

SI Chemistry - Full Discipline Demo

Separation of a Mixture of Solids

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

Match each term with the appropriate statement.

⚡ Heterogeneous	_____ is a term that describe the capacity of a substance to dissolve in another under specific conditions.	1
⚡ Homogeneous	The salt in a salt-water mixture is a _____.	2
⚡ Immiscible	Two liquids that dissolve in each other are _____.	3
⚡ Miscible	When chocolate chips are mixed into cookie batter, the result is a _____ mixture.	4
⚡ Solubility	Oil and water are _____ because they do not dissolve in each other.	5
⚡ Solute	White gold contains silver and palladium evenly dispersed with the gold atoms, forming a _____ mixture.	6

Correct answers:

- 1 Solubility 2 Solute 3 Miscible 4 Heterogeneous
5 Immiscible 6 Homogeneous

Classify each substance as an element, compound, heterogeneous mixture, or homogeneous mixture.

⚗ CH₄

⚗ Grape juice

⚗ KBr

⚗ Oil and vinegar

⚗ P

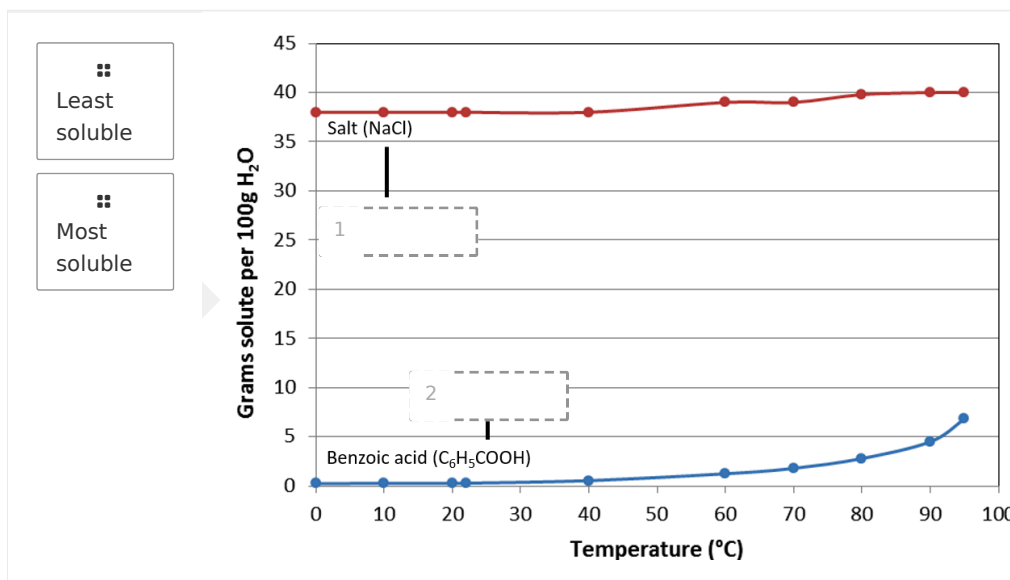
Element	Compound	Heterogeneous Mixture	Homogeneous Mixture
1	2	3	4

Correct answers:

1 P 2 CH₄ KBr 3 Oil and vinegar

4 Grape juice

According to the graph, which substance is the most soluble in water?
Which substance is the least soluble?



Correct answers:

- 1 Most soluble 2 Least soluble

Exploration

The periodic table is a listing of all ____.

- ☐ compounds
- ☒ elements
- ☐ science
- ☐ chemical bonds



Compounds are pure substances, but are composed of two or more elements bonded together in specific proportions.

- ☒ True
- ☐ False



A homogeneous mixture is composed of visibly distinguishable parts and does not have uniform composition. A heterogeneous mixture is composed of visibly indistinguishable parts which have a uniform composition.

☐ True

☐ False

✓

A ____ dissolves into a ____.

☐ solute; solvent

☐ solvent; solute

✓

Two liquids that mix together are ____.

☐ insoluble

☐ miscible

☐ immiscible

✓

Polar solutes are most likely to dissolve into ____, and ____ are most likely to dissolve into nonpolar solvents.

☐ nonpolar solutes; polar solvents

☐ polar solutes; nonpolar solvents

☐ polar solvents; nonpolar solutes

☐ nonpolar solvents; polar solvents

✓

Exercise 1

Data Table 1: Mass of Substances
(SAMPLE ANSWER BELOW)

Substance/Mixture	Mass (g)
Mixture of Solids	5.60
Mass of Paper	0.70
Mass of Paper + Iron Filings	1.70
Mass of Iron Filings	1.00

Mass of 100 mL Glass Beaker	54.70
Mass of 100 mL Glass Beaker + Sand	57.80
Mass of Sand	3.10
Mass of Filter Paper	1.00
Mass of Filter Paper + Benzoic Acid	1.60
Mass of Benzoic Acid	0.60
Mass of 100 mL Glass Beaker	57.80
Mass of 100 mL Glass Beaker + Salt	58.70
Mass of Salt	0.90

Exercise 2

What percent of the total mass of mixture of solids (Initial) was recovered through the separation techniques?

In this experiment, 100% of the total mass of mixture of solids was recovered through the separation techniques.

Describe possible sources of error to account for any deviation between the % of the total mass of mixture of solids (initial) and the sum of separated components.

