2017

AP CollegeBoard

AP Chemistry

Sample Student Responses and Scoring Commentary

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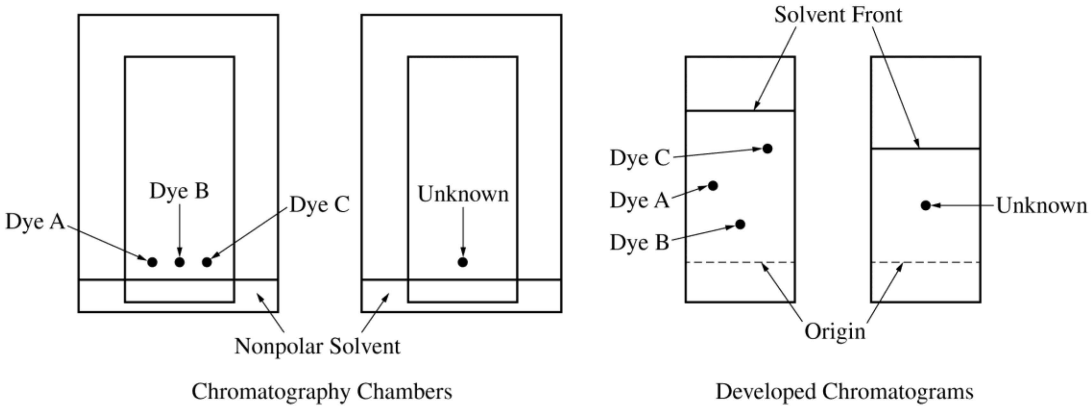
AP® CHEMISTRY
2017 SCORING GUIDELINES

Question 4



A student investigates various dyes using paper chromatography. The student has samples of three pure dyes, labeled A, B, and C, and an unknown sample that contains one of the three dyes. The student prepares the chromatography chambers shown above on the left by putting a drop of each dye at the indicated position on the chromatography paper (a polar material) and standing the paper in a nonpolar solvent. The developed chromatograms are shown above on the right.

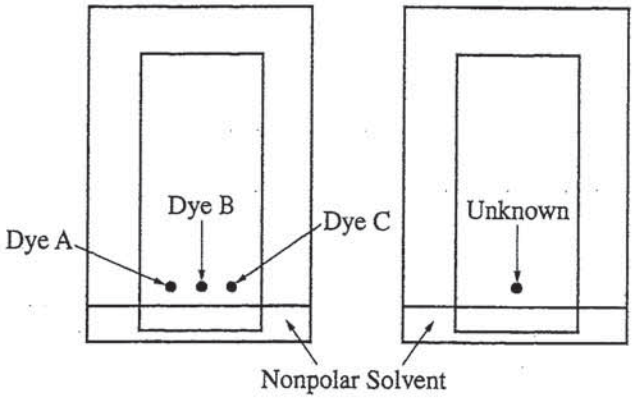
(a) Which dye (A, B, or C) is the least polar? Justify your answer in terms of the interactions between the dyes and the solvent or between the dyes and the paper.

Dye C is the least polar because it moved the farthest. Nonpolar dyes are more strongly attracted to the nonpolar solvent. AND/OR Nonpolar dyes are least strongly retained by the polar paper.	1 point is earned for the correct choice **and** reference to the chromatogram. 1 point is earned for a correct description of dye-solvent **and/or** dye-paper interactions.

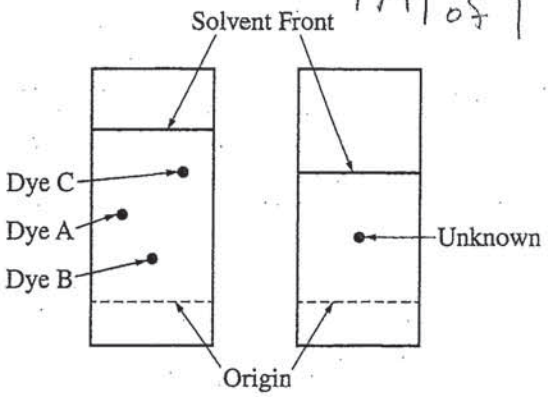
(b) Which dye is present in the unknown sample? Justify your answer.

