Name: Answer Key

Last First MI

Chemistry 234
Exam 2

Fall 2017 Dr. J. Osbourn

Instructions: The first 23 questions of this exam should be answered on the provided Scantron. You must use a pencil for filling in the Scantron sheet. Ensure all erasures are complete. Any questions left blank will be marked incorrect. Answer the remaining questions on the exam itself. Show all work and provide complete explanations.

Please write your name on:

- **The first page (Exam Cover Page)**
- **The second page (Grading Page)**
- **The Scantron Sheet** – Circle your Last Name

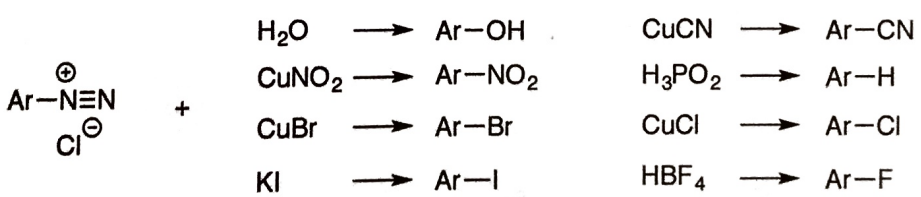
Please bubble in your WVU Student ID Number on your Scantron sheet.

The Periodic Table

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.01																	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											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)

Diazonium Ion Displacement Reactions



Please do not rip off this cover sheet

Name: _____

Last First MI

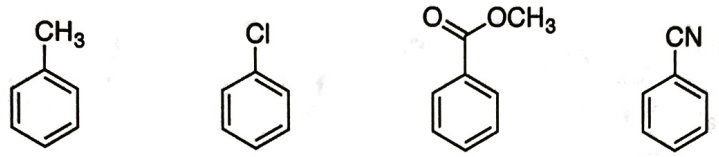
Grading Page (Exam 2):

Page	Points Possible	Points Earned
Multiple Choice (3-7)	46	
8	28	
9	26	
TOTAL	**100**	

Multiple Choice

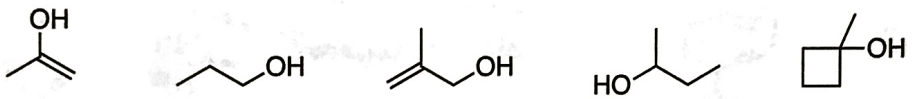
Choose the one best answer for each of the following questions. Bubble your answer in on the provided Scantron sheet. Additionally, circle your answer directly on the exam so that you can check your answers once the key is posted.

1. Which aromatic compound shown below will undergo electrophilic nitration at the fastest rate?



a b c d

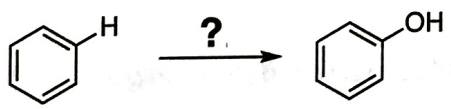
2. Compound III is an allylic alcohol and compound IV is a secondary alcohol.



I II III IV V

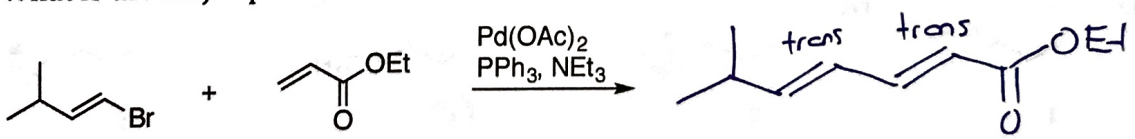
a. I, II
b. I, IV
c. III, V
d. III, II
e. III, IV

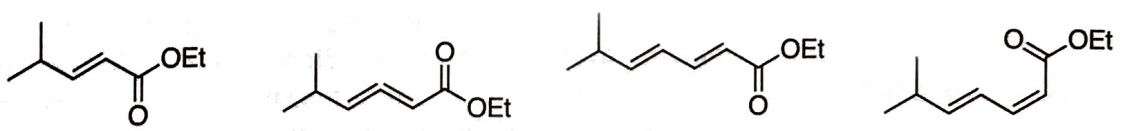
3. Which set of reagents can be used to accomplish the following transformation?



