

SEPARATION OF A MIXTURE

ALL THE DATA YOU WOULD COLLECT IN THE LABORATORY TO COMPLETE THIS LABORATORY REPORT IS IN THIS DOCUMENT HIGHLIGHTED IN YELLOW

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Purpose

The purpose of this experiment is to take advantage of the different physical properties of water, sand and sodium chloride to determine the relative amounts of sand and sodium chloride in an unknown mixture.

Theory

Most chemical reactions yield mixtures of products. Therefore, the separation and purification of the components of mixtures is often necessary in chemical applications. Techniques used to separate and purify mixtures are very important to learn. Substances can be separated from one another if the substances have different properties. For example, materials that differ in boiling point, like sodium chloride and water, can be separated by distillation. If a solution of sodium chloride and water is heated to the boiling point the water will vaporize but the sodium chloride will not because the boiling point of the sodium chloride is much higher than the boiling point of the water. Therefore, the water can be removed from the mixture as it vaporizes. The sodium chloride will remain in the container as a solid.

Materials that differ in their solubility can also be separated from mixtures. For example, a mixture of sodium chloride and sand can be easily purified by noting that sodium chloride (salt) is soluble in water but sand is not. If a mixture of sodium chloride and sand is mixed with water only the sodium chloride will dissolve. If the resulting mixture is filtered through filter paper the solution of water and sodium chloride will flow through the paper and the sand will collect on the paper. The sodium chloride and water can be separated by distillation as described above. In this experiment you will be given two mixtures that contain only sodium chloride and sand. You will separate the sand from the salt in both mixtures using the method described above. One of the mixtures will be a “known” mixture. This means that the percentage of sand and salt in the mixture will be told to you. The other mixture will contain “unknown” percentages of sand and salt. Once you have separated the sand from the salt you will determine the percentage of salt and sand in the mixtures. The percentages of sand and salt can be calculated as shown on the following page.

$$\frac{\text{Mass of sand}}{\text{Mass of sand and salt in mixture}} \times 100 = \text{Percentage of sand in mixture}$$

$$(100\%) - (\text{Percentage of sand in mixture}) = \text{Percentage of salt in mixture}$$

You will perform a total of four Trials in this experiment. You will perform Trial #1 and Trial #2 to determine the percentage of sand and salt in the known mixture. You will perform Trial #3 and Trial #4 to determine the percentage of sand and salt in the unknown mixture. You will also calculate the average values for the known mixture by averaging the values from Trial #1 and Trial #2. You will determine the average values for the unknown mixture by averaging the values from Trial #3 and Trial #4.

You will be told the percentages of sand and salt in the known mixture. Using these values you can calculate the percent error. For example, suppose you collect the following experimental data for Trial #1 and Trial #2 and calculate the average percentages. Also suppose you are told the actual or known percentages in the mixture.

Trial	Percentage of sand (experimental)	Percentage of salt (experimental)
#1	38%	62%
#2	34%	66%

	Percentage of sand	Percentage of salt
Trial #1 and Trial #2 Average (experimental)	36%	64%
Known Values (values given to you)	32%	68%

You will be asked to calculate the percent error for the **percentage of salt** you determined in the experiment. You can do this as follows. Notice that the **absolute value** of the difference between the average experimental value and the known value is used in the calculation.

$$\frac{|\text{Percent salt (average experimental value)} - \text{Percent salt (known value)}|}{\text{Percent salt (known value)}} \times 100 = \text{Percent error}$$

$$\frac{|64 - 68|}{68} \times 100 = 5.9\%$$

According to this calculation 5.9% is percent error for the experimental salt value.

Materials Needed

- “Known” mixtures containing sand and sodium chloride (10 grams per student).
- “Unknown” mixtures containing sand and sodium chloride (10 grams per student).
- Drying oven (set at about 110°C)

Procedure

Put on your chemical-splash safety goggles. Your goggles must be worn at all times while in the laboratory. Don't take off your goggles until you leave the laboratory.

