TITLE: Fractional D.....of Cyclopentane and Cyclohexane **Partner?**

Purpose: The purpose of the lab is to:

- Separate a 40% cyclopentane and 60% cyclohexane by boiling point using fractional distillation.
- Use GC to id compounds from TR
- Use gas chromatography, Anorm to determine the composition of four mixtures.....
- Use gas chromatograph to compare the composition of distilled mixtures to determine success of distillation.
- -Use Dist. Plot to evaluate separation

Reference:

1. Kateley, L. J., *Introduction to Chemistry in the Laboratory*, *20th Ed.*, Lake Forest College, **2021,** Experiment 2, Appendix E_Excel
2. Kateley, L. J., *Introduction to Chemistry in the Laboratory, 20th Ed.*, Lake Forest College, **2021**, Experiment 2, Appendix I_PowerChrom

Observations and Data:

Apparatus

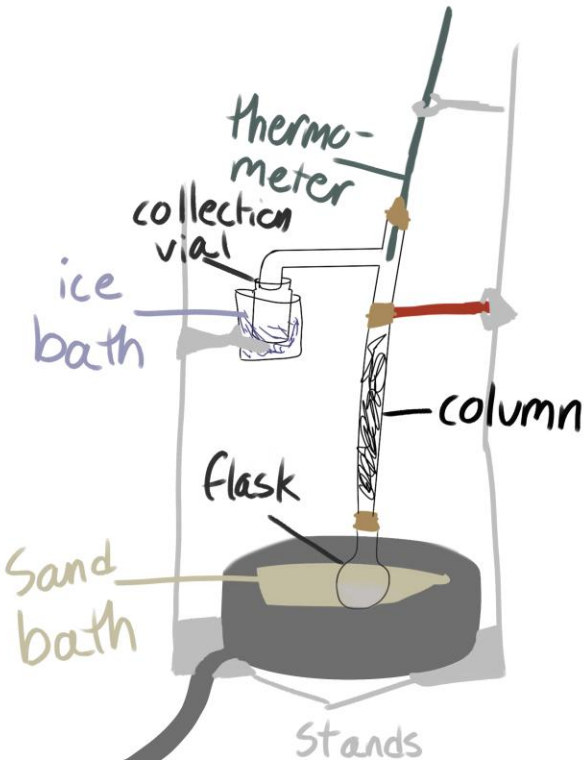

Figure 1. Apparatus set-up for distillation

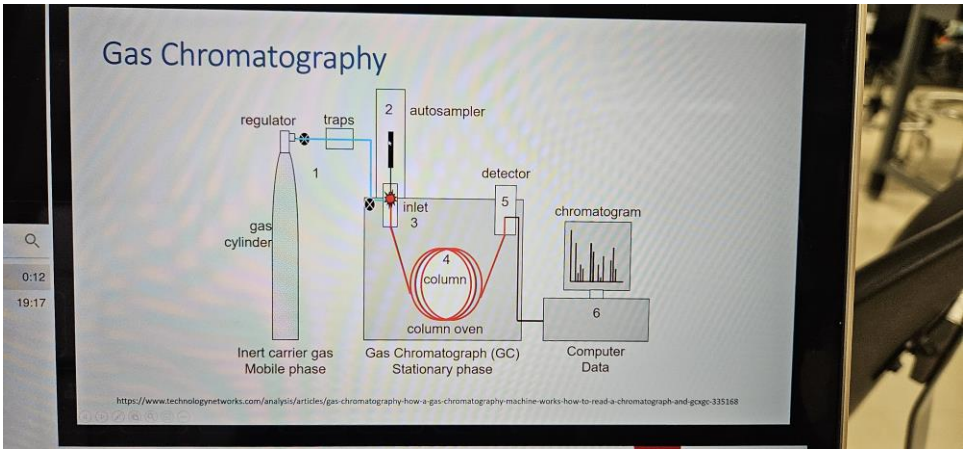

Figure 2. Apparatus gas chromatographer

	MW(g/mol)	BP(°C)
Cyclopentane (C_5H_{10})	70.1	49.2

Cyclohexane (C_6H_{12})	84.2	80.7

Table 1. Molecular properties of cyclopentane and cyclohexane

The stainless-steel sponge in the column helps the distillation process by creating a surface for the vapor to condense on. As the vapor condenses, it heats up the metal until the metal is hot enough to re-vaporize the compounds.

