

Name: **KEY**

**EXAM #2**                      **WEDNESDAY, MARCH 25, 2009**  
**ORGANIC CHEMISTRY II**                      **4:122**

Instructions: Print your name in the spaces provided on every sheet of the exam. Failure to do so will lead to loss of credit.

Make sure that you do the problems on the front and back of every sheet.

On multiple choice questions, clearly circle the answer that you think is correct.

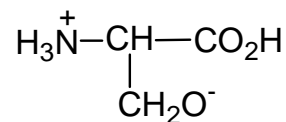
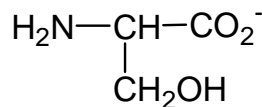
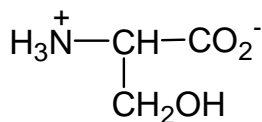
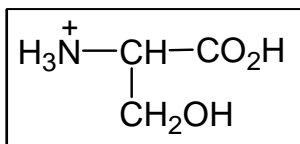
Exams that are done in pencil, red ink, erasable ink, or that have white-out on them will not be regraded.

Question #	Possible Points	Point Scored
1	30	_____
2	14	_____
3	12	_____
4	16	_____
5	20	_____
6	8	_____
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	100	

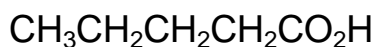
**TOTAL**

1. Multiple Choice Questions. Clearly circle your chosen answer. (30 points; 3 apiece)

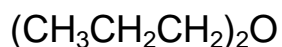
a) Which is the structure of serine at pH = 1? (Problem 19.58b, p 720)



b) Rank the compounds below in order of increasing boiling point. (Problem 19.31a, p 714)



**A**



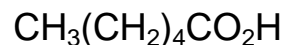
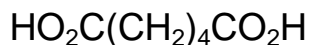
**B**



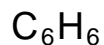
**C**



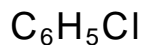
c) Which compound is malonic acid?



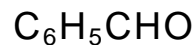
d) Rank the following compounds in order of increasing reactivity in electrophilic aromatic substitution? (Problem 18.41b, p 682)



**A**



**B**

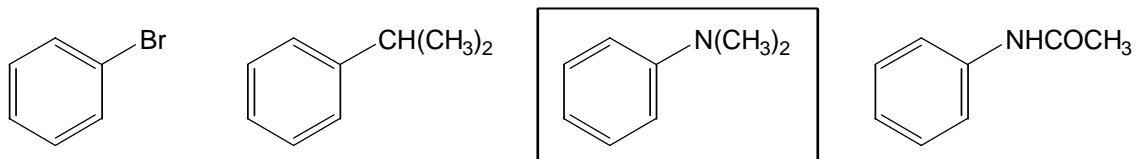


**C**



Name: **KEY**

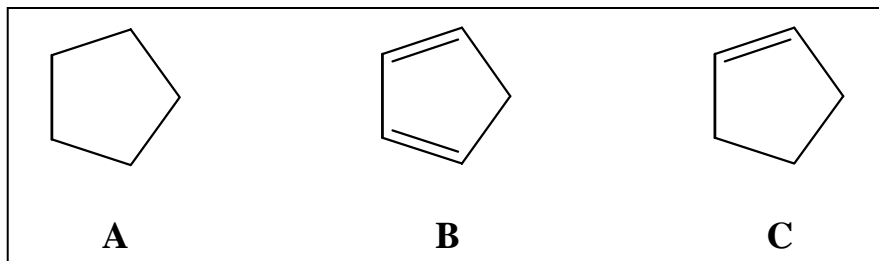
- e) Which compound does not react when treated with  $\text{CH}_3\text{CH}_2\text{COCl}$  and  $\text{AlCl}_3$ ?  
(Problem 18.34, p 681)