a	b	c	d
1. H_2, Pd/C 2. $NaNO_2$, HCl 3. H_2O	1. HNO_3, H_2SO_4 2. Sn, HCl 3. $NaNO_2$, HCl 4. H_2O	1. HNO_3, H_2SO_4 2. $NaNO_2$, HCl 3. CuOH	1. $NaNO_2$, HCl 2. H_2,Pd/C 3. NaOH

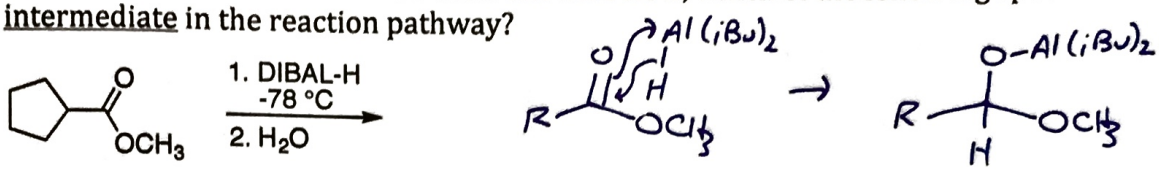
4. What is the major product of the Heck reaction shown below?

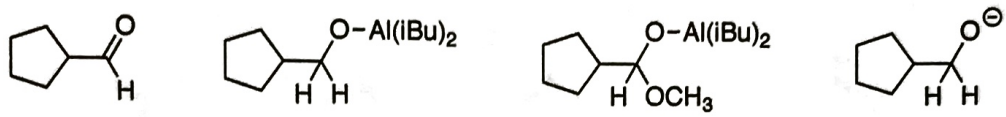




a b c d Both c and d e

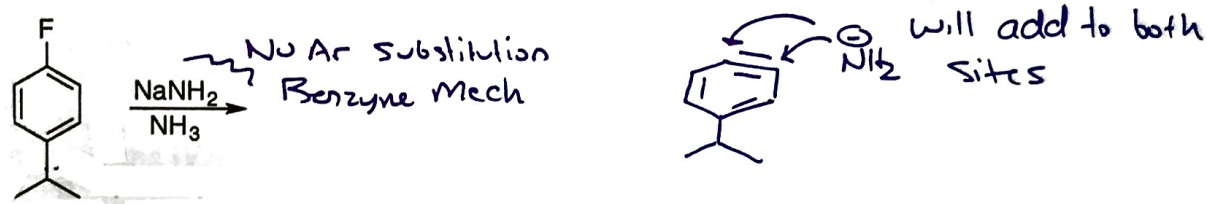
5. In the DIBAL-H reduction of the ester shown below, which of the following species is an <u>intermediate</u> in the reaction pathway?

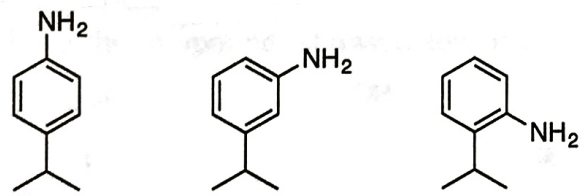




a b c d

6. What is/are the major product(s) in the reaction shown below?

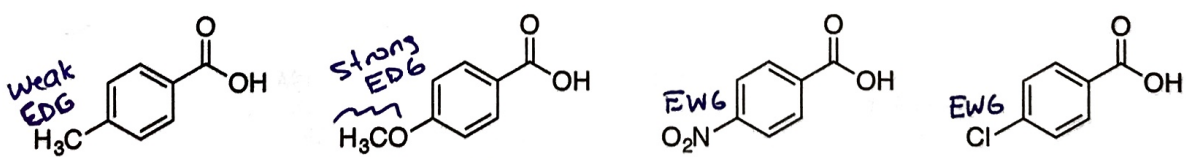




a b c both a and b (d) a, b, and c are all products e

7. Which organometallic reagent shown below would you expect to be the <u>most</u> reactive?
   a. $(CH_3)_2CuLi$
   b. CH_3MgBr
   c. CH_3Li
   d. It is not possible to determine

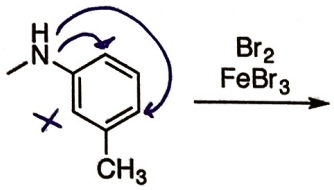
8. Which benzoic acid derivative would you expect to be the <u>least</u> acidic?