Distillation

- Was Mixed, 2mL cyclopentane (40%) and 3mL cyclohexane (60%) to make a clear colorless liquid
- 1 mL saves in mixture vial
- Remaining 4mL added to round flask
- Original temperature of thermometer was 24.5°C
- Powermite heater turned to power level 4
- 18 drops of distilled compound (cyclopentane) collected in vial F1
- Powermite heater turned up to 6.5
- 35 drops of distilled compound were collected in vial F2
- 0.8mL of a mostly cyclohexane mixture remained after distillation

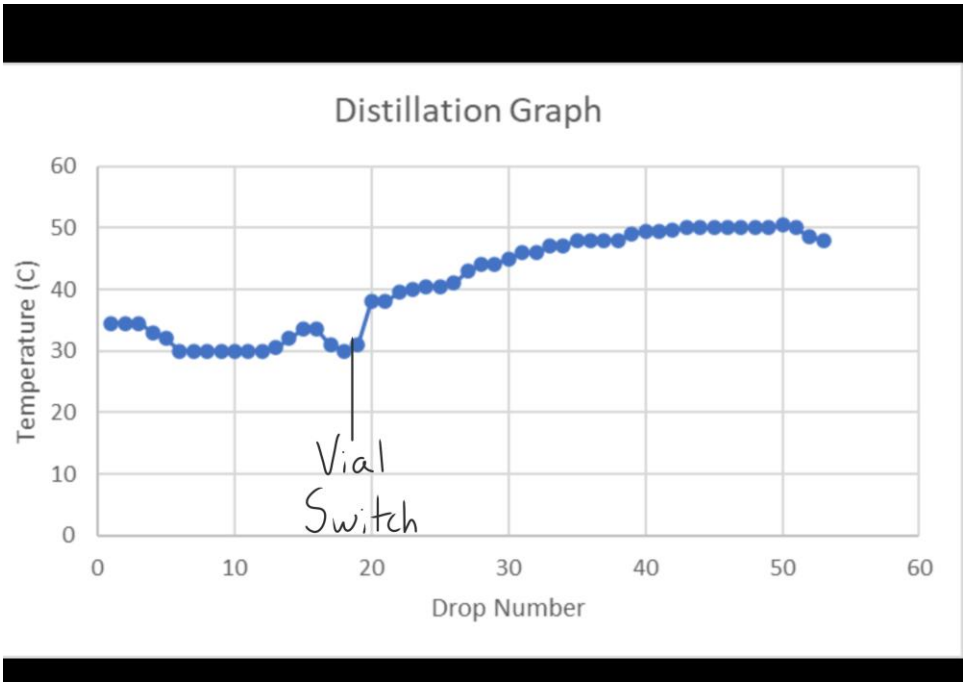

Figure 3. Distillation plot of drops over time

Gas Chromatography

Original Mixture

Peak	Fill	Peak Name	t_R (min)	t_S (min)	t_E (min)	H (V)	H_{Norm}	A (V.s)	A_{Norm}	$W_{0.1}$	Asym	Effic	Res	Type	Amount
1		cyclopentane	0.20	0.11	0.25	0.98	50.00	1.24	46.27	0.03	0.57	864		BD	
2		cyclohexane	0.29	0.25	0.37	0.98	50.00	1.44	53.73	0.03	0.42	1505	3.36	DB	
						1.97	100.00	2.68	100.00						0.000

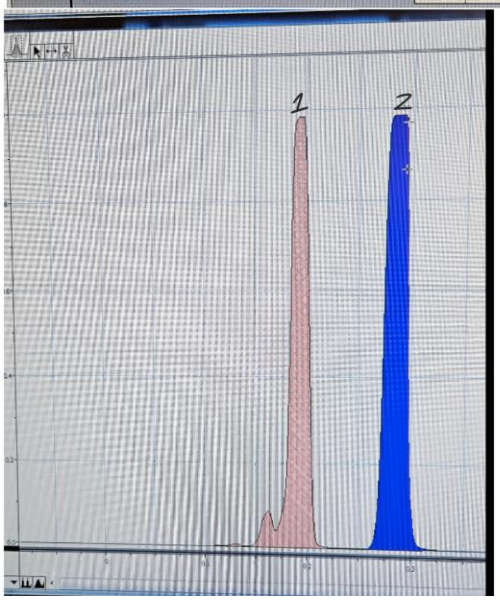

Figure 4. Gas Chromatograph of Mixture

Distillation 1 (F1)

port for Gina and Ilana F1.pfwdat

annel 1

Fill	Peak Name	t_R (min)	t_S (min)	t_E (min)	H (V)	H_{Norm}	A (V.s)	A_{Norm}	$W_{0.1}$	Asym	Effic	Res	Type	Amount
	1	0.20	0.12	0.27	0.98	82.44	0.93	85.19	0.02	0.54	1436		BD	
	2	0.29	0.27	0.35	0.21	17.56	0.16	14.81	0.02	0.67	2981	4.31	DB	
					1.19	100.00	1.09	100.00						0.000