Dye A is present in the unknown sample. The unknown sample moves to a position that is midway between the origin and the solvent front, and so does dye A. OR Dye A has a retention factor (R_f) that is close to 0.50 on the chromatogram with the three dyes, and the unknown also has a retention factor close to 0.50.	1 point is earned for the correct choice. 1 point is earned for a valid justification.

4A 1 of 1



Chromatography Chambers



Developed Chromatograms

4. A student investigates various dyes using paper chromatography. The student has samples of three pure dyes, labeled A, B, and C, and an unknown sample that contains one of the three dyes. The student prepares the chromatography chambers shown above on the left by putting a drop of each dye at the indicated position on the chromatography paper (a polar material) and standing the paper in a nonpolar solvent. The developed chromatograms are shown above on the right.

(a) Which dye (A, B, or C) is the least polar? Justify your answer in terms of the interactions between the dyes and the solvent or between the dyes and the paper.

(b) Which dye is present in the unknown sample? Justify your answer.

a) The least polar dye is DyeC. Since the solvent is nonpolar, it will have greatest intermolecular interaction with other nonpolar substances (nonpolar substances will be most soluble in it)(like dissolves like), this means that whichever dye travels the highest or travels a distance most similar to that of the solvent will be the most nonpolar. In this case its Dye C.

b) The unknown sample is Dye A. In the experiment with Dyes A, B, and C, Dye C travels the highest, Dye A travels about half the distance of the solvent and Dye B travels about 1/4 the distance of the solvent. The unknown Dye travels about half the distance that the solvent travels so the polarity/nonpolarity of its molecules is most similar to that of Dye A, therefore the Unknown is Dye A.

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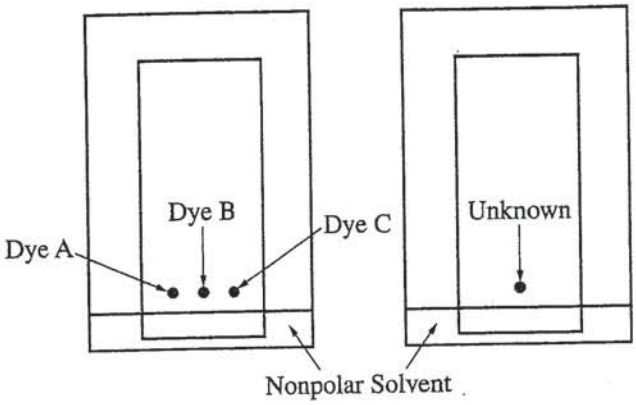
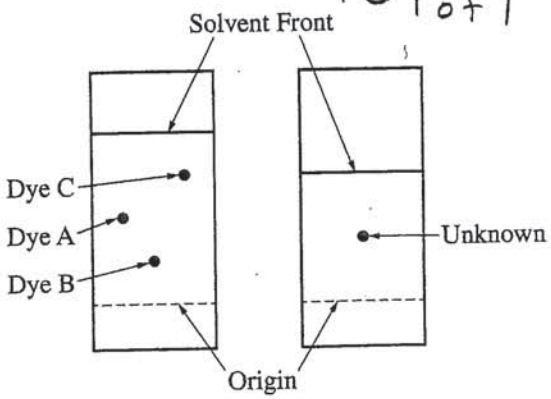


Chromatography Chambers



Developed Chromatograms

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(a) Which dye (A, B, or C) is the least polar? Justify your answer in terms of the interactions between the dyes and the solvent or between the dyes and the paper.