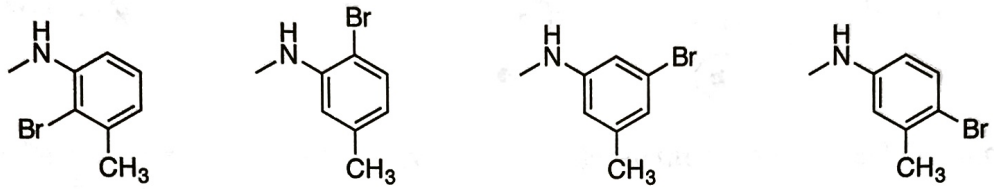


a (b) c d

9. Which statement below is correct regarding pain killing drugs?
   a. Opoids target the μ-receptor in the brain.
   b. NSAIDS work by inhibiting the synthesis of prostaglandins.
   c. Naloxone is a μ-receptor antagonist – it binds to the receptor, but does not activate it.
   d. Morphine was originally isolated from the opium poppy.
   e. All of the above statements are correct.

10. What is/are the major product(s) of the electrophilic aromatic substitution reaction shown below?





I II III IV

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

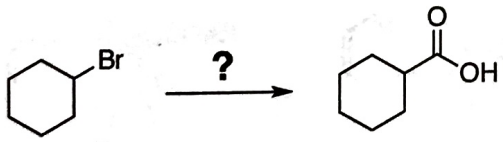
11. Rank the compounds shown below in order of increasing boiling point.

I II III IV

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

IV < I < II < III

12. What reagents are required to carry out the following transformation?



a. $KMnO_4$, OH^-

b. 1. Mg 2. CO_2 3. H_3O^+

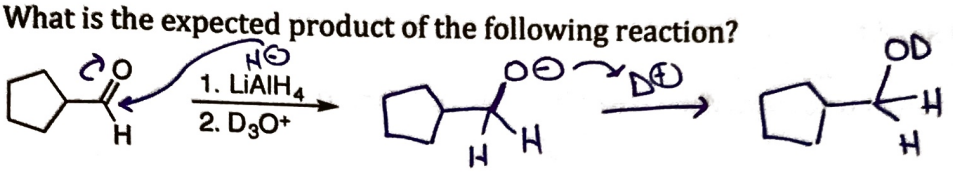
c. 1. Mg 2. NaCOOH

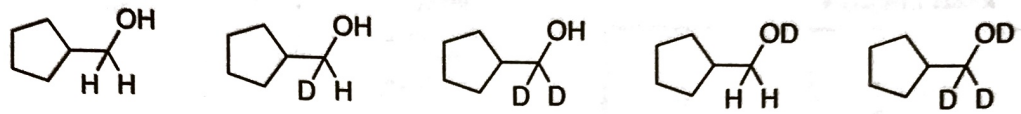
d. 1. Li 2. NaOH 3. H_2CrO_4

e. 1. CH_3Cl, AlCl3 2. H_2CrO_4

13. Which of the following is cyanide's major route of toxicity?
a. It binds to the iron in the blood, which inhibits the ability of oxygen to bind.
b. It shuts down glycolysis by inhibiting lactic acid synthesis.
c. It binds to the lining of the lungs preventing the absorption of oxygen into the bloodstream.
d. It over stimulates the electron transport chain leading to the production of a toxic amount of lactic acid in the body.

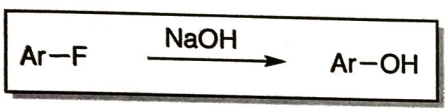
14. What is the expected product of the following reaction?