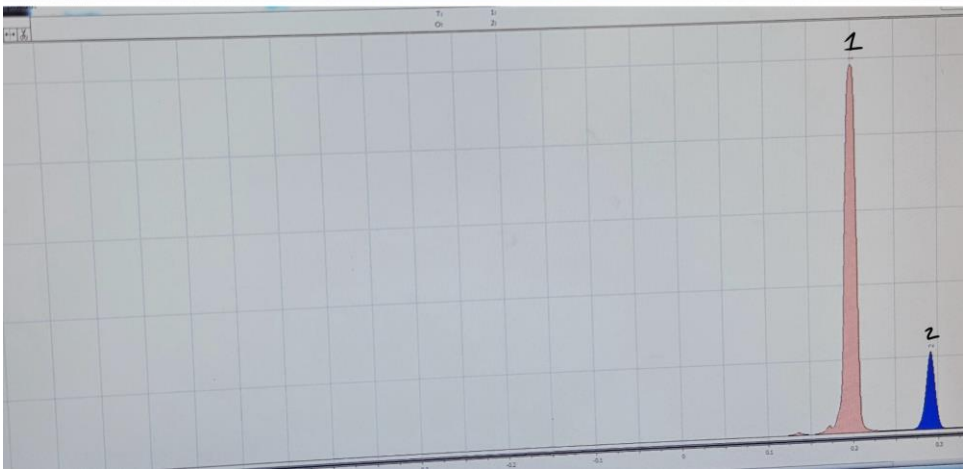

Figure 5. Gas Chromatograph of F1

Distillation 2(F2)

Peak Report for Gina and Ilana F2.pfwdat

Channel 1

Peak	Fill	Peak Name	t_R (min)	t_S (min)	t_E (min)	H (V)	H_{Norm}	A (V.s)	A_{Norm}	$W_{0.1}$	Asym	Effic	Res	Type
1		1	0.19	0.15	0.26	0.98	49.81	0.71	27.53	0.02	1.26	1938		BV
2		2	0.30	0.26	0.37	0.98	50.19	1.86	72.47	0.04	0.39	1026	3.87	VB
						1.96	100.00	2.56	100.00					

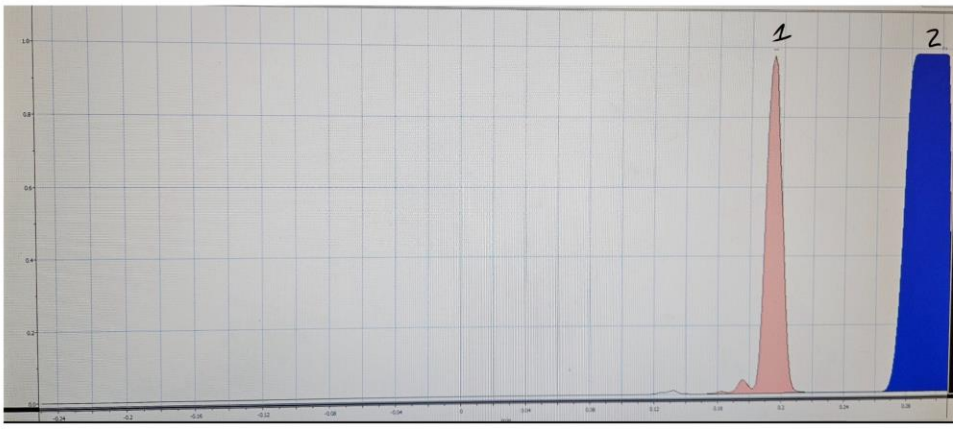

Figure 6. Gas Chromatograph of F2

Remainder

Fill	Peak Name	t_R (min)	t_S (min)	t_E (min)	H (V)	H_{Norm}	A (V.s)	A_{Norm}	$W_{0.1}$	Asym	Effic	Res	Type	Amount
		0.20	0.15	0.23	0.14	12.16	0.07	6.06	0.01	0.96	3353		BB	
		0.30	0.26	0.38	0.98	87.84	1.12	93.94	0.03	0.65	2286	4.91	BB	
					1.12	100.00	1.19	100.00						0.000

