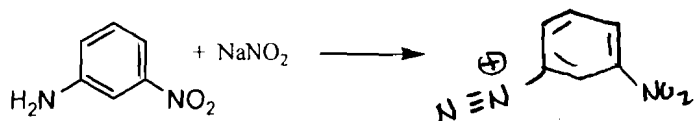


Chem 252 Exam #1 (80 pts)

Name Benjamin Braddock

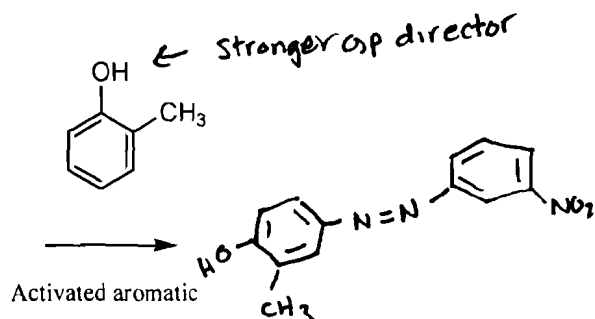
1. (6 pts) For the following azo dye synthesis (reaction #1) fill in the missing structures of the diazonium salt and the azo dye.

Reaction #1



primary amine

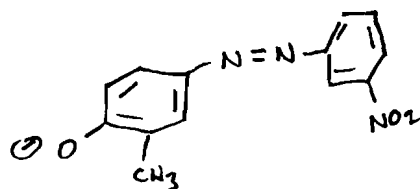
Diazonium salt



Activated aromatic

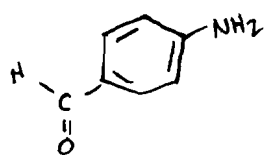
Azo dye

b. (4 pts) For reaction #1, draw the structure of the Azo dye at pH 10.

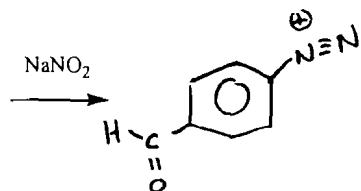


2. (9 pts) For the following azo dye synthesis (reaction #2) fill in the 3 missing structures of the primary amine, diazonium salt and the activated aromatic.

