Answer Key

Chemistry 234-101
Exam 1 – Version A

Summer 2019 Dr. J. Osbourn

Instructions: Answer the first 16 questions of this exam using the bubble sheet attached to the end of this exam booklet. You may detach this sheet if you wish. Answer the remaining questions directly on this exam. Show all work and provide complete explanations.

The Periodic Table

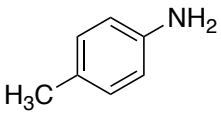
IA																	VIIIA
1 H 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.1	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.6	53 I 126.9	54 Xe 131.29
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac^ (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
^	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

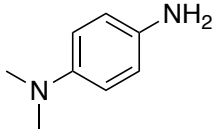
Multiple-Choice

Choose the best answer for each of the following questions. Record each answer on the attached bubble sheet. **Ensure you completely bubble in your answers**. *(2 points each)*

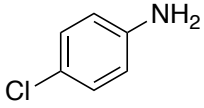
1. Rank the following aniline derivatives from least basic to most basic.



I



II

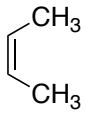


III

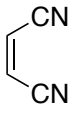
a. I < II < III
b. III < II < I
c. III < I < II
d. II < I < III
e. I < III < II

III < I < II

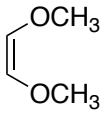
2. Which one of the following would be the best dienophile for a normal Diels-Alder reaction?



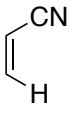
a



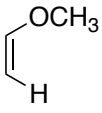
b



c

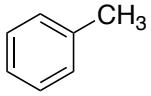


d



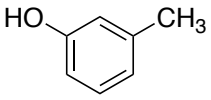
e

3. What is the predominate effect that following substituent has on the aromatic ring?



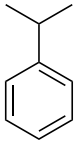
a. Inductive Donation
b. Inductive Withdraw
c. Resonance Donation
d. Resonance Withdraw

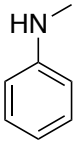
4. The common name for methyl phenol is cresol. What is the best name for the following compound?



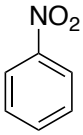
a. *para*-cresol
b. *meta*-cresol
c. *ortho*-cresol

5. Which of the following can undergo a successful Friedel-Crafts alkylation? *Bubble in the letter for all that apply*.

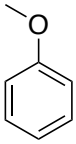

a



b

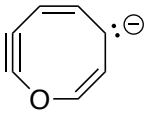


c



d

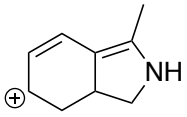
6. How many Pi electrons are present in the following aromatic ring?



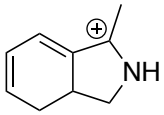
Contributing to aromaticity

a. 6
b. 8
c. 10
d. 12
e. None of the above

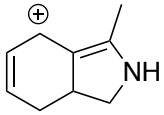
7. Which one of the following is the major resonance contributor?



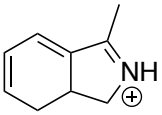
a



b



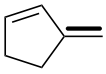
c

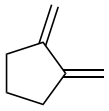


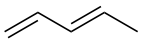
d

8. Which of the following dienes can successfully be used in a Diels-Alder reaction? *Bubble in the letter for all that apply*.

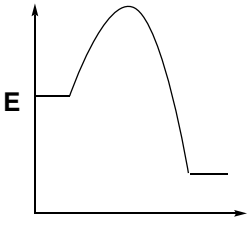

a


b

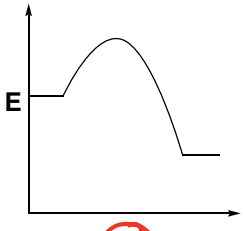

c


d

9. Which reaction coordinate represents formation of a kinetic reaction product?

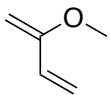
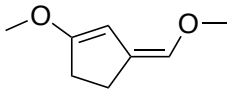
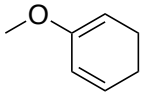
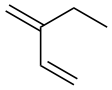


a



b

10. Rank the following dienes from least reactive to most reactive in a normal Diels-Alder reaction.

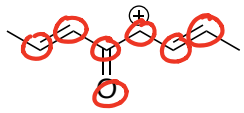





I **II** **III** **IV**

a. I < III < II < IV
b. II < III < IV < I
c. III < II < I < IV
d. IV < I < II < III
e. II < IV < I < III

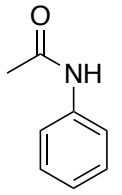
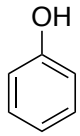
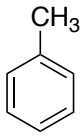
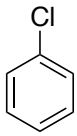
II < IV < I < III