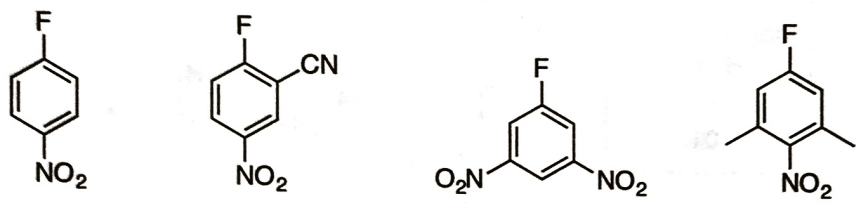


a b c d e

15. Which compound shown below will not undergo the following nucleophilic aromatic substitution reaction?

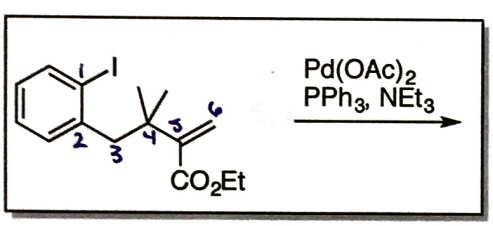


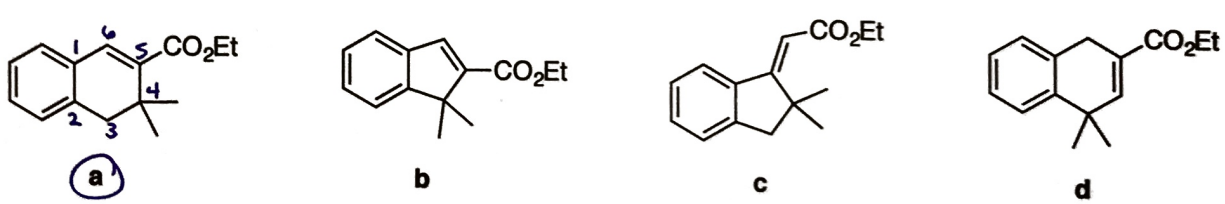
EWG must be ortho and/or para to halogen



a b c d

16. What is the major product of the following intramolecular Heck reaction?

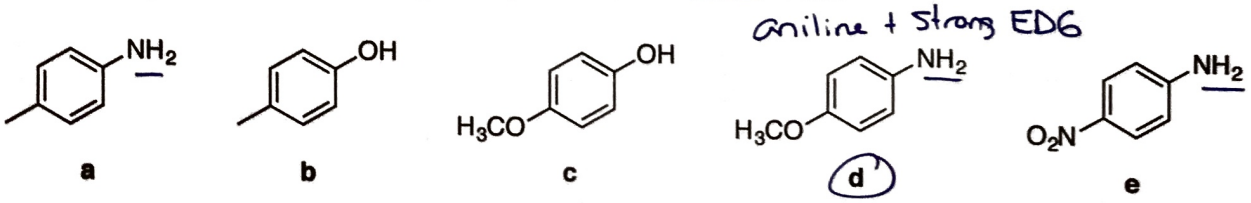




a b c d

17. Which compound below would you expect to be the most basic?

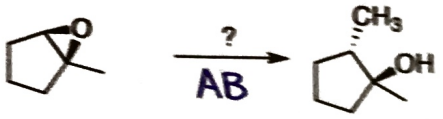
aniline + strong EDG



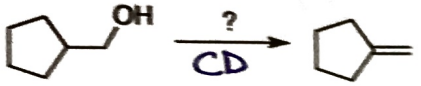
a b c d e

For questions 18-23, select the appropriate reagent from the reagent bank to accomplish each step in the synthetic sequence below. You can only use each reagent once. *Note that some answers may require you to bubble in more than one letter.* ***Record each answer on your Scranton sheet!***

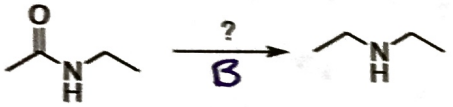
18.