A. Determination of “known” mixture – Trial #1

1. Place a dry 100-mL beaker on a balance and zero (tare) the balance. Then add about a tablespoon of the “known” sand and sodium chloride mixture to the beaker and record the mass of the mixture on your data sheet. Indicate the percentage of sand and salt in your “known” mixture on your data sheet. The percentage should be written on the container.
2. Add 20 mL of distilled water to the mixture. Measure the volume using a clean graduated cylinder. Stir the sample for five minutes to dissolve all of the salt in the mixture.
3. Write your name on a piece of filter paper using a pencil (**not a pen**). Put the filter paper on a clean watch glass and weigh. Set aside the watch glass and fold the filter paper into quarters and place it in a funnel.
4. Filter the mixture of sand, salt and water through the filter paper. Collect the filtrate in a clean 100-mL graduated cylinder. The filtrate is the liquid that flows through the filter paper. Use small amounts of additional distilled water and a rubber policeman to transfer any sand remaining in the beaker to the funnel. Make sure that **all** of the sand is transferred to the filter paper. Collect all of the filtrate that runs through the filter paper in the graduated cylinder.
5. Carefully transfer the filter paper with the sand to the watch glass that you weighed earlier. Unfold the filter paper so that it lies flat on the watch glass. Place the filter paper and the watch glass in a drying oven set at approximately 110°C. **The racks inside the oven will be very hot. Be careful not to burn yourself. Your instructor will instruct you how to safely place your watch glass in the oven.** Allow the filter paper to remain in the oven until the paper and the solid are completely dry. This should take 15 minutes to 20 minutes.
6. You can begin **Part B** of the experiment for Trial #2 while your sample from Trial #1 dries in the oven.

7. Carefully remove your watch glass from the oven when its contents are completely dry. **The watch glass and oven racks will be very hot. Use oven mitts and tongs to avoid burning yourself. Ask your instructor for assistance if you need it.**

8. Weigh the watch glass and its contents once it has cooled to room temperature. **Don't place a hot watch glass on the balance.** Determine the percentage of sand and salt in the mixture.

B. Determination of “known” mixture – Trial #2

1. Perform **Part A** of this experiment for the “known” mixture a second time for Trial #2 and record your data on your data sheet. **Obtain your “known” sample from the same container that you used in Part A.**

2. You can begin **Part C** of the experiment for Trial #3 while your sample from Trial #2 dries in the oven.

C. Determination of “unknown” sample – Trial #3

1. Place a dry 100-mL beaker on a balance and zero (tare) the balance. Then add about a tablespoon of the “unknown” sand and sodium chloride mixture to the beaker and record the mass of the mixture on your data sheet. Write the unknown code for the unknown on your data sheet. The unknown code should be written on the container.

2. Add 20 mL of distilled water to the mixture. Measure the volume using a clean graduated cylinder. Stir the sample for five minutes to dissolve all of the salt in the mixture.

3. Write your name on a piece of filter paper using a pencil (**not a pen**). Put the filter paper on a clean watch glass and weigh. Set aside the watch glass and fold the filter paper into quarters and place it in a funnel.

4. Filter the mixture of sand, salt and water that you prepared above through the filter paper. Collect the filtrate in a clean 100-mL graduated cylinder. Use small amounts of additional distilled water and a rubber policeman to transfer any sand remaining in the beaker to the funnel. Make sure that **all** of the sand is transferred to the filter paper. Collect all of the filtrate that runs through the filter paper in the graduated cylinder.

5. Carefully transfer the filter paper with the sand to the watch glass that you weighed earlier. Unfold the filter paper so that it lies flat on the watch glass. Place the filter paper and the watch glass in a drying oven set at approximately 110°C. **Be careful not to burn yourself.** Allow the filter paper to remain in the oven until the paper and the solid are completely dry. This should take 15 minutes to 20 minutes.

6. You can begin **Part D** of the experiment for Trial #4 while your sample from Trial #3 dries in the oven.

7. Carefully remove your watch glass from the oven when its contents are completely dry. **The watch glass and oven racks will be very hot. Use oven mitts and tongs to avoid burning yourself. Ask your instructor for assistance if you need it.**

8. Weigh the watch glass and its contents once it has cooled to room temperature. **Don't place a hot watch glass on the balance.** Determine the percentage of sand and salt in the mixture.

D. Determination of “unknown” mixture – Trial #4

1. Perform **Part C** of this experiment for the “unknown” mixture a second time (Trial #4) and record your data on your data sheet. **Obtain your “unknown” sample from the same container that you used in Part C.**

2. **Clean all glassware and equipment that you used during this experiment and return it to its proper location. Clean your workstation and wash your hands with soap and water before you leave the laboratory.**

Name _____

Date _____

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Prelaboratory Assignment

1. What safety precautions should you take while removing your watch glass and sample from the drying oven?

Be careful, don't burn yourself on the rack.

