Name: _____

Separation of a Mixture Using Paper Chromatography

**Based on Experiment 2D in the Heath Lab Manual*

Objectives:

1) To assemble and operate a paper chromatography apparatus.

2) To study the meaning and significance of R_f values.

3) To test various food colourings and to calculate their R_f values.

4) To compare measured R_f values with standard R_f values.

5) To separate mixtures of food colouring into their component colours.

6) To identify the components of mixtures by means of their R_f values.

Materials:

Red food colouring	Green food colouring	Unknown food colouring
3 Erlenmeyer Flasks	3 glass test tubes	Chromatography Paper
Water	Scissors	Pencil
Ruler		

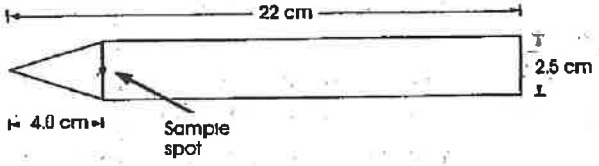
Procedure:

1) Put the three test tubes into the three Erlenmeyer flasks.

2) Using the scissors, pencil, and ruler, cut one 70 *cm* strip of chromatography paper.

3) From the 70 *cm* strip, cut three 22 *cm* strips. Four centimetres from the bottom of each strip, make a line with a ruler and then cut a triangle, as seen below:

Figure 1:

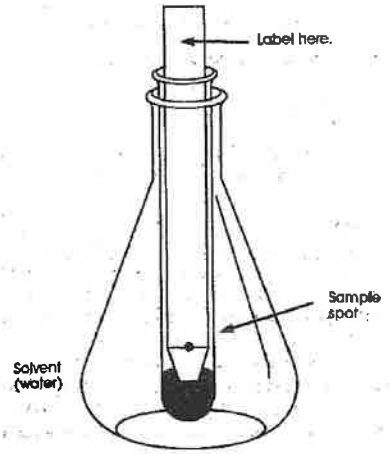


4) Place water in each test tube about 2 *cm* deep (half the triangle).

5) At the food colouring station, using a capillary tube or a toothpick (whichever is supplied), make a sample spot (as seen above) on each of the three chromatography strips. One sample is the red food colouring, one is the green, and the third is the unknown. Label each strip at the top with a pencil.

6) Carefully put each strip into a test tube so that the point of the triangle just touches the bottom of the test tube. Make sure the strip is not bent or curved.

Figure 2:



7) Observe the water (solvent) carry the food colouring (solute(s)) up the strip. **Each component (primary) colour solute that makes up the food colouring will dissolve in the solvent and travel a different distance up the strip due to the capillary action of the solvent. Some solutes are more soluble in the solvent and so travel higher, while some solutes adsorb to the paper strip better and don't travel with the solvent front as far.*

8) When the solvent has reached two-thirds to three-quarters high on the strip, remove the strips and place them on paper towel to dry. Wait a few minutes for the water to stop moving, and then label the height of the water with a pencil before it dries out. Call this the '*solvent front*'.

9) Label each *solute front* with its primary colour name on the strip so that all three strips are fully labeled.

10) With a *centimeter* ruler, measure the solvent and solute(s) fronts on each strip from the pencil line where the sample spot was placed, and write the

measurement neatly on the strip. Be sure to measure with correct significant figures.

11) Transfer all quantitative data to Table 1, and calculate the R_f value (with correct significant figures) for each solute in each strip. **Each primary colour is made up of an industry standard dye, and each different standard dye has its own specific R_f value, due to its unique properties.*

12) Clean up test tubes and flasks. Wash down the station and wash hands with soap.

13) Each member of the group will take one fully labeled chromatography strip to attach to lab report as an *Appendix*, which is the last subheading in the report.