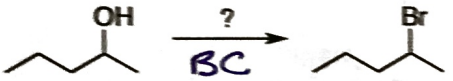
19.



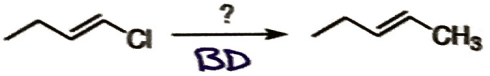
20.



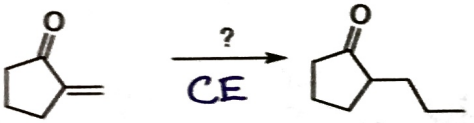
21.



22.



23.



Reagent Bank

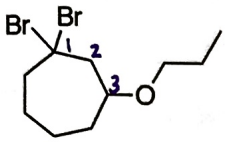
PCC **A**	1. $LiAlH_4$ 2. H_3O^+ **B**	H^+ H_2O **C**
NaBr **D**	$NaBH_4$ CH_3OH **E**	1. CH_3MgBr 2. H_3O^+ **AB**
1. BH_3•THF 2. NaOH H_2O_2 **AC**	$Na_2Cr_2O_7$ H_2SO_4 **AD**	PCl_3 **AE**
HBr **BC**	1. $(CH_3)_2CuLi$ 2. H_2O **BD**	Br_2 H_2O **BE**
$POCl_3$ Pyridine **CD**	1. $(CH_3CH_2)_2CuLi$ 2. H_2O **CE**	

Completion Section: Answer the remaining questions on the exam itself. Read the questions carefully and provide complete explanations.

24. Provide the IUPAC name for each compound shown below. *(3 points each)*

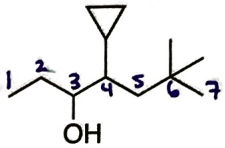
-1 wrong #
-1 wrong abc order of substituents

a)



1,1-dibromo-3-propoxycycloheptane (+1) (+1) (+1)

b)

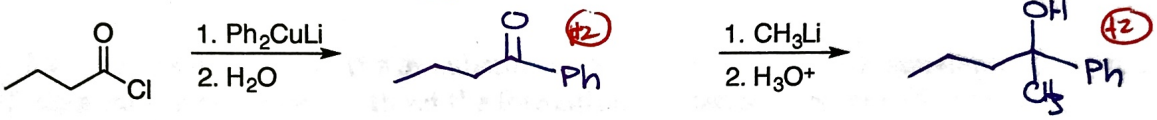


4-cyclopropyl-6,6-dimethyl-3-heptanol (+1) (+1) (+1)
or heptan-3-ol

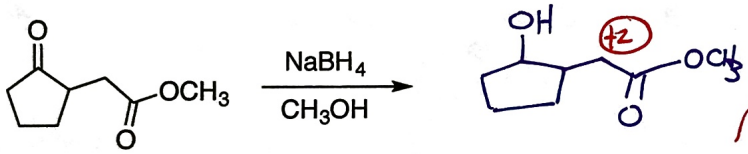
25. Predict the major organic product(s) for each reaction below. *Note: some questions have multiple steps associated with them.* *(2 points each)*

-1 for silly mistakes like forgetting a C as long as it doesn't affect the desired functional group transformation

a.

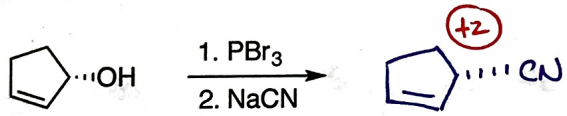


b.



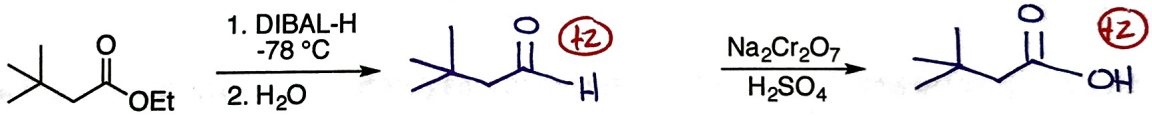
-2 if ester is reduced to -OH

c.