Figure 7. Chromatograph of remaining mixture

Instrument	HP5890
Oven	50ºC
Injector	120°C
Detector	150°C
Split vent flow	44-45mL/min
Column flow	35mL/min
Sample size	needle bleed
Column Restek 5	Crossbond® 5%diphenyl/95%dimethy polysiloxane
Column length	15 meters
Column inside diameter	0.53mm
Column catalog number	10252
Serial number	118671A

Table 2. Gas chromatographer information

Conclusion:

1. **It? shows a small jump in temperature between the distillation of the cyclopentane and the cyclohexane. This shows that cyclopentane has a lower vaporization/ boinling point than cyclohexane.**
2. **The distillation temperatures where lower than the boiling point of the molecules. Cyclopentane has a boiling point of 49.2 °C but drops formed at temperatures as low as 30°C. Cyclohexane has a boiling point of 80.7°C but most drops formed around around 48 °C.**
3.

	Mixture	Distillation One	Distillation 2	Remainder
Cyclopentane	0.20	0.20	0.19	0.20
Cyclohexane	0.29	0.29	0.30	0.30

Table 3. Retention Time

Cyclohexane's larger molecular weight and surface area may factor in to its longer retention time.

4.

	Mixture	Distillation One	Distillation 2	Remainder
Cyclopentane	46.27	85.19	27.53	6.06
Cyclohexane	53.73	14.81	72.47	93.94

Table 4. A_{norm}

Distillation One has a higher percentage of cyclopentane than the original mixture while distillation two has a higher percentage of cyclohexane than the original mixture. The remainder has the highest percentage of cyclohexane suggesting that it is the most cyclohexane enriched mixture.

5.

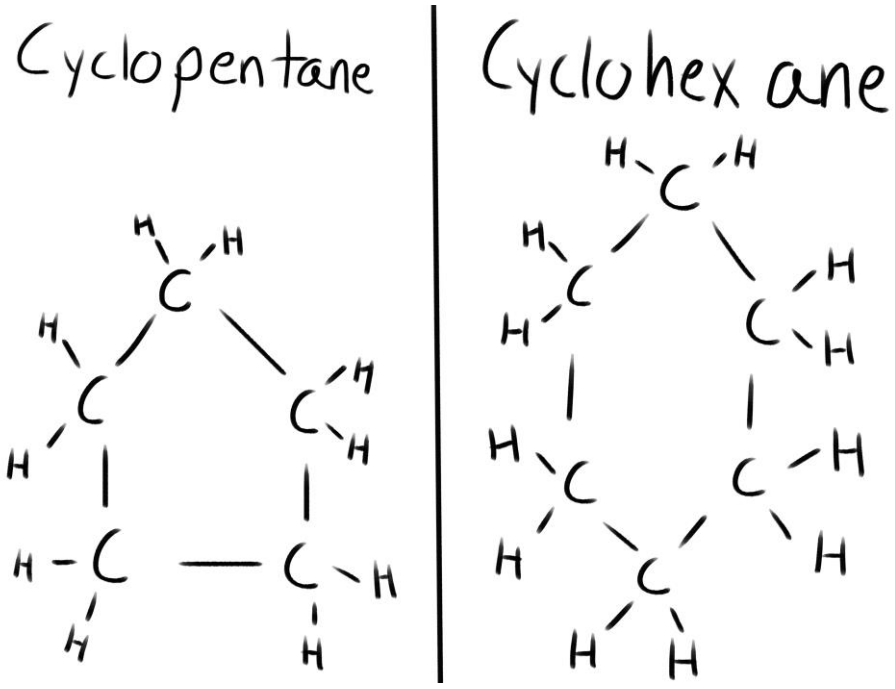

Figure 8. Lewis structures of cyclopentane and cyclohexane

5. The distillation was relatively successful. Each distillation was enriched with the ideal compound however none of the distillations isolated the mixture into a pure compound. The divide between cyclopentane and cyclohexane on the temperature vs volume graph was also quiet minor.