# SI Organic Chemistry - Full Discipline Demo

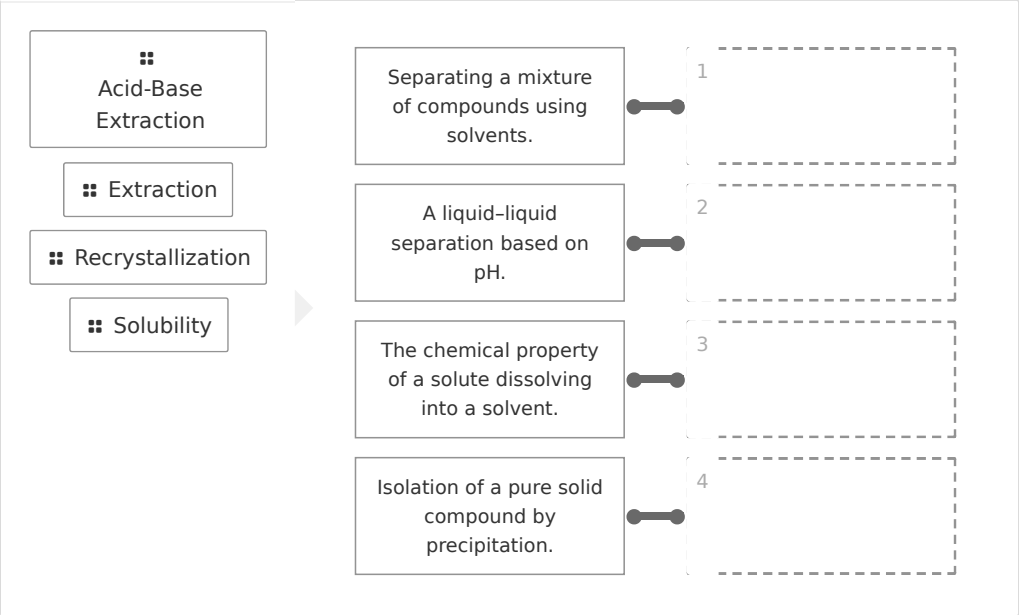
## Solubility of Compounds

## Final Report - Answer Guide

| | |
|---|---|
| **Institution** | Science Interactive University |
| **Session** | SI Organic Chemistry - Full Discipline Demo |
| **Course** | SI Organic Chemistry - Full Discipline Demo |
| **Instructor** | Sales SI Demo |

## Test Your Knowledge

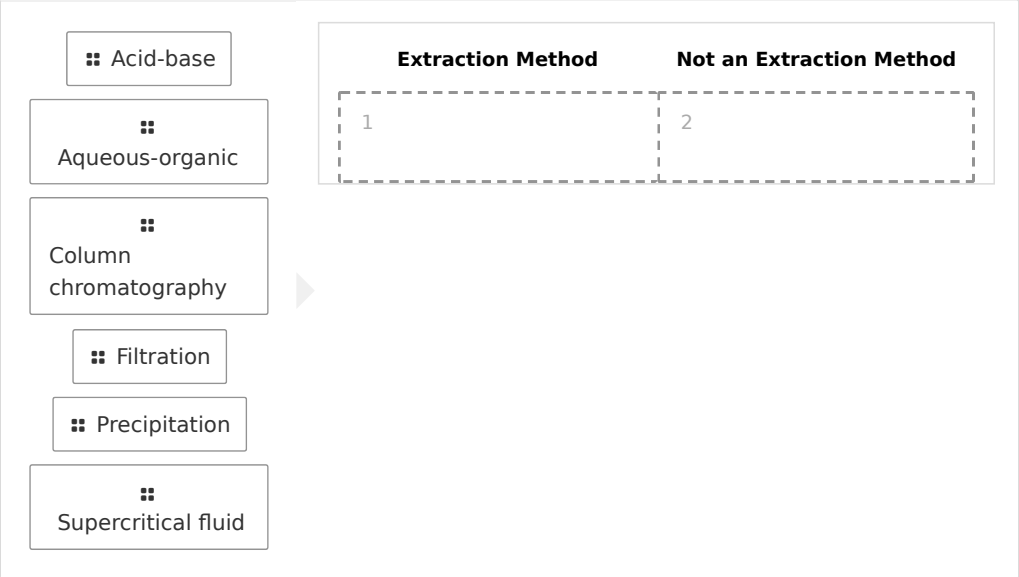
**Match teach term with the best description.**