-1 for wrong / no stereochem

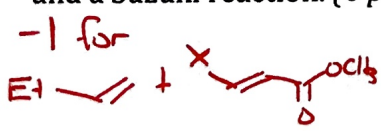
d.

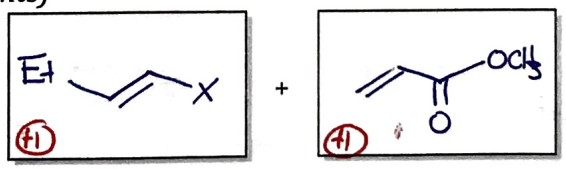


e.

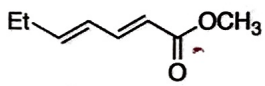
26. Provide the necessary starting materials to prepare the product below using a Heck reaction and a Suzuki reaction. *(6 points)*

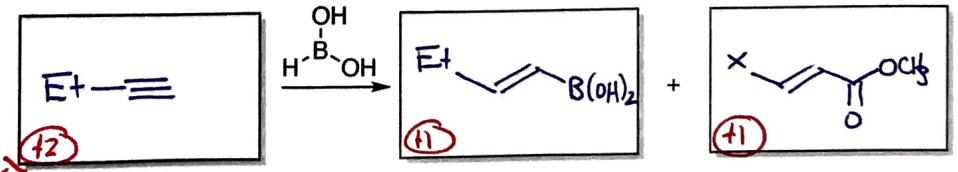
-1 for





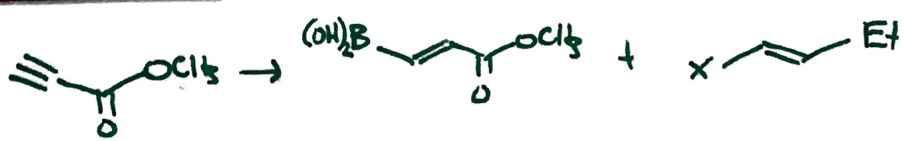
Heck





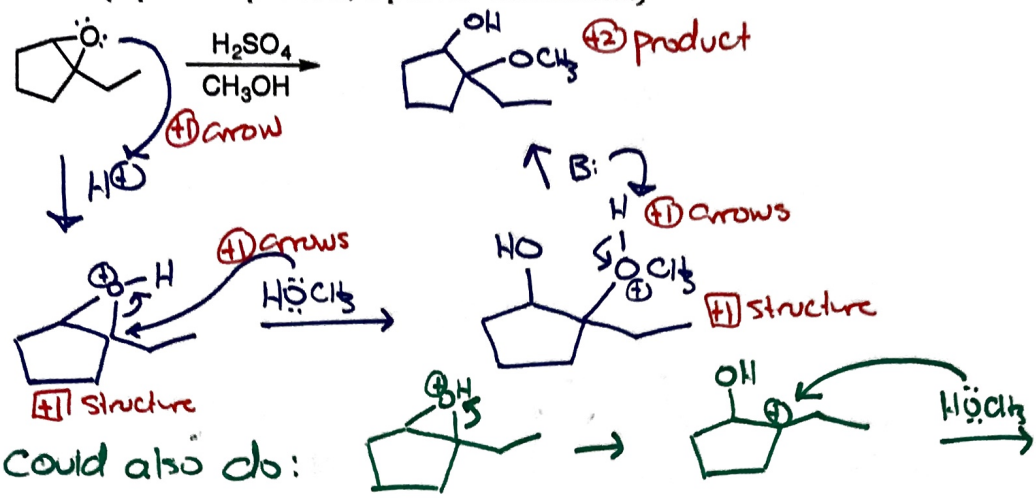
Suzuki

+2 ⇒

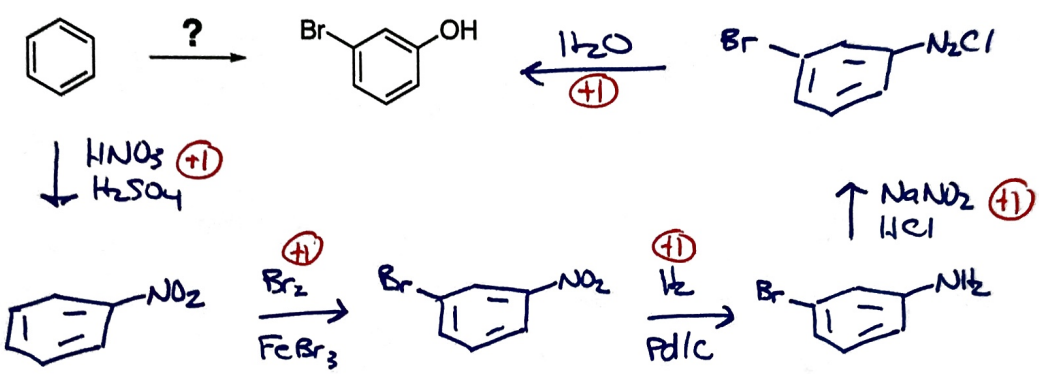


