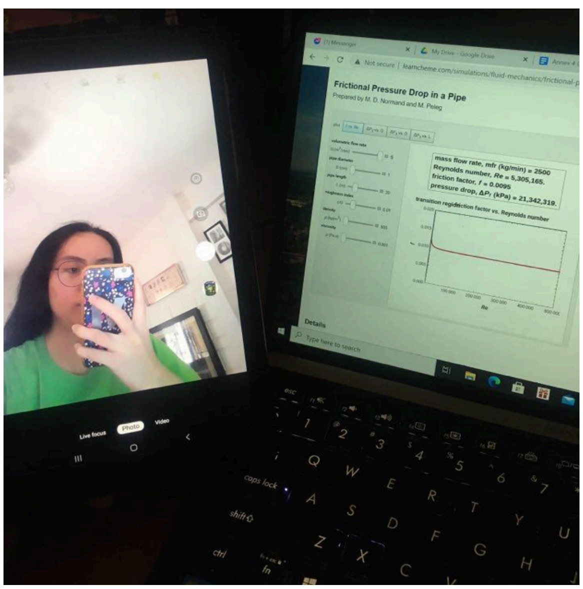
Canama	1	1	20	0.01	500	0.001		854,729	0.0095	1,061,033
Delco	1	1	20	0.01	500	0.001		854,729	0.0095	1,061,033
Talandron	1	1	20	0.01	500	0.001				



TALANDRON: Raw Data and Documentation

Table 3.1 Raw Data Set for Objective 1

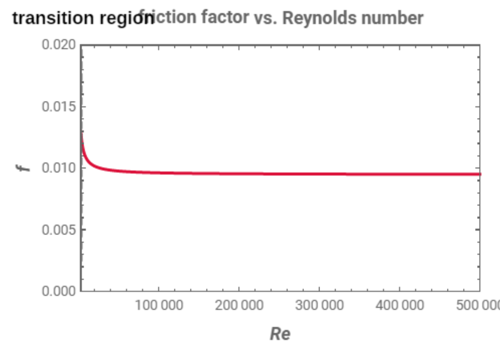
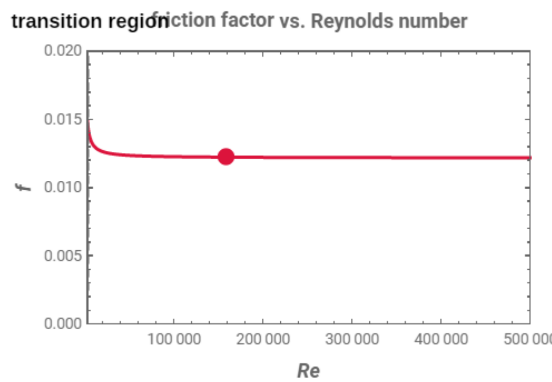
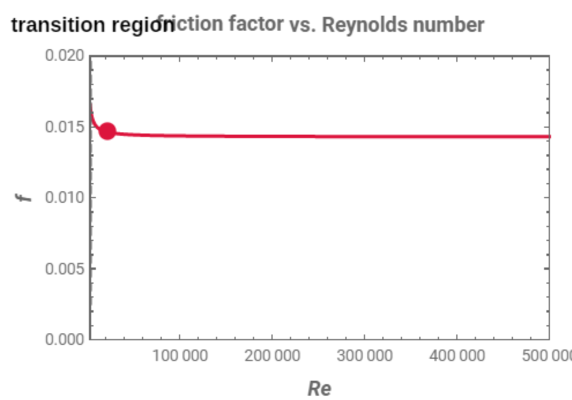
Run	Q (m^3/min)	D (cm)	L (m)	ε/D	ρ (kg/m^3)	μ (Pa.s)	Flow Regime (screenshot)
1	1	1	20	0.01	500	0.001	
2	2	2	40	0.02	750	0.01	
3	3	3	60	0.03	1000	0.1	