11. How many atoms are in conjugation in the following compound?



a. Four
b. Five
c. Six
d. Seven
e. None of the above

12. Rank the following benzene derivatives from most deactivated to most activated.

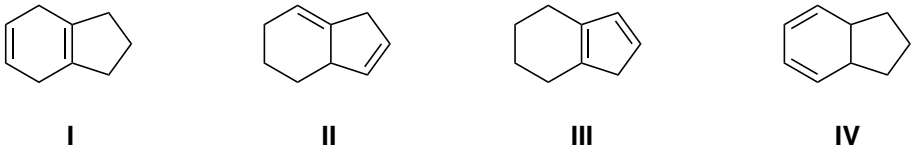





I **II** **III** **IV**

a. IV < III < I < II
b. IV < I < III < II
c. III < I < IV < II
d. III < IV < II < I
e. II < IV < III < I

IV < III < I < II

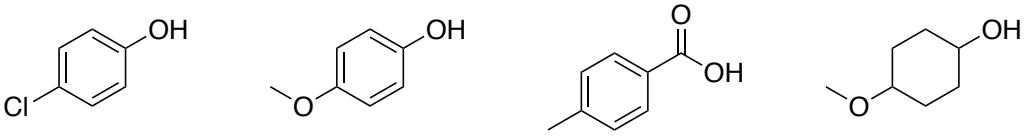
13. In the following series, diene II is the least stable and diene III is the most stable.



I II III IV

a. II, III
b. I, II
c. I, III
d. II, IV
e. I, IV

14. Rank the following from least acidic to most acidic.

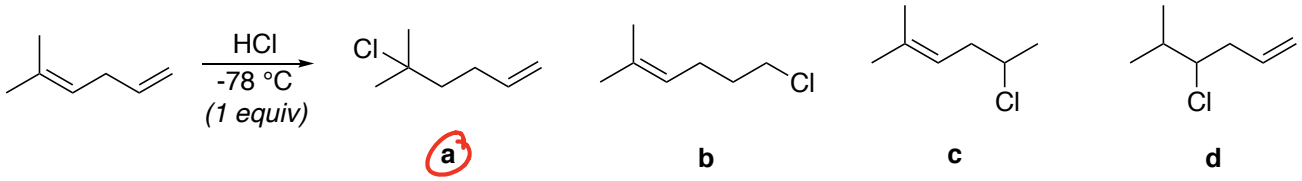


I II III IV

a. IV < II < III < I
b. IV < III < II < I
c. IV < II < I < III
d. II < IV < I < III

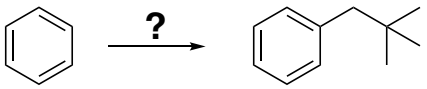
IV < II < I < III

15. What is the major product for the following reaction?

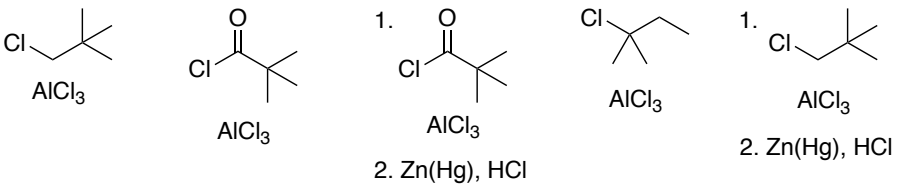


a b c d

16. Choose the best reagent (or reagent set) to accomplish the following transformation.



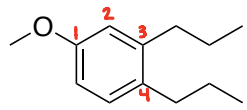
a b c d e



Completion Section

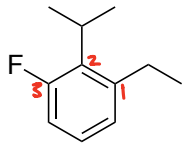
Answer the remaining questions directly on the exam itself. Please write neatly and **darkly** as your answers will be scanned for grading.

