Past-paper walk-through

Separation of Solutions and Mixtures ▪ 3.9

eXercise

Questions in this set

- 2024 Q7
- 2017 Q4

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

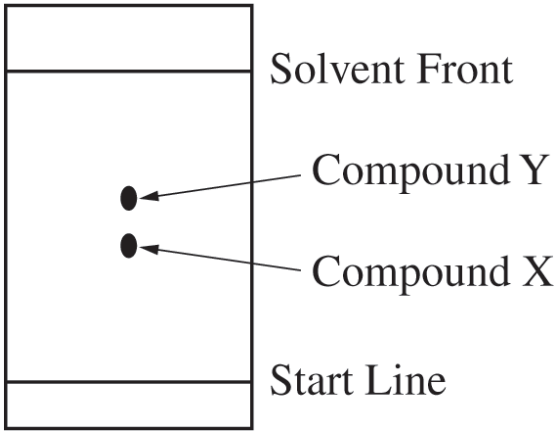
Question 7

2024 ▪ Q7

1. A student conducts a chromatography experiment and needs to prepare 100.0 mL of 0.340 M NaCl(aq) to use as the solvent.

(a) Calculate the mass of solid NaCl (molar mass 58.44 g/mol) needed to prepare the 100.0 mL of 0.340 M NaCl(aq).

Question 7



Question 7

2024 ▪ Q7

1. A student conducts a chromatography experiment and needs to prepare 100.0 mL of 0.340 *M* NaCl(*aq*) to use as the solvent.

(b) In the following table, briefly list the additional steps necessary to prepare the 100.0 mL of 0.340 *M* NaCl(*aq*) solution using only materials selected from the choices given. Assume that all appropriate safety measures are already in place. Not all materials in the list may be needed.

Question 7

Materials available: Solid NaCl, Distilled water, Weighing paper and scoop, Balance, 100.0 mL volumetric flask, 50.0 mL graduated cylinder, Pipet, 150 mL beakers, Chromatography paper.

Step	Step Description and Materials Used
1.	Use the weighing paper and scoop to measure the correct mass of solid NaCl on the balance.
2.	_____ (student fills in)
3.	Swirl the mixture to dissolve the solid NaCl.
4.	_____ (student fills in)
5.	Stopper and invert the mixture several times to ensure that the mixture is homogeneous.

Question 7

Fill in steps 2 and 4.

Question 7

2024 ▪ Q7

1. A student conducts a chromatography experiment and needs to prepare 100.0 mL of 0.340 *M* NaCl(*aq*) to use as the solvent.

(c) The student uses the NaCl(*aq*) solvent to separate a mixture of compounds X and Y in a chromatography experiment. After 30 minutes, the student removes the chromatography paper from the chamber. The results of the experiment are shown. [Diagram: a rectangular chromatography-paper strip inside a chamber. From top to bottom: a horizontal line labeled “Solvent Front” near the top; below it, two spot markers close together labeled with arrows — the upper spot labeled “Compound Y” and, just below it, the lower spot labeled “Compound X”; near the bottom, a horizontal line labeled “Start Line”.]

Question 7

A second student conducts the same chromatography experiment but removes the chromatography paper from the chamber after 15 minutes instead of 30 minutes. Predict the effect, if any, this would have on the separation distance between compounds X and Y in the new experiment. Explain your reasoning.

Solution 7

(a)

Mark scheme

- Mass of NaCl needed $= 0.1000\ \text{L} \times \dfrac{0.340\ \text{mol}}{1\ \text{L}} \times \dfrac{58.44\ \text{g}}{1\ \text{mol}} = 1.99\ \text{g NaCl}.$

Solution 7

(b)

Mark scheme

- Step 2: Combine the solid NaCl and some distilled water in a 100.0 mL volumetric flask (to dissolve the solid). Step 4: Fill the volumetric flask with distilled water to the calibration (100.0 mL) mark (bring the solution to its final, precise volume).

Solution 7

(c)

Mark scheme

- The separation between compounds X and Y would decrease: the solvent front will not travel as far up the chromatography paper, so the two spots have less distance/time over which to separate before the paper is removed from the chamber.

Question 4

2017 ▪ Q4

[Figure, left group "Chromatography Chambers": two rectangular chambers side by side. Left chamber: a strip of chromatography paper suspended inside, with three spots labeled "Dye A", "Dye B", "Dye C" placed at the same height near the bottom of the paper, each with an arrow pointing down to its spot; the bottom of the paper dips into a reservoir labeled "Nonpolar Solvent". Right chamber: a similar strip with one spot labeled "Unknown" with an arrow pointing to it, also dipping into the same nonpolar solvent reservoir.
Right group "Developed Chromatograms": two rectangular strips after development. Left strip: a horizontal line near the top labeled "Solvent Front" (with an arrow pointing to the line); a horizontal dashed line near the bottom labeled "Origin" (with an arrow pointing to it); three dots between origin and solvent front, from lowest to highest: "Dye B" (lowest dot, closest to origin), "Dye A" (middle dot), "Dye C"

Question 4

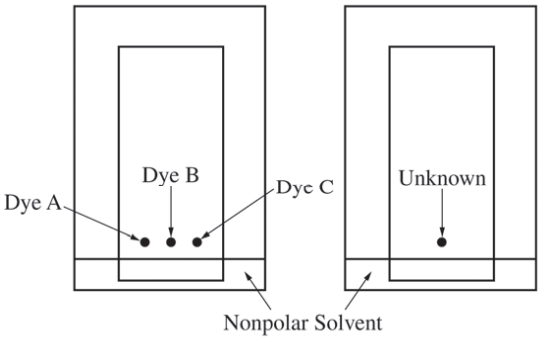
(highest dot, closest to solvent front) — each labeled with an arrow. Right strip: same solvent front line at top, dashed origin line near bottom; one dot labeled "Unknown" positioned at a height matching Dye A's position on the left strip.]

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.

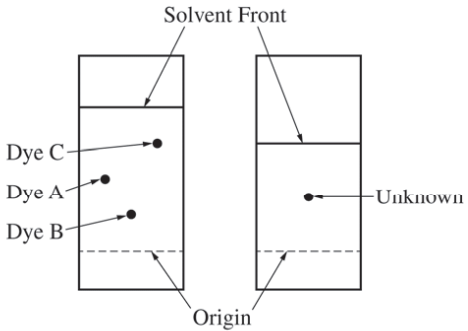
(a) Which dye (A, B, or C) is the least polar? Justify your answer in terms of the interactions between the dyes and the solvent or between the dyes and the paper.

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

Question 4



Chromatography Chambers



Developed Chromatograms

Solution 4

(a)

Mark scheme

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

Solution 4

(b)

Mark scheme

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