Correct answers:

1 Extraction 2 Acid-Base Extraction 3 Solubility 4 Recrystallization

**Categorize each technique based on whether it is or is not an extraction method.**




Correct answers:

1 Acid-base Aqueous-organic Supercritical fluid

2 Column chromatography Precipitation Filtration

## Exploration

**Solubility is the chemical property of how well a solute dissolves into a solvent.**

- True ✔
- False

**Recrystallization enriches a single compound from a mixture as a solid precipitate.**

- True ✔
- False

**Extraction is a technique to separate a mixture of compounds using two miscible liquids.**

- ○ True
- ○ False ✔

## Exercise 1

**Based on your results in Data Tables 1–3, if you performed the same solubility tests at room temperature on 4-methylbenzoic acid, which solvents would 4-methylbenzoic acid be soluble in? Explain you answer.**

4-methyl benzoic acid would only be soluble in acetone. This is because benzoic acid is the closest in structure it was only soluble in acetone at room temperature.

**Based on your results in Data Table 1 and 2, which compound(s) were insoluble at room temperature but soluble in boiling water? Explain you answer.**

Based on the results benzoic acid was insoluble in water at room temperature and soluble at boiling.

**Based on your results in Data Tables 1-3, what would be a good solvent to separate a mixture of sodium chloride and glucose? Explain you answer.**

Hot acetic acid would a be the best solvent to separate sodium chloride and glucose because sodium chloride is completely insoluble in acetic acid, but glucose is fully soluble in hot acetic acid.

Data Table 1: Solubility of solids at room temperature
(SAMPLE ANSWER BELOW)

| Room Temperature | Glucose | Sodium Chloride | Benzoic Acid | Sodium Sulfate |
|---|---|---|---|---|
| Water | FS or PS | FS or PS | IS | PS or FS |
| Isopropanol | IS | IS | IS | IS |
| Oil | IS | IS | IS | IS or PS |
| Acetone | IS | IS | FS | IS |
| Acetic acid | PS or FS | PS or FS | IS | IS |

Data Table 2: Solubility of solids in boiling water
(SAMPLE ANSWER BELOW)

| Boiling | Glucose | Sodium Chloride | Benzoic Acid | Sodium Sulfate |
|---|---|---|---|---|
| Water | FS | FS | IS or PS | FS or PS |
| Isopropanol | IS | IS | FS | IS |
| Oil | IS | IS | IS or PS | IS or PS |
| Acetone | IS | IS | FS | IS |
| Acetic acid | FS or PS | FS or PS | IS or PS | PS or FS |

Data Table 3: Solubility of solids in ice bath
(SAMPLE ANSWER BELOW)

| 0°C | Glucose | Sodium Chloride | Benzoic Acid | Sodium Sulfate |
|---|---|---|---|---|
| Water | FS | FS | IS | FS or PS |
| Isopropanol | IS | IS | IS or PS | IS |
| Oil | IS | IS | IS | IS |
| Acetone | IS | IS | FS | IS |
| Acetic acid | FS | IS or PS | IS | PS or IS |

Data Table 4: Classifying compounds
(SAMPLE ANSWER BELOW)

| Compound | Polar or nonpolar | Organic or inorganic |
|---|---|---|
| Water | Polar | inorganic |
| Isopropanol | Polar | organic |
| Oil | Nonpolar | organic |
| Acetone | Nonpolar | organic |
| Acetic acid | Polar | organic |
| Glucose | Polar | organic |
| Sodium Chloride | Polar | inorganic |
| Benzoic Acid | Nonpolar | organic |
| Sodium sulfate | Polar | inorganic |

## Exercise 2

**Explain why benzoic acid is soluble in a sodium hydroxide solution but insoluble in distilled water.**

Benzoic acid became soluble in the aqueous solution when adding sodium hydroxide because the base deprotonated the carboxylic acid to the make a sodium carboxylate salt.  This salt is ionic and is soluble in a polar aqueous solution.  Benzoic acid is insoluble in water because it is an organic molecule.