17. Provide IUPAC systematic names for each compound shown below. *(3 points each)*

a) 

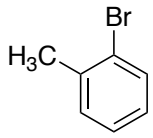
+1 +1 +1

3,4-dipropylanisole

b) 

+1 Correct # +1 Correct Substituents +1

1-ethyl-3-fluoro-2-isopropylbenzene

c) 

+1 +1 +1

Ortho-bromotoluene

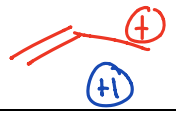
or

1,2-dibromotoluene

or 1-bromo-2-methylbenzene

18. Draw a representative structure for each of the following. *(1 point each)*

No Partial Credit

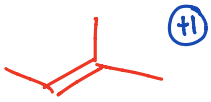


+1

allylic cation

+1

pyridine



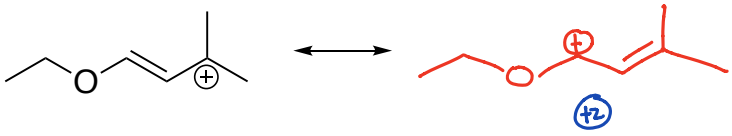
+1

tri-substituted alkene

+1

styrene

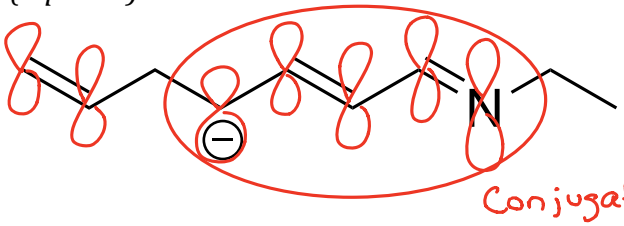
19. Draw the other resonance structures for the structure shown below. Circle the major contributor to the resonance hybrid. *(5 points)*