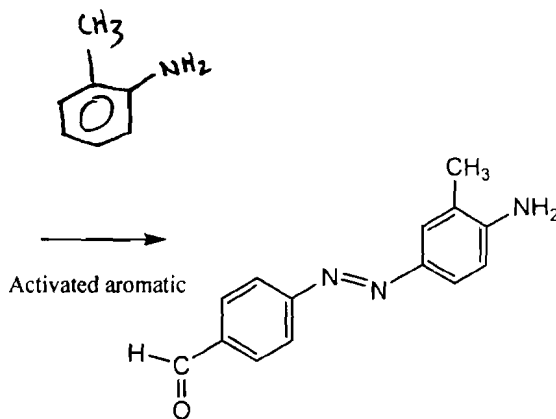
Reaction #2



primary amine



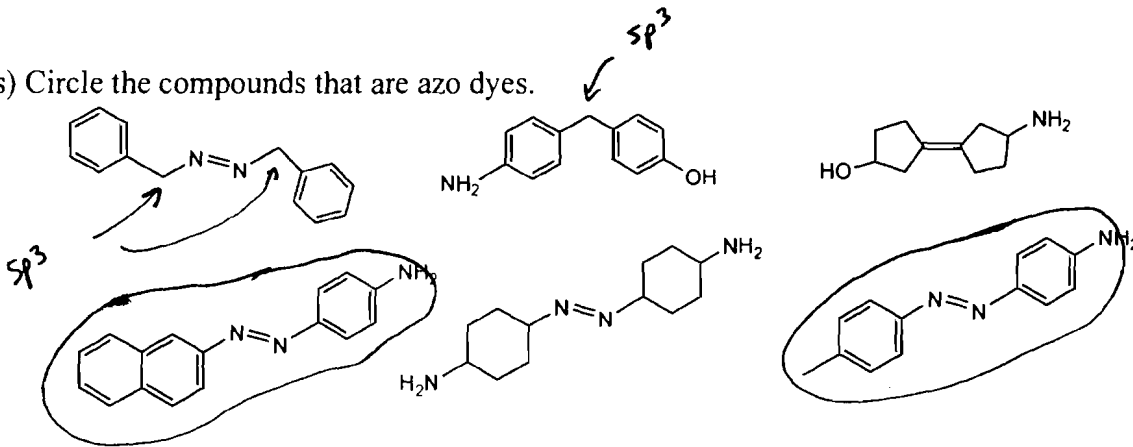
Diazonium salt



Activated aromatic

Azo dye

3. (6 pts) Circle the compounds that are azo dyes.

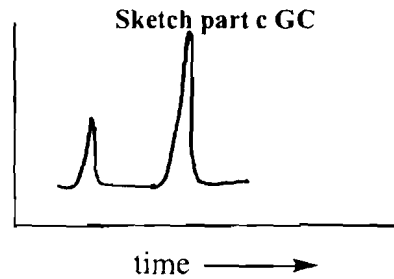
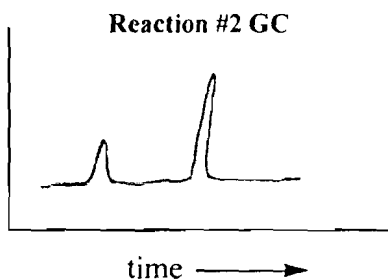
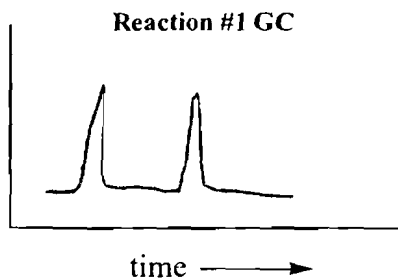
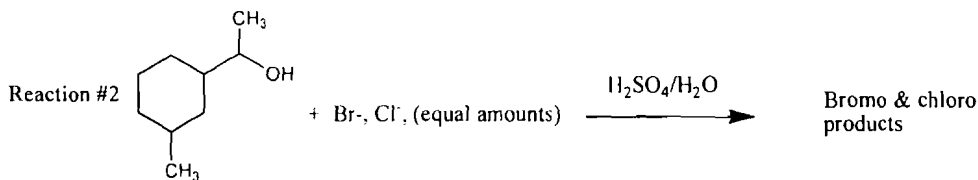
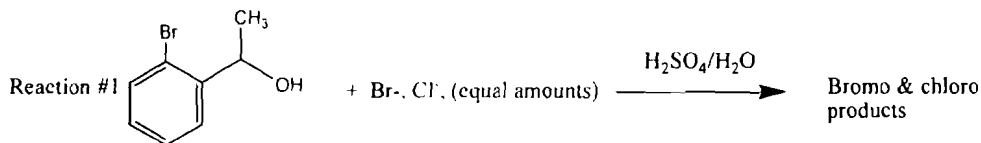


4. (3 pts) When you performed the competing nucleophile lab (PLKE21A & B) which purification technique(s) listed below would be a way to purify and separate the chloro product from the bromo product (circle all that would apply).