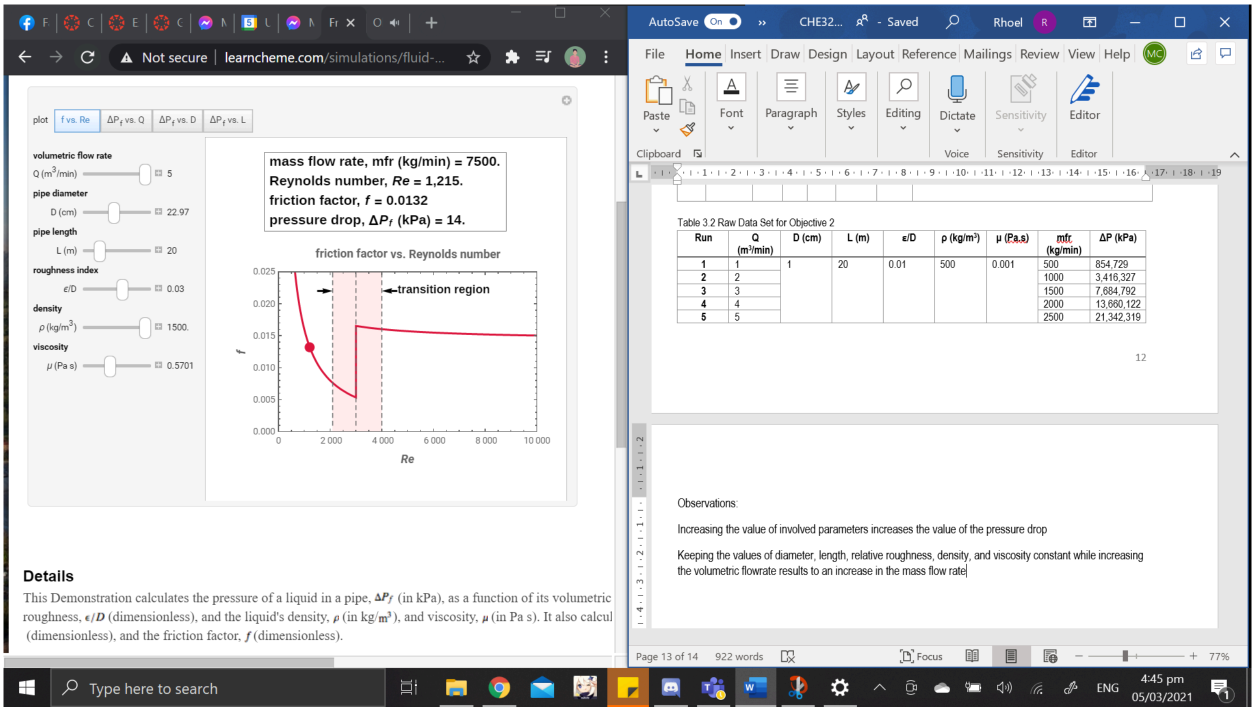
Table 3.2 Raw Data Set for Objective 2

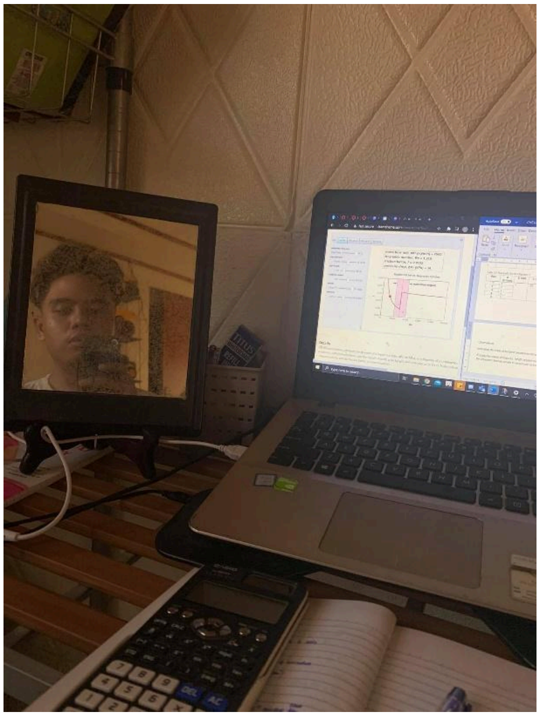
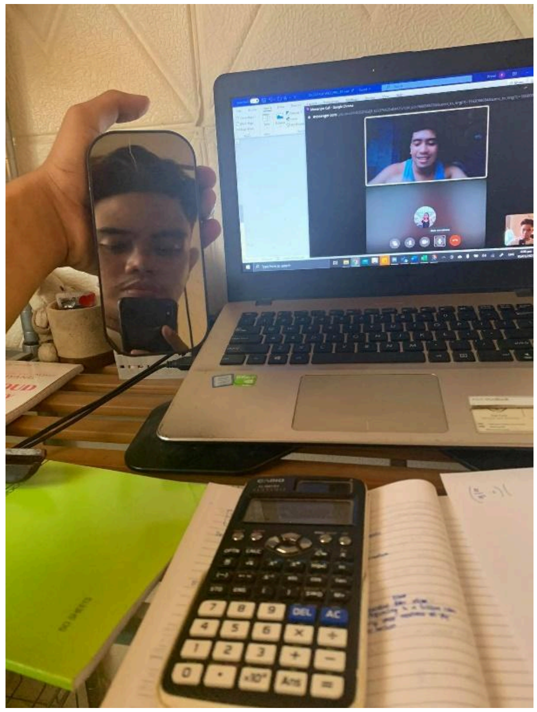
Run	Q (m^3/min)	D (cm)	L (m)	ε/D	ρ (kg/m^3)	μ (Pa.s)	mfr (kg/min)	ΔP (kPa)
1	1						500	854,729
2	2						1000	3,416,327
3	3	1	20	0.01	500	0.001	1500	7,684,792
4	4						2000	13,660,122
5	5						2500	21,342,319

Observations:

Increasing the value of involved parameters increases the value of the pressure drop

Keeping the values of diameter, length, relative roughness, density, and viscosity constant while increasing the volumetric flowrate results to an increase in the mass flow rate



TEAM MEETING DOCUMENTATION

Gibson
oks na atong EP?

12:13 PM

Monica
okayhan na kooo

Gibson
ang kining mass flow rate?

dili diay vol flowrate ang naa sa simulator?

Gibson
yeah pero ang obj is mass flow rate

Monica
volumetric

mon

wdym