(b) Which dye is present in the unknown sample? Justify your answer.

a) dye C is the least polar, because it interacted the most with the like solvent, while the more polar dyes were attracted to the paper, also polar, and didnt move as far.

b) dye A, moved the same distance

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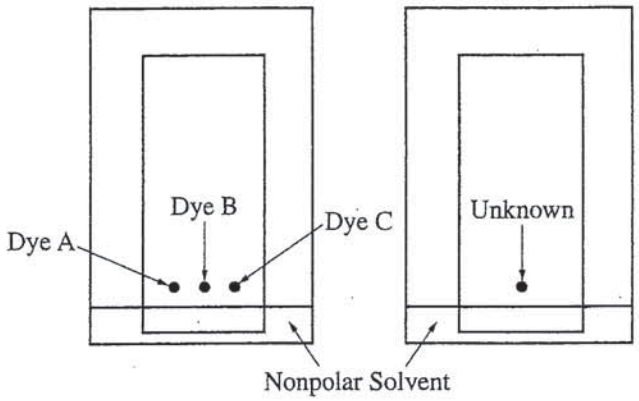
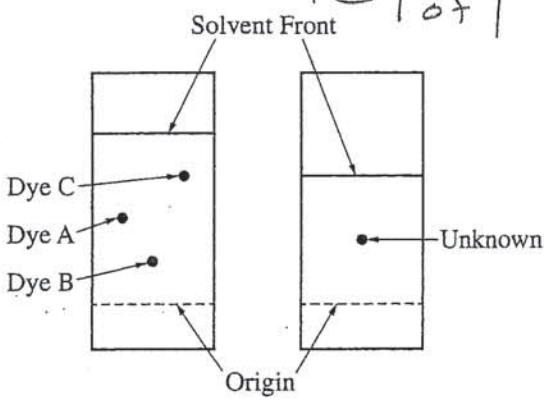


Chromatography Chambers



Developed Chromatograms

4. A student investigates various dyes using paper chromatography. The student has samples of three pure dyes, labeled A, B, and C, and an unknown sample that contains one of the three dyes. The student prepares the chromatography chambers shown above on the left by putting a drop of each dye at the indicated position on the chromatography paper (a polar material) and standing the paper in a nonpolar solvent. The developed chromatograms are shown above on the right.

(a) Which dye (A, B, or C) is the least polar? Justify your answer in terms of the interactions between the dyes and the solvent or between the dyes and the paper.

(b) Which dye is present in the unknown sample? Justify your answer.

4. (a) The least polar dye is dye C because it moved the farthest from the origin, towards the nonpolar solvent.

(b) Dye A is present in the unknown sample because it rose the same amount as Dye A from the origin.

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AP® CHEMISTRY
2017 SCORING COMMENTARY

Question 4

Overview

This question assessed students' ability to demonstrate the ability to interpret the results of a chromatography experiment correctly and to identify the least polar dye from among three dyes (A, B, or C).

In this question the Learning Objective (LO) assessed was 2.10. The Science Practices (SP) assessed were 4.2, 5.1, and 6.4.

In part (a) the dye that traveled the farthest on the chromatogram was the least polar. The students then were expected to use dye/solvent interactions and/or dye/stationary phase interactions to justify the response interpretation. The least polar dye has greater attractions to the nonpolar solvent, and/or the least polar dye has the weakest attractions for the polar paper. In part (b) students were expected to correctly identify an unknown from among the three known dyes. Since the solvent fronts for the two chromatograms were not equal, the justification for the unknown identification needed to reference retention factor values (or a description of retention factors) for the two chromatograms (unknown and selected dye).

Sample: 4A
Score: 4

This response earned 4 of 4 possible points. The student earned 1 point in part (a) for correctly identifying dye C as the least polar and indicating that it traveled the farthest. An additional 1 point was earned for identifying the attraction of dye C to the nonpolar solvent. The response earned 2 points in part (b). The student correctly identifies the unknown as dye A and gives the correct ratio of the distance traveled by the solvent front to the distance traveled by the dye.

Sample: 4B
Score: 3

This response earned 3 of 4 possible points. In part (a) the student correctly identifies the least polar dye with a reference to the chromatogram for 1 point. The student correctly describes the dye/solvent interactions for 1 point. In part (b) the student correctly identifies the unknown as dye A for 1 point. The student claims the unknown and dye A moved the same distance, so no point was earned for the justification.

Sample: 4C
Score: 2

This response earned 2 of 4 possible points. In part (a) the student correctly identifies the least polar dye but does not describe the interactions between the dye and the solvent, so 1 point was earned. In part (b) the student earned 1 point for correctly identifying the unknown as dye A. The student states that the unknown and dye A move the same distance, so the justification point was not earned.