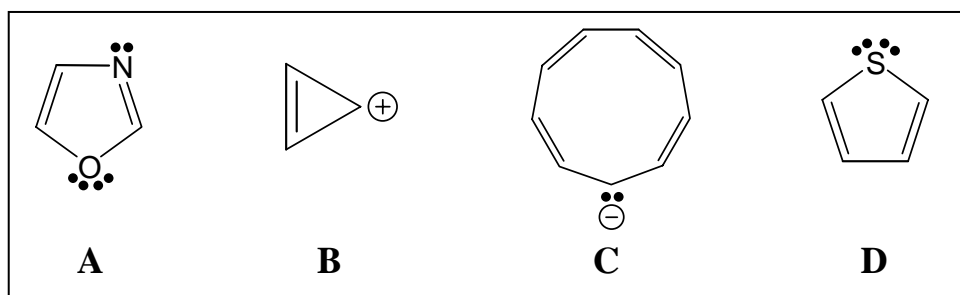
- f) Which is the electrophile in electrophilic aromatic nitration of benzene?



- g) Rank the compounds in the box in order of increasing acidity. (Problem 17.17, p 624)



h) Which species are aromatic? Assume the rings are planar. (Problem 17.29, p 634)



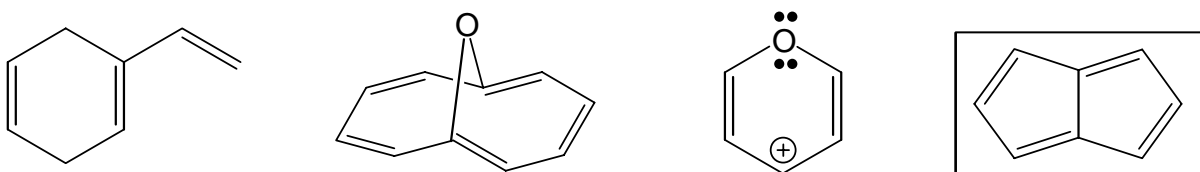
**B and C**

**A and D**

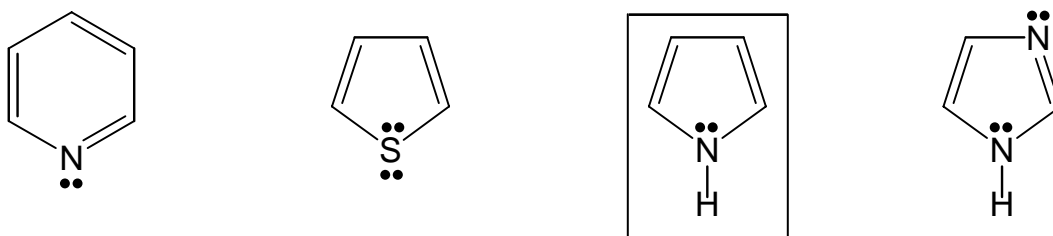
**C only**

**all of them**

i) Which compound is antiaromatic? (Problem 17.30, p 634)



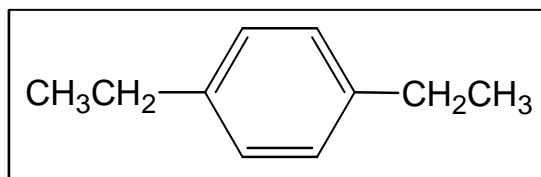
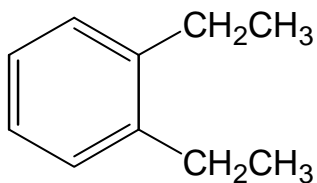
j) Which compound is pyrrole?



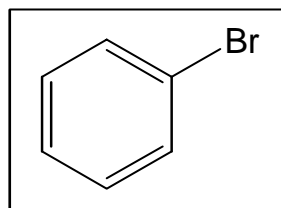
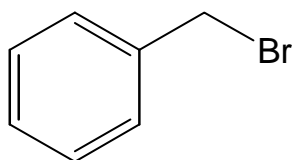
Name: **KEY**

2. Comparison Questions. Clearly circle your chosen answer. (14 points; 2 apiece)

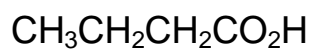
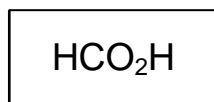
- a) Which compound gives  $^{13}\text{C}$  NMR signals at 16, 29, 128 and 141 ppm? (Problem 17.47c, p 636)



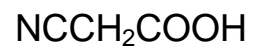
- b) Which compound is unreactive as an electrophile in EAS reactions? (Problem 18.7, p 650)



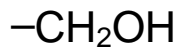
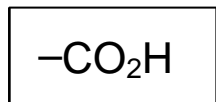
- c) Which compound is formic acid?