2. Suppose you collect the following data in the experiment while analyzing a known mixture of sand and salt in Trial #1 and Trial #2. **You are told that the known sample contains 43% sand and 57% salt.**

Trial #1

- Mass of sand and salt mixture 5.87 g
- Mass of watch glass, filter paper, and sand **after drying** 38.05 g
- Mass of watch glass and empty filter paper **before filtering** 35.12 g
- Mass of dry sand 2.93 g

Trial #2

- Mass of sand and salt mixture 5.35 g
- Mass of watch glass, filter paper, and sand **after drying** 36.72 g
- Mass of watch glass and empty filter paper **before filtering** 34.19 g
- Mass of dry sand 2.53 g

Complete the tables using the data shown above.

Trial	Percentage of sand (experimental)	Percentage of salt (experimental)
#1		
#2		

	Percentage of sand	Percentage of salt
Trial #1 and Trial #2 Average (experimental)		
Known Values	43%	57%

What is the percent error for the **percentage of salt** using this data?

Name _____

Date _____

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Data Sheet

A. Determination of “known” mixture – Trial #1

Percentage of sand in the known mixture (written on container) **87%**

Percentage of salt in the known mixture (written on container) **13%**

Note: Be sure to zero (tare) the balance with a dry 100-mL beaker on the balance before adding the sand and salt mixture to the beaker and weighing. Indicate the mass of your mixture below.

Mass of sand and salt mixture **5.85 g**

Mass of watch glass, filter paper, and sand **after drying** **39.42 g**

Mass of watch glass and empty filter paper **35.03 g**

Mass of dry sand 4.39g

B. Determination of “known” mixture – Trial #2

Note: Be sure to obtain your “known” sample from the same container that you used in **Part A** of this experiment.

Percentage of sand in the known mixture (written on container) **87%**

Percentage of salt in the known mixture (written on container) **13%**

Note: Be sure to zero (tare) the balance with a dry 100-mL beaker on the balance before adding the sand and salt mixture to the beaker and weighing. Indicate the mass of your mixture below.

Mass of sand and salt mixture **4.43 g**

Mass of watch glass, filter paper, and sand **after drying** **39.02 g**

Mass of watch glass and empty filter paper **34.98 g**

Mass of dry sand _____

C. Determination of “unknown” mixture – Trial #3

Unknown code written on container

#1

Note: Be sure to zero (tare) the balance with a dry 100-mL beaker on the balance before adding the sand and salt mixture to the beaker and weighing. Indicate the mass of your mixture below.

Mass of sand and salt mixture

4.91 g

Mass of watch glass, filter paper, and sand **after drying**

38.06 g

Mass of watch glass and empty filter paper

36.34 g

Mass of dry sand

D. Determination of “unknown” mixture – Trial #4

Note: Be sure to obtain your “unknown” sample from the same container that you used in **Part C** of this experiment.

Unknown code written on container

#1

Note: Be sure to zero (tare) the balance with a dry 100-mL beaker on the balance before adding the sand and salt mixture to the beaker and weighing. Indicate the mass of your mixture below.

Mass of sand and salt mixture

4.65 g

Mass of watch glass, filter paper, and sand **after drying**

37.74 g

Mass of watch glass and empty filter paper

34.99 g

Mass of dry sand

Name _____

Date _____

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Questions

1. Perform the necessary calculations to complete the tables below using the data you collected in **Trial #1** and **Trial #2** of this experiment.

Trial	Percentage of sand (experimental)	Percentage of salt (experimental)
#1		
#2		

	Percentage of sand	Percentage of salt
Trial #1 and Trial #2 Average (experimental)		
Known Values		

What is the percent error for the **percentage of salt** using this data?

2. Perform the necessary calculations to complete the tables below using the data you collected in **Trial #3** and **Trail #4** of this experiment.

Trial	Percentage of sand (experimental)	Percentage of salt (experimental)
#3		
#4		

	Percentage of sand	Percentage of salt
Trial #3 and Trial #4 Average (experimental)		

3. You are given mixture of **salt** and **sugar** (instead of salt and sand). Could you determine the percentages of salt and sugar in the mixture using the same method that you used in this experiment? Indicate **Yes** or **No**.

Explain your answer below.