

SI Chemistry - Full Discipline Demo

Chromatography of Food Dyes

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Categorize the following statements as true or false.

⚡ An adsorbent is a solid that lacks affinity for the solvent and the chemical components of the mixture.	
⚡ Chromatography is a technique commonly used to separate mixtures of chemical compounds into their constituent components.	
⚡ The choice of a solvent in paper chromatography is unimportant.	
⚡ The leading edge of the solvent, as it moves up the chromatography paper, is called the solvent front.	
True	False
1	2

Correct answers:

1

Chromatography is a technique commonly used to separate mixtures of chemical compounds into their constituent components.

The leading edge of the solvent, as it moves up the chromatography paper, is called the solvent front.

2

An adsorbent is a solid that lacks affinity for the solvent and the chemical components of the mixture.

The choice of a solvent in paper chromatography is unimportant.

Match each type of chromatography with the best description.

⚡ Gas ⚡ Liquid ⚡ Paper ⚡ Thin-layer	➡	Solid particles are spread over a flat glass or plastic surface and a solvent is allowed to travel up through the solid particles	1	
		Solvent travels over a column of tiny beads	2	
		Vapor travels over a column of tiny beads	3	
		A sheet of cellulose is placed in a liquid, which travels up the sheet	4	

Correct answers:

1 Thin-layer 2 Liquid 3 Gas 4 Paper

Match the R_f value to the appropriate paper chromatography results.

R_f Value ⚡ $R_f = 0.91$ ⚡ $R_f = 0.46$	➡	Solvent distance = 68 mm, Dye distance = 31 mm	1	
		Solvent distance = 64 mm, Dye distance = 58 mm	2	

Correct answers:

1 $R_f = 0.46$ 2 $R_f = 0.91$

Exploration

The two phases of chromatography are the ____.

- ☐ solid phase and mobile phase
- ☐ solid phase and soluble phase
- ☒ stationary phase and mobile phase
- ☐ stationary phase and column phase

✓

Liquid and gas chromatography are also called ____ chromatography due to the equipment design.

- ☒ column
- ☐ particle
- ☐ adsorbent
- ☐ eluent

✓

Chromatogram results are considered to have better resolution if the R_f values of the components being separated are farther apart rather than closer together.

- ☒ True
- ☐ False

✓

FD&C dyes are specific dyes banned from human consumption under the Food, Drugs and Cosmetics Act.

- ☐ True
- ☒ False

✓

R_f values are calculated by dividing the ____ by the ____.

- ☐ solvent front distance; center of compound distance from base line
- ☒ distance the compound moved; solvent front distance
- ☐ length of compound spot; width of compound spot
- ☐ number of compound spots; mass of solution

✓

Exercise 1

What might happen if a student used a pen to mark the baseline on the chromatography paper?

If I used a pen to mark the baseline, the dye in the pen would run up the chromatogram with the samples that are being tested.

What would happen if the student did not stop the development before the solvent reached the top of the paper?

If I did not stop the chromatogram the solvent would leave the paper and there would not be a good marking for the solvent front, and all of the spots would continue to the top of the paper and start to diffuse into large spots (at the top).

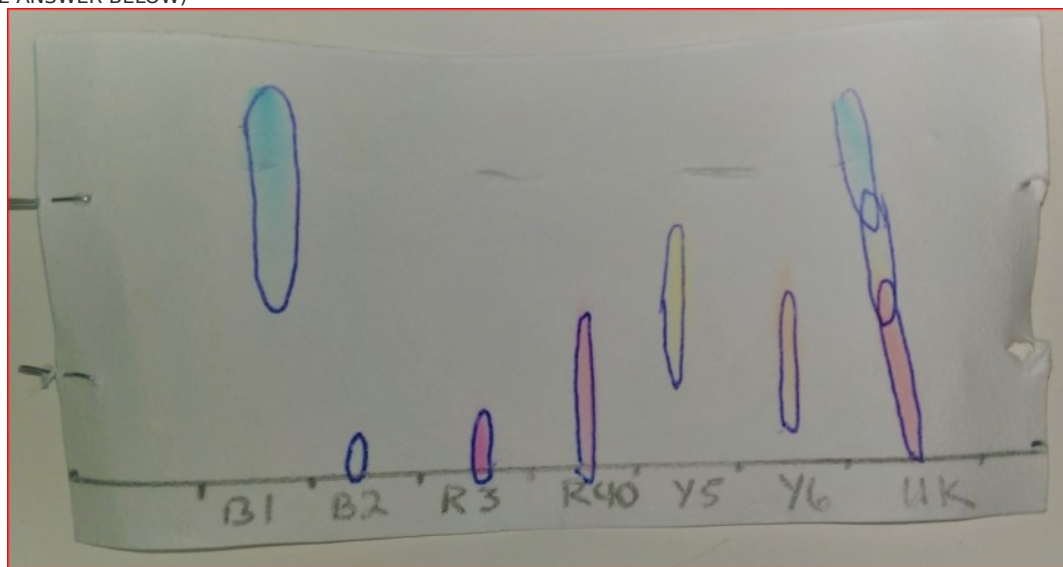
What would happen if the solvent level was above that of the dye spots on the paper at the start of the development?

