Prelab Information for Experiment #3:

Title: Studying $S_N1$ and $S_N2$ Reactions: Nucleophilic Substitution at Saturated Carbon

Ima Student — Date of Experiment
Partner's name goes here — TA's name and section

Purpose: [Paraphrase the purpose in your lab manual, using complete sentences.] The purpose of this experiment is to: 1) Synthesize an alkyl bromide from a primary alcohol using $S_N2$ chemical conditions, and 2) Examine some of the factors that contribute to the overall rate of $S_N1$ chemistry.

Part 1: SYNTHESIZING 1-BROMOBUTANE USING MACROSCALE TECHNIQUES

Mechanism: [This is where you would draw out your reaction mechanism, using proper arrows and all protonation and deprotonation steps.]

Reagents: [This is where your reagents table would go. This time I'll help! M.W.= molecular weight, B.P.= boiling point ]

| Name of Reagent | M.W. | B.P. | density | hazards |
|---|---|---|---|---|
| 1-butanol | 74.1 | 118 | 0.810 | flammable |
| Hydrobromic acid | 80.9 | | 1.49 | Corrosive, toxic |
| Sulfuric Acid | 98.1 | 280 | 1.84 | Corrosive, toxic |
| Sodium Bicarbonate soln | | | | Corrosive |
| 1-bromobutane | 137.0 | 102 | 1.276 | Flammable, irritant |

Procedures:

1) Make a 300 ml ice bath in a 400 ml beaker.
2) Place a boiling chip, 5.0 grams of butanol, and 10 ml HBr and allow the mixture to cool.
3) Add slowly, with stirring, 4 ml $H_2SO_4$.
4) Assemble a reflux and allow the mixture to reflux for 1 hour.
5) Remove from heat and allow the mixture to cool in a water bath. Add 10 ml water and add another boiling chip
6) Assemble a distillation apparatus and distill off 10-15 ml ml directly into a test tube.
7) Add 5 ml to the test tube, mix, and remove the upper aqueous layer.
8) Wash with 5 ml 5% $NaHCO_3$ solution
9) Wash with 5 ml water.
10) Dry with anh. $CaCl_2$ for 10 min.

11) Weigh product into a tared vial.
12) Record an IR of the product.
[During any of the glassware steps, feel free to sketch what the actual apparatus looks like. This will decrease the time that you will spend putting together the glassware.]

PART 2: FACTORS AFFECTING THE RATES OF $S_N1$ REACTIONS

Mechanism: [typical $S_N1$ stuff, but you need to draw it out !!!]

| Name of Reagent | M.W. | B.P. | density | Hazards |
|---|---|---|---|---|
| 2-bromopropane | | | | |
| 2-propanol | | | | |
| 0.5 M NaOH soln | N/A | N/A | N/A | Corrosive, toxic |
| phenolphthalein | N/A | N/A | N/A | flammable |
| 2-bromo-2-methyl propane | | | | |
| 2-chloro-2-methyl propane | | | | |

[I found the information to fill out the last table in the lab manual. You need to look these things up BEFORE you get to lab.]

Procedures:
Part A: Leaving Group Effects
1) Prepare a 50% propanol solution and place 50 ml of the solution into each of two 125 ml Erlenmeyer flask.
2) Add 5 drops of phenolphthalein and 200 µl of 0.5M NaOH solution to each Erlenmeyer flask.
3) Add 50 µl 2-bromo-2-methyl propane with swirling. Record the time required for the solution to clear.
4) Add 50 µl 2-chloro-2-methyl propane with swirling. Record the time required for the solution to clear.

Part B: Alkyl Group Effects
1) Prepare a 50% propanol solution and place 50 ml of the solution into each of two 125 ml Erlenmeyer flask.
2) Add 5 drops of phenolphthalein and 200 µl of 0.5M NaOH solution to each Erlenmeyer flask.
3) Add 50 µl 2-bromo-2-methyl propane with swirling. Record the time required for the solution to clear.
4) Add 50 µl 2-bromopropane with swirling. Record the time required for the solution to clear. If the solution fails to clear in 15 min, record the time as greater than 15 min.

Part C: Solvent Polarity Effects
1) Prepare 50 ml of 40% propanol solution and place it into a 125 ml Erlenmeyer flask

2) Prepare 50 ml of 60% propanol solution and place it into a 125 ml Erlenmeyer flask
3) Add 5 drops of phenolphthalein and 200 µl of 0.5M NaOH solution to each Erlenmeyer flask.
4) Add 50 µl 2-bromo-2-methyl propane with swirling to each Erlenmeyer flask. Record the time required for the solutions to clear

Prelab questions: [ You need to answer these as part of your prelab exercise!!. I'll write out a few questions and answers, but then you are on your own!]
1) Why should care be exercised in handling concentrated acids?

Contact with acids is bad because the acids are highly corrosive and can cause irreversible damage especially with skin and the eyes.

2) Why do primary alkyl halides undergo $S_N2$ reactions more rapidly that secondary and tertiary alkyl halides?

Primary alkyl halides are less hindered at the site of backside attack so that the reaction can take place more easily and hence more rapid conversion to the bromide can take place.

4) By observing the reaction mixture, what visual evidence can be obtained that 1-butanol is being converted to 1-bromobutane?

5) etc.

6) etc.
7) etc.
8) etc.
and 9) etc.

This is what we want for a prelab for this experiment!
Cheers!
LPS