

University of Utah Chemistry Demonstration:

Rainbow Reaction:

Solutions for the experiment:

Many of the following solutions might already be prepared. Please check before remaking.

SAFETY

Conc. H₂SO₄.....highly corrosive
Wear gloves when preparing H₂SO₄
solutions. Rinse skin/eyes under H₂O
for 15 mins. if skin/eyes come in
contact with H₂SO₄.

- Indicators: Add the following amounts listed below to 30 mL 95% EtOH in individual pre-labeled glass bottles available in the lab. Be sure to bring individual pipets for each indicator.
 - Red: 1.5 g phenolphthalein + 3 g nitrophenol
 - Orange: 0.45 g phenolphthalein + 6 g nitrophenol
 - Yellow: 6 g nitrophenol
 - Green: 0.6 g thymolphthalein + 6 g nitrophenol
 - Blue: 1.5 g thymolphthalein
 - Violet: 0.9 g phenolphthalein + 0.4 g thymolphthalein
- Acid-Alcohol Solution: Add 2.8 mL concentrated H₂SO₄ to 1 L distilled H₂O. CAUTION. Wear gloves when preparing, and add acid slowly to the water to prevent splashing. Add 1 L 95% EtOH. Transfer to a 2 L Nalgene bottle, or other container easy for pouring.
- H₂SO₄-Glycerin Solution: Wear gloves to prepare. Add 10 mL conc. H₂SO₄ to 20 mL glycerol. Transfer this solution to the pre-labeled bottle available in the lab. Caution: this is an exothermic rxn.
- Base Solution: Add 1 g NaOH to 2 L distilled H₂O. Transfer to a 2 L Nalgene bottle, or other container easy for pouring. (You will need just about the whole 2 L for the experiment).

Preparation:

Prepare all above solutions before you leave the lab.

Do the following prep at the location of the demonstration:

- Place 6-600mL beakers in a row. Add 2 drops of the red indicator into one beaker, 2 drops of the orange indicator into the next beaker, and continue as above with the other indicators into the remaining beakers. Make sure you keep track of the order of the beakers. You want to keep the beakers in red, orange, yellow, green, blue, violet order. If you want to further dissolve the indicators at the bottom of the beakers, add a few drops of 95% EtOH. The indicators should not be visible in the beakers when you start the experiment.
- Add 25 drops of the H₂SO₄-glycerin solution to the bottom of a 2 L or larger beaker.

Instructions:

- Make sure the beakers with the indicators are placed in correct order.
- Starting with red, pour ~30 mL of the acid-alcohol solution into each beaker. You will observe that there is no color change.
- Now into each beaker pour ~30 mL of the base solution. There is still no color change because it is not enough base to develop the colors.

- Starting with red pour more of the base solution into each beaker until the color develops. About 150 mL in each beaker.
- Next add 2 drops of the H₂SO₄-glycerin solution into each beaker. The colors will stay until you stir each beaker with a stirring rod.
- The solutions are now colorless. To redevelop the colors add base (starting with red...) until the color reappears. About 100 mL in each beaker.
- All beakers should be colored. Take the two outside beakers (red and violet) and pour them simultaneously into the large beaker with the H₂SO₄-glycerin solution already at the bottom. When the two colored solutions meet and are poured into the beaker, the solution will turn colorless. Repeat pouring two colors at once into the large beaker (orange & blue, and yellow & green). The end!

Disposal: The final solution can be poured down the drain

This is an experiment in acid/base chemistry. Each indicator turns a different color in the presence of base, and turn to colorless in the presence of acid.