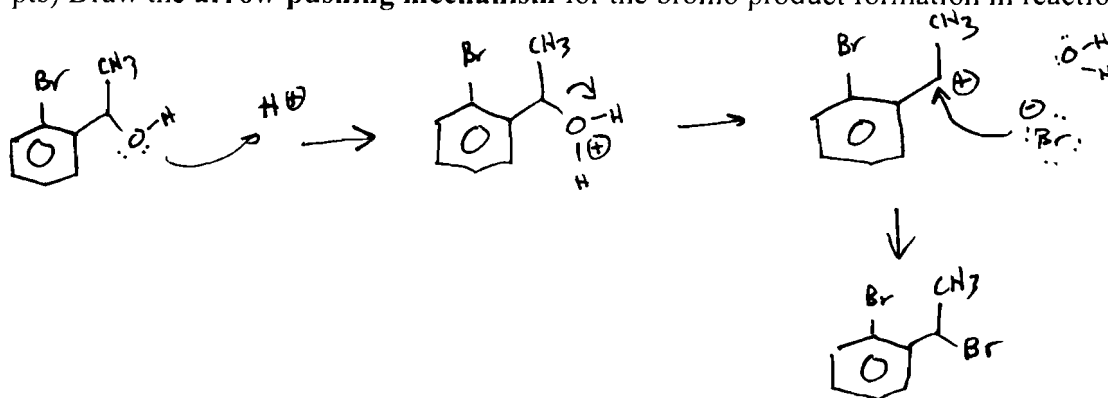
- 1) Recrystallization, 2) Acid/base extraction, 3) Distillation, 4) Chromatography, 5) Wishful thinking.
- Handwritten notes: "solids" under 1, "Both neutral" under 2, "liquids" above 3 and 4, "Chromatography" circled, "Wishful thinking" circled.*

5. Reaction #1 and #2 listed below are 2 substitution reactions similar to the what you did in lab (PLKE21A & B). Also shown are the GC results for each reaction.

- a. (4 pts) From the GC results what was the mechanism for reaction #1? (Sn1 or Sn2) Sn1 - equal amounts Cl/Br
- b. (4 pts) From the GC results what was mechanism for reaction #2? (Sn1 or Sn2) Sn2
- c. (4 pts) Sketch the GC for reaction #1 if there was **twice as much Br<sup>-</sup> present** than Cl<sup>-</sup> (the nucleophilic solution did **not** contain an **equimolar** amount of Br<sup>-</sup> and Cl<sup>-</sup> ions). Make the sketch in the 3<sup>rd</sup> GC below.



d. (6 pts) Draw the **arrow pushing mechanism** for the bromo product formation in reaction #1.

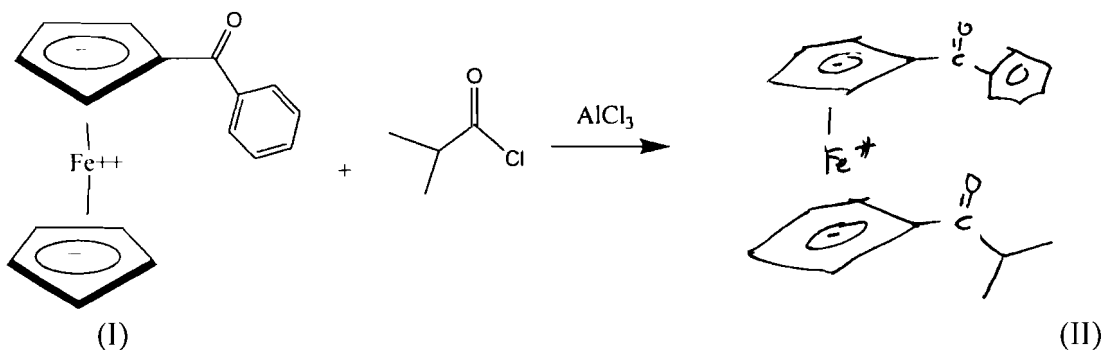


e. (3 pts) Explain the difference in the reaction mechanism outcome for reaction #1 and #2 (why didn't they have the same mechanism?)

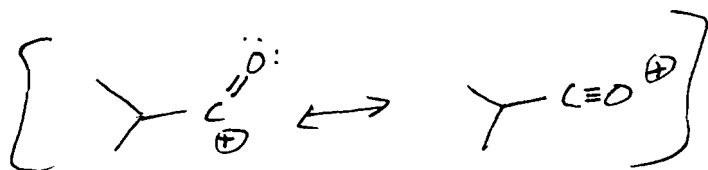
in #1 we have a very stable benzylic cation formation etc.

in #2 is only a 2° cation, not easily formed so  $S_N2$  can compete with  $S_N1$

6.a (4 pts) Monobenzoyl ferrocene (I) is reacted with one equivalence of isopropoyl chloride and aluminum chloride to generate a disubstituted ferrocene (II). Depict the disubstituted ferrocene product (II).



b) (3 pts) Depict the 'electrophile' that reacts with (I) in the above reaction.

