

CHEM 3331 (Richardson) Midterm Exam 2 – Jul. 25, 2023

Your Name: _____

Student ID: _____

Recitation (fill in one circle):

O 211 (Charlie Lu)

O 212 (Kajal)

O 213 (Mia Muse)

O 214 (Kylie Fisch)

Question	Score	Out of
1		15
2		25
3		30
4		30
5		10 e.c.
Total		100

This is a closed-book exam, except for one double-sided sheet of 8.5 x 11” paper. The use of calculators or cell phones will not be allowed during the exam. You may use models sets brought in a clear bag. Use the backs of the pages for scratch work. If your final answer is not clearly specified, you will lose points. For mechanisms, show all intermediates including correct formal charges, but do not show transition states.

Periodic Table of the Elements

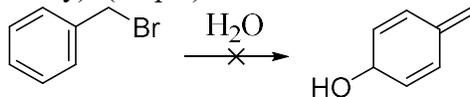
The periodic table includes the following series:

- Lanthanide Series:** 57 La (138.905), 58 Ce (140.116), 59 Pr (140.908), 60 Nd (144.243), 61 Pm (144.913), 62 Sm (150.36), 63 Eu (151.964), 64 Gd (157.25), 65 Tb (158.925), 66 Dy (162.500), 67 Ho (164.930), 68 Er (167.259), 69 Tm (168.934), 70 Yb (173.055), 71 Lu (174.967).
- Actinide Series:** 89 Ac (227.028), 90 Th (232.038), 91 Pa (231.036), 92 U (238.029), 93 Np (237.048), 94 Pu (244.064), 95 Am (243.061), 96 Cm (247.070), 97 Bk (247.070), 98 Cf (251.080), 99 Es (254), 100 Fm (257.095), 101 Md (258.1), 102 No (259.101), 103 Lr (262).

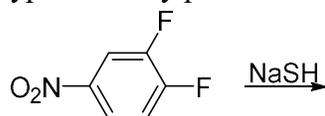
pKa Values

HI	-10	CH ₃ COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN ₃	4.7	RSH	10-12	H ₂	35
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	NH ₃	36
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH	16-18	H ₂ C=CH ₂	45
HF	3.2	HCN	9.4	O=C-CH	9-25	CH ₄	60

- 1) Explain why the following product is not observed in this S_N1 reaction, in thirty words or less (plus structures if necessary). (15 pts)

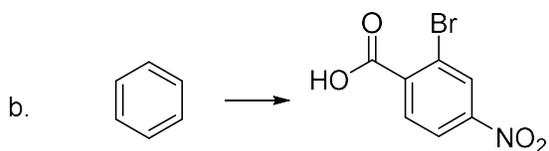
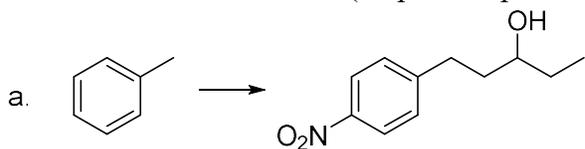


- 2) The reaction shown below could hypothetically produce multiple products. (25 pts)

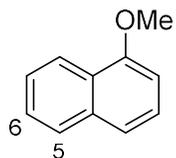


- Show the mechanism for the replacement of the upper fluorine, including all resonance forms for the intermediate. (10 pts)
- Show the mechanism for the replacement of the lower fluorine, including all resonance forms for the intermediate. (10 pts)
- In twenty words or less, explain which of these outcomes is favored and why. (5 pts)

- 3) Find a way to synthesize the desired product from the given starting material plus any other organic molecules needed. If more than one step is necessary, show the product of each step. Do not show mechanisms. (30 pts - 15 pts each)



- 4) In an effort to understand the mechanism for nitration, you react 1-methoxynaphthalene with HNO_3 and H_2SO_4 . (30 pts)



1-methoxynaphthalene

- a. Show the mechanism for nitration at carbon 5, including all resonance forms. (10 pts)
- b. Show the mechanism for nitration at carbon 6, including all resonance forms. (10 pts)
- c. Which reaction is faster, and why? (10 pts)
- 5) Extra credit! In the lab one day, you react the compound shown below with H_2SO_4 , and get a product with the formula $\text{C}_{15}\text{H}_{20}$. You mix the product with Br_2 but find that it does not undergo any reaction. Draw the product and give a curved-arrow mechanism for its formation. (10 pts e.c.)