Data and Observations:

Table 1 – Chromatography Data and R_f Calculation and Analysis

Food Colouring	Component Colour	Solute Height (*cm*)	Solvent Height (*cm*)	R_f value (solute/solvent)	Industry Dye from Table 2
Red					
Green					
Unknown					

Table 2 – Industry Primary Dye R_f Values

Dye	Red #2	Red #3	Red #4	Yellow #5	Yellow #6	Blue #1	Blue #2
R_f	0.81	0.41	0.62	0.95	0.77	1.0	0.79

Sample Calculations:

**Pick one solute from any of the three samples, tell the reader which it is, then show one R_f calculation by giving the general formula, then substitute in the data (with units), then give the R_f with correct significant figures.*

Questions:

1) What is the lowest possible R_f value? What is the highest? Explain why for each.

2) Discuss, quantitatively, the precision (clustering) of the experimental R_f values for blue. Can you conclude that the blue samples are the same industry dye? Which one? How accurate are the experimental R_f values compared to the chosen blue industry dye?

3) Discuss, quantitatively, the precision (clustering) of the experimental R_f values for yellow. Can you conclude that the yellow samples are the same industry dye? Which one? How accurate are the experimental R_f values compared to the chosen yellow industry dye?

4) How come pencil was used for the sample line instead of pen?

Conclusion:

Restate and comment on Objective 6, and where the reader can view these results.

Appendix:

On a blank white sheet, affix the fully labeled chromatography strip.

Chemistry 11 Lab Marking Rubric – *Chromatography*

Name: _____

Lab Report Component	Mastery	High Achievement	Basic Achievement	Non- Achvmt	Student Evaluation	Teacher Evaluation (score/ notes)
Headings	A descriptive lab title is clearly present at the beginning of the lab report and all subsequent subheadings are present and properly formatted. Name and date are in the upper right hand corner of the report (1)		There are error(s) in the title and subheadings, or name is not present. (0.5)	A lab title &/or subheadings are missing from the lab report (0)		
Objectives, Materials, Procedure	The objective(s), materials, and procedure are stated accurately (1)		The objective(s), and/or materials, and/or procedure are stated but are not accurate (0.5)	The objective, materials, or procedure is not included in lab report (0)		
Data & Observations	Data is complete **with proper significant figures** and is presented in titled, neat tables. All proper units are included. (3)	Data is complete but may not be presented in a neat manner, or is missing some proper units, or has one or two calc, sig fig errors, or tables are not titled. (2)	Data is incomplete (missing measurements, observations, or given information, many improper calcs, sig figs, no units) (1)	Data is not present in the lab report (0)		
Sample Calculations	A sample of the Rf calculation is correctly presented in a neat, orderly fashion with formulas and units present. Sig. Figs. are correct. (2)	A sample of all calculations is present but: - includes minor errors, or -is not presented in a neat, orderly fashion, or -is missing formulas or units, or -sig. figs. are not correct. (1)	Some sample calculations are missing from the lab report or There are some major errors in the calculations (0.5)	The calculations are in complete error or are missing from the report. (0)		
Questions	All questions are answered in complete sentences, showing correct calculations as needed with accurate units and sig figs. **Answers use lab results to support statements.** Answers are complete, cohesive, and concise, and supported by results (6)	Some questions not answered in complete sentences or not answered adequately or correctly, some work not shown, some sig figs and/or units incorrect. Answers aren't always supported by lab results. (5 / 4)	Complete sentences not used, no work shown, may inadequate or incorrect answers, major sig fig errors in many questions, no connection between lab results and answers (3 / 2 / 1)	Question answers not present (0)		
Conclusion	The pertinent objectives are restated and answered and/or commented upon relating to the results of the experiment. Location in write-up referenced (2)	Objectives are not restated, or answers and/or comments are not quite complete, location in write-up not referenced, or incorrectly (1)	Major errors in conclusion such as an attempt that does not address the pertinent objectives (0.5)	No Conclusion. (0)		
Appendix	Subheading present, strip is labeled with title and solute and solvent measurements. Neatly done. (1)		Errors in Appendix or messy. (0.5)	No Appendix (0)		
Overall Neatness	Clear and neat, spaced out appropriately (1)		Ruler not used throughout, scribbles, whiteout used, messy printing, very small font, scrunched info. (0.5)	Difficult to Decipher / no ruler (0)		
TOTAL	----------	----------	----------	----------	/17	/17