-1 on Str if missing charge

+1 Circle

20. Draw in all p-orbitals on the following molecule. Then circle the atoms involved in conjugation. *(4 points)*



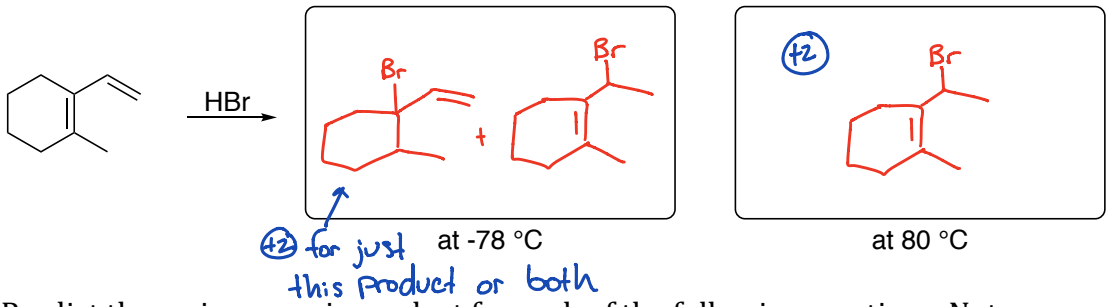
Conjugated

+2 all 7 p-orbitals drawn

• -1 if missing one

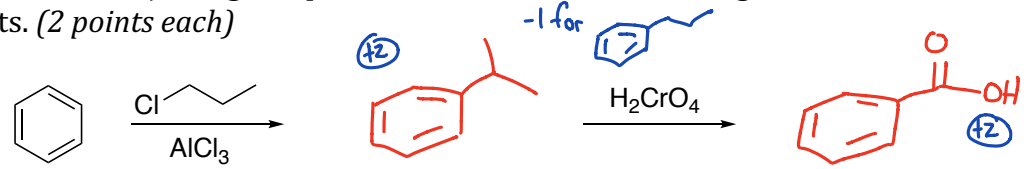
+2 Conjugated system circled

21. Predict the product(s) for the following reaction at the given temperatures. *(2 points each)*



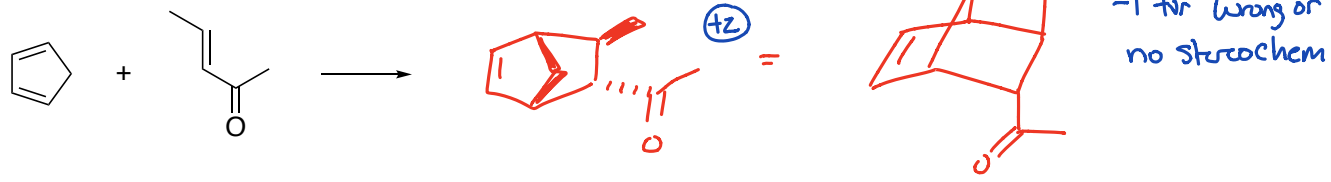
22. Predict the major organic product for each of the following reactions. Note: some steps have two parts. *(2 points each)*

a.

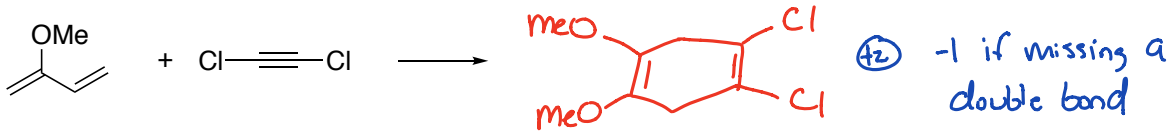


b.

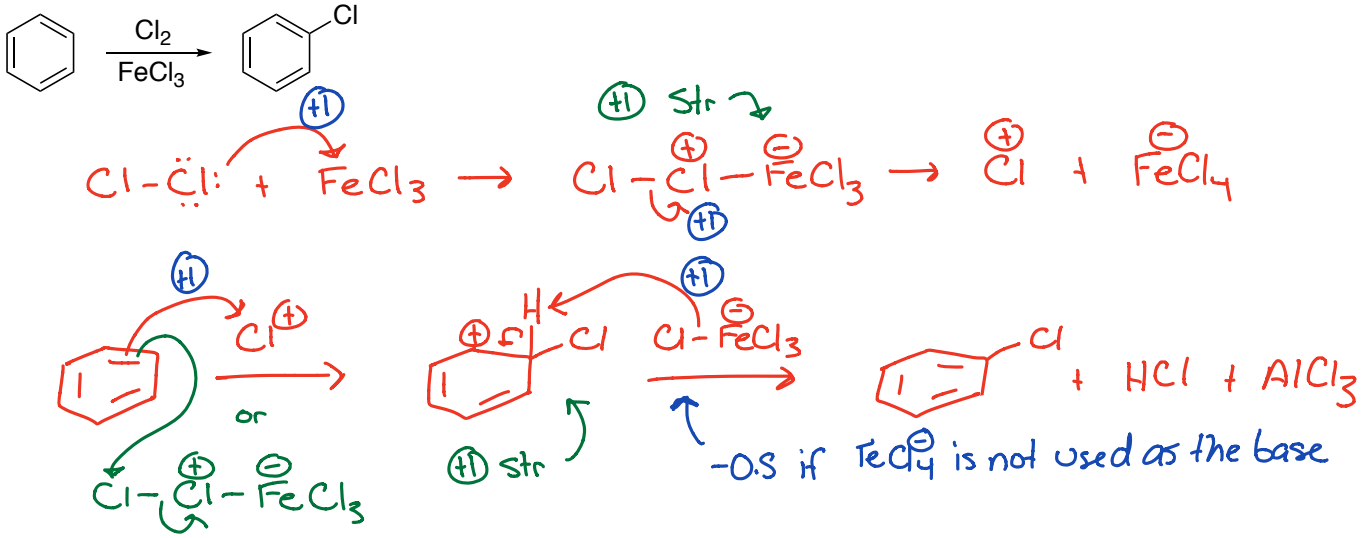
c.