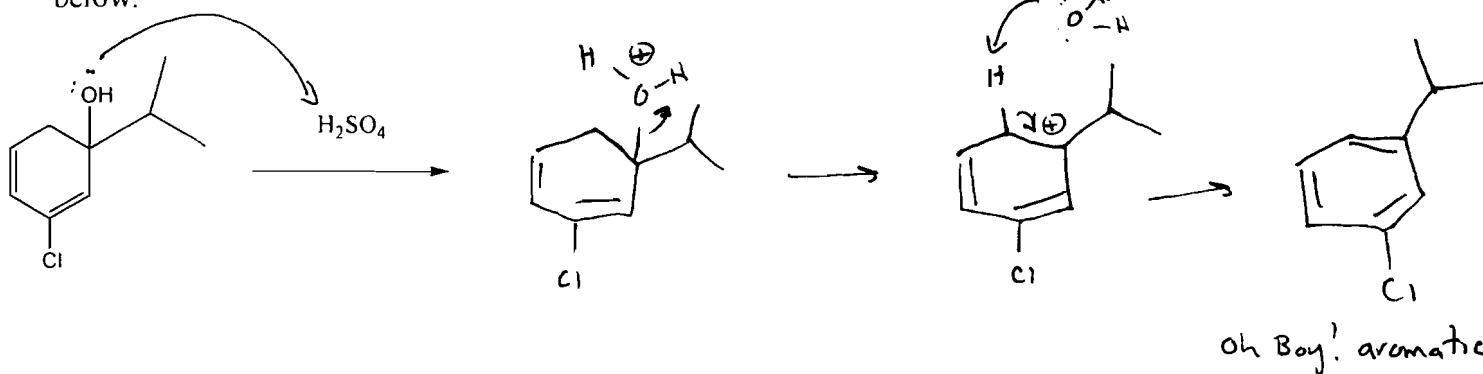


c) (3 pts) If you had to purify your product by column chromatography which compound (I) or (II) would come off the column first?

I - is less polar, no less C=O group.

d) (3 pts) The **mechanism** for the reaction above is (circle one) 1)  $S_N2$ , 2)  $S_N1$ , 3) addition reaction, 4) nucleophilic acyl substitution, 5) Electrophilic aromatic substitution

6. a) (8 pts) Draw the reaction mechanism and products for the alcohol dehydration reaction shown below.



b) (4 pts) For the reaction above, circle what is true regarding sulfuric acid ( $\text{H}_2\text{SO}_4$ )

- a. sulfuric acid is considered a catalyst
- b. sulfuric acid helps shift the equilibrium to the right
- c. sulfuric acid is consumed in the reaction (is not regenerated)
- d. Without sulfuric acid the reaction rate would be much slower.

c) (3 pts) For the reaction above, how could you ensure that the reaction equilibrium is shifted to the right (formation of the products). *Removal of the products  $\text{H}_2\text{O}$  or the alkene as its formed.*

d) (3 pts) At the end of the experiment above (as well as what you did in lab), sodium sulfate is added to the product. What is the purpose of this?

*To Dry the organic product (remove the water from the organic product)*

**Extra credit (2 pts)** Interpret the following Nasrudin story:

In the teahouse, some soldiers were boasting about their recent campaign. The local inhabitants crowded eagerly around them to listen. "And", one fearsome-looking warrior was saying, "I took my double-edge sword and charged the enemy, scattering them to right and left like chaff. We carried the day."

There was a gasp of applause. "That reminds me", said Nasrudin, who had seen a few battles in his time, 'of the time when I cut off the leg of an enemy on the battlefield, Severed it right through.'

'You would have done better, sir,' replied the captain of the soldiers, 'to have cut off his head.'

'That would have been impossible,' said Nasrudin. 'You see, someone else had already done that.'