Photo 1: Test Tube A (Alkalized) and Test Tube B
(SAMPLE ANSWER BELOW)

No sample answer provided

Photo 2: Test Tube A (Neutralized) and Test Tube B
(SAMPLE ANSWER BELOW)

No sample answer provided

Data Table 4: Solubilizing Amine and Carboxylic Acid
(SAMPLE ANSWER BELOW)

| | Number of Drops |
|---|---|
| Benzoic Acid | 6 |

## Competency Review

**A chemical compound whose polarity is similar to a particular solvent will likely be soluble in that solvent.**

- True ✔
- False

**The size of crystals formed during recrystallization is dependent upon _____.**

- the size of the molecule
- how quickly the temperature of the solvent changes ✔
- how quickly the pH of the solution changes
- the size of the container

**Adding an acid to a carboxylic acid will increase its solubility in an aqueous solution.**

- True
- False ✔

**____ is an example of an extraction method.**

- Solvent-amine
- Organic-lipid
- Aqueous-organic ✔
- All of the above

**Distilled water is a more polar solvent than acetone.**

- True ✔
- False

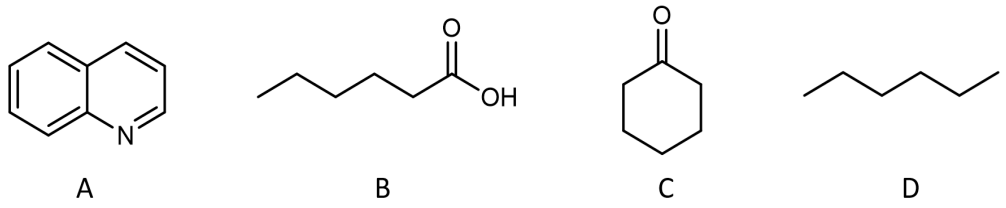
**Benzoic acid is less polar than glucose.**

- True ✔
- False

**Benzoic acid solubility in water has an inverse relationship with temperature of the solution.**

- True
- False ✔

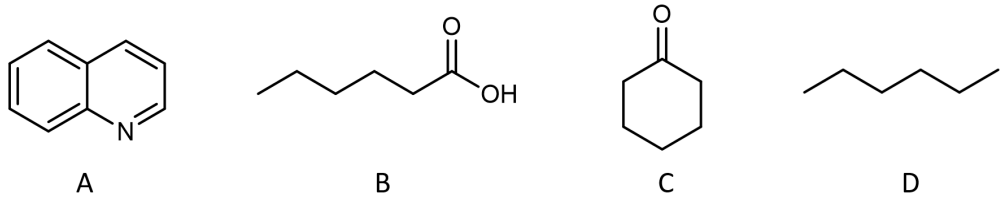
**Compound _____ will become more soluble in water when reacted with hydrochloric acid.**




A B C D

- A ✔
- B
- C
- D

**Compound _____ will become more soluble in water when reacted with sodium hydroxide.**




A B C D

- A.
- B. ✔
- C.
- D.

**Creating a carboxylate salt from a carboxylic acid makes the compound _____ polar and ___ soluble in water.**

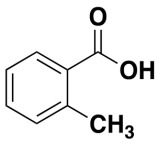
- more; less
- less; more
- more; more ✔
- less; less

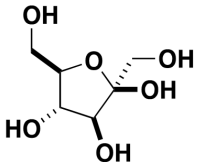
## Extension Questions

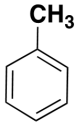
**1. Five compounds and their structures are shown below. For each compound, state whether it is soluble in water, an organic solvent, an acidic solution, and a basic solution.**

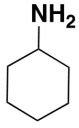
1. **Lithium chloride**
2. **2-methylbenzoic acid**
3. **Fructose**
4. **Toluene**
5. **Cyclohexylamine**

LiCl




**A.** **B.** **C.** **D.** **E.**

(SAMPLE ANSWER BELOW)

1. Lithium chloride is an ionic compound and is soluble in water, acidic, and basic solutions

2. 2-methylbenzoic acid is an acidic organic compound. It is soluble in organic solvents and basic solutions.

3. Fructose is a polar organic compound that is soluble in water, acidic, and basic solutions, and organic solvents.

4. Toluene is a nonpolar organic compound and is only soluble in organic solvents.

5. Cyclohexylamine is a basic organic compound. It is soluble in organic solvents and acidic solutions.