GENERAL

answers to ap experiment 10 chromatography lab

Published: September 19, 2026 | Index ID: #-

Answers to AP Experiment 10: Chromatography Lab – A Comprehensive Guide

For AP Chemistry students, mastering the laboratory portion of the exam is just as vital as mastering the written portion. Experiment /10, the Chromatography Lab, is a cornerstone of the AP Chemistry curriculum, testing students' ability to separate and identify components of a mixture using paper chromatography. Whether you're preparing for the exam, reviewing a past test, or simply looking to deepen your understanding of chromatography, this guide offers the **answers to AP Experiment /10 chromatography lab** along with detailed explanations, step by step procedures, data analysis techniques, and common pitfalls to avoid. By the end, you'll not only know how to answer the exam questions but also how to apply chromatography principles in real world scenarios.

Overview of AP Experiment /10: Chromatography

Experiment 10 introduces students to the fundamentals of chromatography, a technique that separates components of a mixture based on differential migration through a stationary phase. The lab's primary objective is to isolate and identify the pigments in a standard mixture, typically a plant extract or a commercial dye solution. Students use paper chromatography, which is accessible, inexpensive, and ideal for high school laboratories.

Purpose and Learning Outcomes

- Understand the principles of chromatographic separation.
- Calculate and interpret Rf values.
- Identify pigments based on Rf and color.
- Apply systematic data analysis to draw conclusions.
- Develop laboratory skills such as precise spotting, solvent handling, and accurate measurement.

Materials and Equipment

1. Chromatography paper (filter paper or chromatography paper sheets)
2. Solvent system (commonly a mixture of ethyl acetate and hexane or a standard solvent like 90 /% ethanol + 10 /% water)
3. Sample solution (plant extract, dye mixture, or standard solution)
4. Capillary tubes or micropipettes for spotting
5. Glass tubes or chromatography stands
6. Marking pencils and ruler
7. Petri dish or beaker for solvent reservoir
8. Timer or stopwatch
9. Safety equipment (gloves, goggles, lab coat)

General Procedure

1. Mark a baseline about 1 /cm from the bottom of the chromatography paper.
2. Spot the sample at the baseline using a small droplet (~5 /µL) in the center.
3. Place the paper vertically in the solvent reservoir, ensuring the spot is above the solvent level.
4. Allow the solvent front to rise until it is about 1 /cm from the top of the paper.
5. Remove the paper, dry it, and record the positions of the solvent front and pigment spots.

6. Measure distances and calculate Rf values (Rf /= /distance traveled by spot/distance traveled by solvent front).
7. Compare Rf values and colors with reference standards to identify pigments.

Key Concepts Covered in the Lab

Understanding the science behind chromatography is essential for answering exam questions accurately. Below are the core concepts students should master:

- Stationary Phase – The paper provides a matrix that impedes the movement of polar molecules.
- Mobile Phase – The solvent carries the sample upward, creating a concentration gradient.
- Solubility and Polarity – Compounds with higher affinity for the solvent travel farther.
- Rf Value – A dimensionless number representing the ratio of distances; it is characteristic of a compound in a given solvent system.
- Separation Efficiency – The ability of the solvent system to produce distinct, well resolved spots.

Common Exam Questions and Their Answers

The AP Chemistry exam often asks students to interpret chromatograms, calculate Rf values, and identify compounds. Below, we provide sample questions along with comprehensive answers that illustrate the reasoning process students should follow.

Question 1: Calculating Rf Values

Problem:A chromatogram shows a pigment spot that traveled 4.2 cm from the baseline, while the solvent front traveled 10.5 /cm. What is the Rf value of the pigment?

Answer: Rf /= /distance traveled by spot / distance traveled by solvent front /= /4.2 /cm / 10.5 /cm /"H /0.40.

Question 2: Identifying Pigments Based on Rf and Color

Problem: A student obtains the following Rf values in a 90 /% ethanol + 10 /% water system:

- Spot A: Rf /= /0.35, green color.
- Spot B: Rf /= /0.60, yellow color.
- Spot C: Rf /= /0.75, blue color.

The reference chart indicates that chlorophyll a has Rf "H 0.35, carotenoids have Rf "H 0.60, and anthocyanins have Rf /"H /0.75. Identify each spot.

Answer: Spot /A is chlorophyll /a, Spot /B is a carotenoid (e.g., ;" 6 &÷FVæR'Â æB 7 ÷B ô2 —2 â çF†ö7•anin (e.g., cyanidin)

Question 3: Interpreting Experimental Errors

Problem:A chromatogram shows overlapping spots, making it difficult to assign Rf values. Which of the following is the most likely cause?

- A) The sample was too dilute.
- B) The solvent system was too strong.
- C) The baseline was marked too far from the bottom.
- D) The paper was not dry before spotting.

Answer:B) The solvent system was too strong. A strong solvent causes rapid migration, reducing resolution and leading to overlapping spots.

Question 4: Calculating the Height of the Solvent Front

Problem: In a chromatogram, the solvent front moved 12 cm, but the paper was 15 cm long. What percentage of the paper length did the solvent travel?

Answer: (12 /cm / 15 /cm) /× /100 /% /= /80 /%. The solvent traveled 80 /% of the paper length.

Step by Step Lab Procedure for Optimal Results

Executing the chromatography lab with precision is essential for reliable data. Below is a detailed protocol, including tips to avoid common mistakes.

1. Prepare the Chromatography Paper

1. Cut a strip of paper about 10 /cm wide and 20 /cm long.
2. Mark a horizontal baseline 1 /cm from the bottom using a pencil.
3. Ensure the paper is flat and free of creases.

2. Spot the Sample

1. Using a clean capillary tube, draw up ~5 /µL of the sample.
2. Place a single, small droplet at the baseline, centered on the strip.
3. Let the droplet dry completely before proceeding.

3. Set Up the Solvent System

1. Fill a beaker with 5–10 /mL of the chosen solvent.
2. Place a small piece of paper or a cotton pad at the bottom of the beaker to keep the solvent level steady.
3. Position the paper vertically so that the baseline is above the solvent level.

4. Run the Chromatogram

1. Start the timer as soon as the paper is inserted.
2. Allow the solvent to ascend until it is about 1 /cm from the top.
3. Remove the paper and place it on a drying rack.
4. Mark the solvent front with a pencil.

5. Measure Distances and Calculate Rf Values

1. Using a ruler, measure the distance from the baseline to the center of each pigment spot.
2. Measure the distance from the baseline to the solvent front.
3. Calculate Rf values for each spot.
4. Compare Rf values with reference standards.

Data Analysis Techniques

Accurate data analysis turns raw measurements into meaningful conclusions. Here's how to approach the analysis systematically.

1. Record All Measurements in a Lab Notebook

- Include date, time, solvent system, and any observations.
- Photograph the chromatogram for visual reference.
- Note any anomalies (e.g., streaking, faint spots).

2. Calculate Rf Values with Precision

Use the formula: **Rf /= /distance traveled by spot / distance traveled by solvent front**. Round Rf values to two decimal places for consistency.

3. Compare with Reference Rf Charts

AP Chemistry labs often provide a reference table of Rf values for common pigments under the same solvent system. Match each measured Rf to the nearest reference value to identify the pigment.

4. Evaluate Separation Quality

- Check that spots are distinct and not overlapping.
- Ensure the solvent front is not too close to the top (avoid over run).
- Verify that the baseline is correctly marked.

5. Discuss Sources of Error

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