Most of the dye would dissolve into the mobile phase in the Petri dish and no longer be on the paper.

Why is it important to mark the solvent level on the chromatography paper as soon as you remove it from the Petri dish?

The solvent front will dry and it will not be easy to see where the solvent front ended on the chromatogram.

Photo 1: Chromatogram
(SAMPLE ANSWER BELOW)



Data Table 1: Chromatogram Data
(SAMPLE ANSWER BELOW)

Sample	Solvent front (mm)	Spot 1 mm	Spot 1 R _f	Spot 2 mm	Spot 2 R _f	Spot 3 mm	Spot 3 R _f
Blue 1	60	40	0.67	---	---	---	---
Blue 2	60	6	0.10	---	---	---	---
Red 3	60	4	0.04	---	---	---	---
Red 40	60	10	0.17	---	---	---	---
Yellow 5	60	23	0.38	---	---	---	---
Yellow 6	60	13	0.22	---	---	---	---
UK	60	40	0.67	23	0.38	13	0.22

Data Table 2: FD&C Dyes in Sample
(SAMPLE ANSWER BELOW)

Sample:	FD&C Dyes in Sample
Unknown Sample	Blue #1, Yellow #5, Red #40

Competency Review

Chromatography is useful for identifying unknown substances in a ____.

- ☐ pure solution
- ☒ mixture ✓
- ☐ solid

A(n) ____, used as part of the stationary phase, has an affinity for the solvent and the chemical components of the mixture.

- ☒ adsorbent ✓
- ☐ eluent
- ☐ R_f factor
- ☐ chromatogram

____ chromatography uses a column of solid beads and a liquid solvent to separate mixtures.

- ☐ Paper
- ☐ Thin-layer
- ☐ Gas
- ☒ Liquid ✓

In paper chromatography, a strip of paper is utilized as the ____.

- ☐ mobile phase
- ☒ stationary phase ✓
- ☐ solvent front
- ☐ eluent

R_f values of unknown compounds are compared to standards to determine their identity.

- ☒ True ✓
- ☐ False

FD&C dyes are used to color food items with hues of ____.

- ☐ blue
- ☐ yellow
- ☐ red
- ☒ All of the above ✓

During a paper chromatography experiment using food dyes, saltwater serves as the ____ in the experiment.

- ☐ adsorbent
- ☒ eluent
- ☐ stationary phase
- ☐ unknown component

✓

During paper chromatography experiments, why is the solvent front marked with a pencil as soon as the filter paper is removed from the chamber?

- ☐ To identify the location of the solvent front once the paper dried
- ☐ To measure the distance traveled by the solvent during the development
- ☐ To determine the retention factor of the compound
- ☒ All of the above

✓

An unknown food dye produced two spots on a chromatogram with R_f values of 0.15 and 0.23. Use the table below to identify the unknown compounds.

Sample	Solvent front (mm)	Spot 1 (mm)	Spot 1 R _f
Blue 1	60	40	0.67
Blue 2	60	6	0.1
Red 3	60	4	0.07
Red 40	60	10	0.17
Yellow 5	60	23	0.38
Yellow 6	60	13	0.22

- ☐ Blue 1 and Red 3
- ☐ Yellow 5 and Red 40
- ☐ Blue 2 and Yellow 6
- ☒ Red 40 and Yellow 6



Extension Questions

Metal ions can be separated by paper chromatography through a process similar to the one you used to separate food dyes. However, the metal ions are not as distinctly colored as the food dyes, so often an additional step is needed where the developed paper is treated with a chemical agent that will make the metal ions appear visible. The table below gives some data that was obtained running both some known metal ions and an unknown sample containing one or more metal ions.

Sample	Color of Treated Component	Distance Component Moved (mm)	Distance Solvent Moved (mm)
Cu ⁺² ion	Blue	45	60
Ni ⁺² ion	Brown	30	60
Co ⁺² ion	Brown	18	60
Fe ⁺² ion	Red	55	60
Unknown	Brown	20	60
	Blue	43	

a. What ion(s) is/are contained in the unknown solution?

b. Which of the metal ions has the strongest affinity for the solvent system?

c. If the solvent was allowed to travel 80 mm instead of the 60 mm used in this experiment, at what distance would you expect to find the Ni ion located?

(SAMPLE ANSWER BELOW)

a. Co and Cu are contained in the unknown solution.

b. Fe ion has the strongest affinity for the solvent system.

c. 40 mm would be expected for Ni ion if the solvent was allowed to travel for 80 mm.