While there was 100% recovery, the recovered mass of each component may not be true, as some of the small particles may have transferred to another component. For example, some of the sand may have transferred into the salt/benzoic acid mixture or the benzoic acid may have filtered through the paper.

What was the most challenging step to perform in the separation procedure? What would you suggest to make the step less challenging?

While each student will have their own thoughts to this answer, the most probable answer will be decanting the liquid from the sand after boiling. It requires careful technique to keep the sand in the beaker while decanting. To make the step less challenging, the students may suggest using a sieve or other similar item to help in the decanting process.

Data Table 2: Mixture Summary
(SAMPLE ANSWER BELOW)

Substance/Mixture	Mass (g)	% of Total Mixture
Mass of Mixture of Solids (Initial)	5.00	100%
Mass of Iron Filings	1.25	25.0%
Mass of Sand	1.25	25.0%
Mass Benzoic Acid	1.25	25.0%
Mass of Salt	1.25	25.0%

Competency Review

The simplest chemical substances are composed of only ____ type(s) of atom.

- ☐ 0

☒ 1

☐ 2

☐ 3
- ✓

Compounds can only be separated into their component elements by ____.

- ☐ breaking chemical bonds

☐ removing impurities

☐ breaking element bonds
- ✓

A ____ is composed of visibly distinguishable parts and does not have uniform composition.

- ☐ homogeneous mixture
- ☒ heterogeneous mixture ✓

____ is an example of a homogeneous mixture.

- ☒ Apple juice ✓
- ☐ Oil and vinegar dressing

In salt water, water (H_2O) is the ____ and salt (NaCl) is the ____.

- ☐ solute; solvent
- ☒ solvent; solute ✓

When both a solute and solvent are solids, they are said to be either miscible or immiscible.

- ☐ True
- ☒ False ✓

Solubility is described in terms of both concentration and temperature.

- ☒ True ✓
- ☐ False

____ is a kinetic process defined by rate, and is not specific to concentration.

- ☐ Solubility
- ☒ Dissolution ✓
- ☐ Miscible

Chemists have developed the general rule "like dissolves like" for determining solubility.

☐ True



☐ False

Consider two substances: Substance A is soluble in a range of temperatures and Substance B is only soluble in hot water. When temperature is low and the two are mixed together, they will most likely create a ____ mixture; when temperature is high and two are mixed together, they will most likely create a ____ mixture.

☐ homogeneous; heterogeneous

☐ heterogeneous; homogeneous



A sample of solid iron and sand can be most easily separated using a ____.

☐ piece of tape

☐ magnet



☐ bare hand

To calculate the percent of a total mixture, divide the mass of ____ by the mass of ____ and multiply by 100%.

☐ one substance; the mixture of solids



☐ the mixture of solids; one substance

Salt and benzoic acid in an aqueous solution can be separated with ice and filter paper.

☐ True



☐ False

Extension Questions

In addition to the separation techniques used in this lab (magnetism, evaporation, and filtering), there are other commonly used separation techniques. Some of these techniques are:

Distillation - this process is used to separate components that have significantly different boiling points. The solution is heated and the lower boiling point substance is vaporized first. The vapor can be collected and condensed and the component recovered as a pure liquid. If the temperature of the mixture is then raised, the next higher boiling component will come off and be collected. Eventually only non-volatile components will be left in the original solution.

Centrifugation - a centrifuge will separate mixtures based on their mass. The mixture is placed in a centrifuge tube which is then spun at a high speed. Heavier components will settle at the bottom of the tube while lighter components will be at the top. This is the technique used to separate red blood cells from blood plasma.

Sieving - this is similar to filtration, but the sample is passed through a screen which allows smaller particles to go through and retains the larger particles.

Paper chromatography - this is a technique that separates a mixture based on the individual substance's tendency to travel across a paper surface. This technique is used frequently to separate different dyes.

Separatory Funnel - this is a glass container with a stopcock on the bottom. Two immiscible solutions are put in it. Since the solutions do not mix, they will separate into two layers, the more dense one will be on the bottom. The stopcock can then be opened and the more dense liquid will flow out and can be collected.

Consider the following separation problems. Decide which of the above techniques, including the ones you used in your lab, would be the best to use for separating the mixtures. You may need to use more than one technique for a given sample. Then give a brief explanation as to how you would do the separation.

A. Water and Sugar

B. Mixture of Hexane (Boiling Point = 68.7°C) and Octane (Boiling Point = 125°C)

C. Solid I₂ (non-polar solid) and NaCl

D. The mixture of inks present in a "Sharpie" permanent marking pen

E. Nickel shavings and copper pellets

(SAMPLE ANSWER BELOW)

A. Evaporation. Heat the solution until the water evaporates, leaving the sugar crystals behind.

B. Distillation. Begin heating the solution - the hexane will come off first (at a lower temperature). The vapor can be condensed to give the hexane. The octane will be left behind in the distillation flask.

C. Filtration or decantation followed by evaporation. Add water to the mixture. The NaCl will dissolve but the I₂ will not. The water/NaCl mixture can then be filtered off or decanted, leaving the solid I₂ behind. The water can be removed by evaporation.

D. Paper chromatography. Put a streak of the ink on the paper and apply the appropriate solvent. The different dyes in the ink will separate.

E. Magnetism. Nickel is magnetic while copper is not. A magnet will pick up the nickel, leaving the copper behind.