

Solubility Lab

Purpose:

In this lab, you will investigate the solubility of succinic acid ($C_4H_6O_4$) at different temperatures and, as a class, construct a solubility curve for this compound.

Materials Needed:

| | |
|--------------------|--------------------|
| 6 test tubes | Beaker |
| Glass stirring rod | 10 g succinic acid |
| Test tube holder | Ruler |
| Thermometer | Ice |
| Graduated cylinder | Hot plate |
| Test tube rack | Balance |

Safety Precautions:

- Succinic acid is toxic if ingested by mouth. Wash hands with soap and water after the lab.
- If succinic acid crystals or solution hit the hot plate, it will smoke creating a fume that is irritating for the lungs.
- Never stir a solution with a thermometer - use only the stirring rods.
- Use the tongs when removing the beaker from the hot plate to prevent burns.
- You will be sharing a hot plate with another lab group - please be aware of the people around you!

Procedure:

1. Prepare a warm-water bath by adding 300 mL of water to your beaker and placing it on your hot plate.
2. Heat the beaker, stirring occasionally, until your assigned temperature is reached. Using tongs, remove the beaker from the hot plate.
3. Place approximately 4 grams of succinic acid in each of two test tubes. Add 20 mL of distilled water.
4. Place each test tube in your warm water bath and stir every 30 seconds for 7 minutes.
5. Every minute check the temperature of the succinic acid solution to ensure that it is within $2^\circ C$ of your desired temperature.
6. After 7 minutes, carefully decant (pour) the liquid from each test tube into two empty test tubes.
7. Unplug the hot plate. (Do not adjust the temperature setting!)
8. Carefully pour the hot water from your beaker into the sink.
9. Prepare a cold-water bath by filling your beaker with water and ice.
10. Place the two test tubes containing the clear liquid into the cold water bath for two minutes. Stir once or twice.
11. Remove the test tubes from the cold-water bath and allow them to sit at room temperature for 5 minutes.
12. Swirl the liquid once or twice so that the forming crystals settle at the bottom.
13. Measure the height of the crystals in the test tubes in millimeters (mm) and record in the data table below.
14. Rinse the succinic acid crystals from the test tubes into the collection beaker.
15. Clean up lab area.
16. Wash your hands thoroughly with soap and water!

Group Data:

| Temperature: ___ °C | |
|---------------------|---------------------|
| Trial | Crystal height (mm) |
| 1 | |
| 2 | |
| Average | |

Class Data:

| Temperature: 45 °C | | Temperature: 55 °C | | Temperature: 60 °C | | Temperature: 65 °C | |
|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|
| Group | Crystal Height (mm) | Group | Crystal Height (mm) | Group | Crystal Height (mm) | Group | Crystal Height (mm) |
| 1 | | 1 | | 1 | | 1 | |
| 2 | | 2 | | 2 | | 2 | |
| Avg. | | Avg. | | Avg. | | Avg. | |

Insert Graph

Analysis Questions:

1. Was the heated succinic acid solution saturated or unsaturated? How do you know?
2. When you decanted the heated succinic acid solution was it saturated, unsaturated or supersaturated? How do you know?
3. Before you stirred the cooled succinic acid solution, was it saturated, unsaturated or supersaturated? How do you know?
4. Explain why succinic acid crystals formed and settled to the bottom of the test tube once the solution was cooled.
5. Why is it important to collect data from more than one trial?
6. What procedures in this lab might have led to errors?
7. Use the solubility curve that the class constructed to estimate the crystal height for succinic acid at 50 °C.