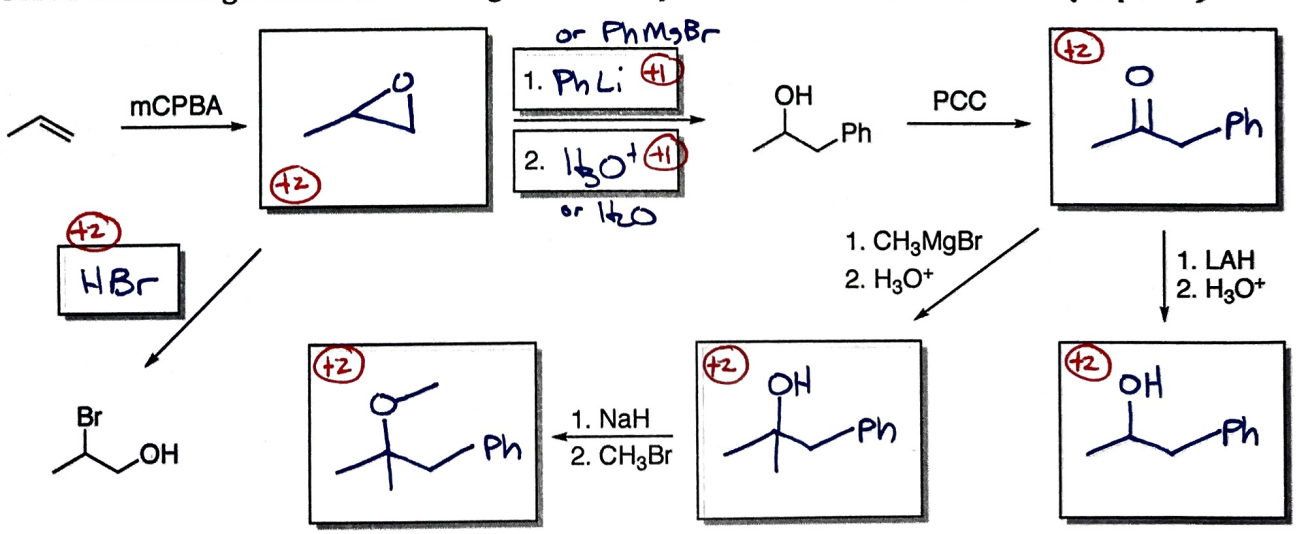
also accept this for Suzuki

27. Predict the product and show the complete electron pushing mechanism for the reaction below. *(2 points – product; 5 points - mechanism)*



28. Provide a valid synthesis for the di-substituted benzene shown below starting with benzene. Each step should take place without the formation of multiple isomers. *(5 points)*



-3 if Br is put on before $-NO_2$

29. Fill in the missing structures and reagents in the synthetic scheme shown below. *(14 points)*