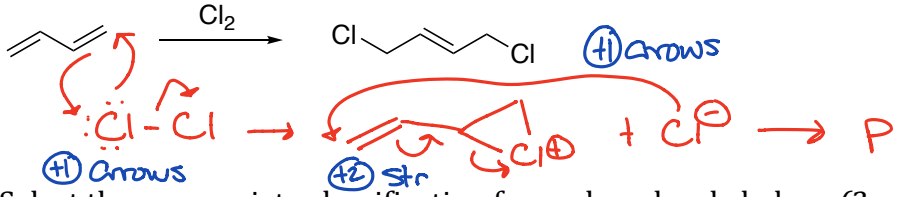
d.



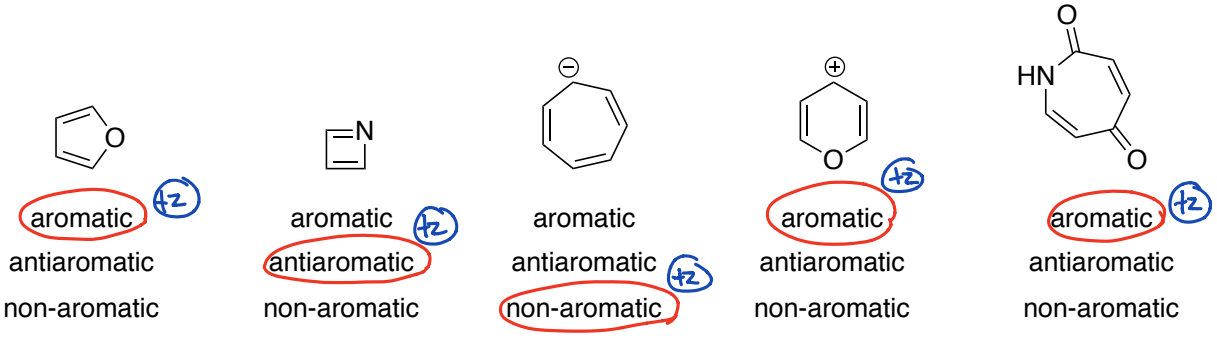
23. Draw the complete electron pushing mechanism for the following reaction. *(6 points)*



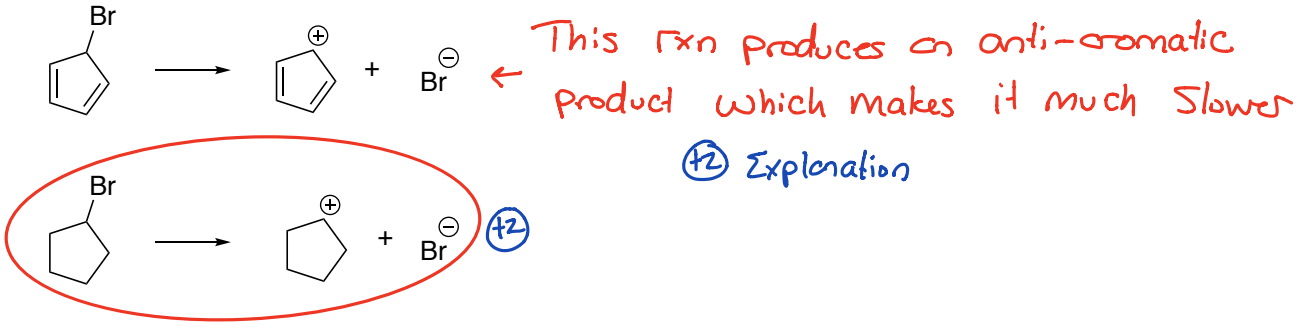
24. Draw the complete electron pushing mechanism for formation of the following product. *(4 points)*



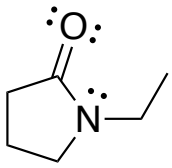
25. Select the appropriate classification for each molecule below. *(2 points each)*



26. Circle the reaction that takes place at the faster rate. Briefly explain your choice. *(4 points)*



27. Consider the following structure and answer the questions below. *(2 points each)*



a. What is the hybridization of the oxygen and the nitrogen?

O = sp^2 +1 N = sp^2 +1

b. In what orbital does the nitrogen lone pair reside?

p-orbital +2

c. Is either lone pair on the oxygen involved in conjugation?

No. +2