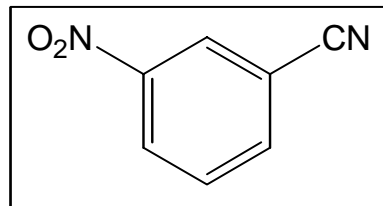
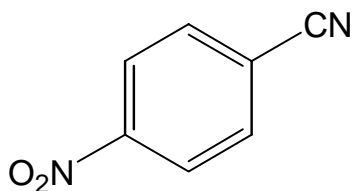
- d) Which compound is the stronger acid? (Problem 19.36d, p 715)



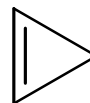
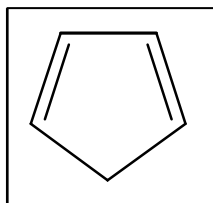
e) Which substituent is a ring deactivator in EAS reactions?



f) Which is the major product when benzonitrile,  $C_6H_5CN$ , is treated with  $HNO_3$  and  $H_2SO_4$ ?  
(Product 18.33b, p 681)

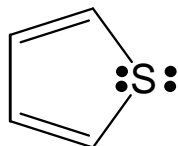


g) Which compound is the stronger acid? (Problem 17.40b, p 635)

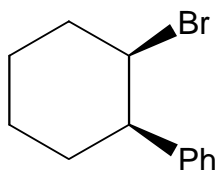


3. Draw structures or provide names for the following compounds. Names are right or wrong.  
No partial credit! (12 points; 4 apiece)

a) Draw the structure of thiophene.



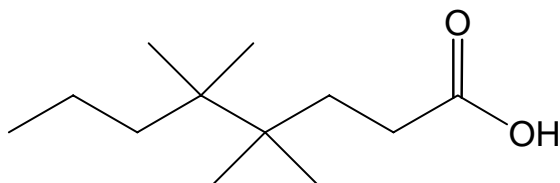
b) Name the following compound. (Problem 17.25h, p 633)



*cis*-1-bromo-2-phenylcyclohexane  
Or  
*1R,2R*-1-bromo-2-phenylcyclohexane

Name: **KEY**

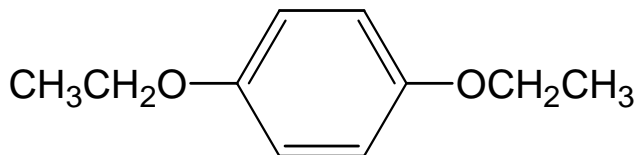
c) Name the following compound. (Problem 19.28c, p 714)



4,4,5,5-tetramethyloctanoic acid

4. Structures from Spectroscopic Data (16 points; 4 apiece)

a) A compound  $C_{10}H_{14}O_2$  has strong IR absorption at  $3150-2850\text{ cm}^{-1}$  and gives the following  $^1\text{H NMR}$  data:  $\delta$  1.4 ppm (triplet, 6H),  $\delta$  4.0 ppm (quartet, 4H),  $\delta$  6.8 ppm (singlet, 4H). What is the structure of the compound? (Problem 17.6, p 612)



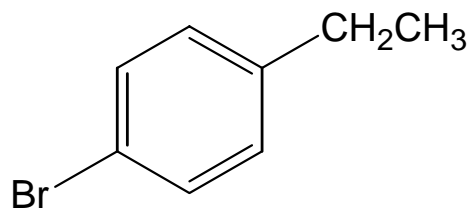
b) Propose a structure for a compound  $C_3H_5ClO_2$  that gives the following spectral data.  
(Problem 19.51a, p 717)

IR:  $3500-2500\text{ cm}^{-1}$ ,  $1714\text{ cm}^{-1}$

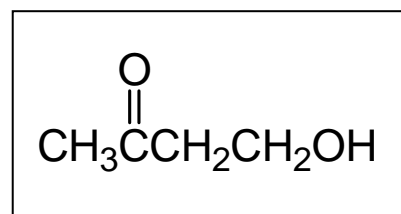
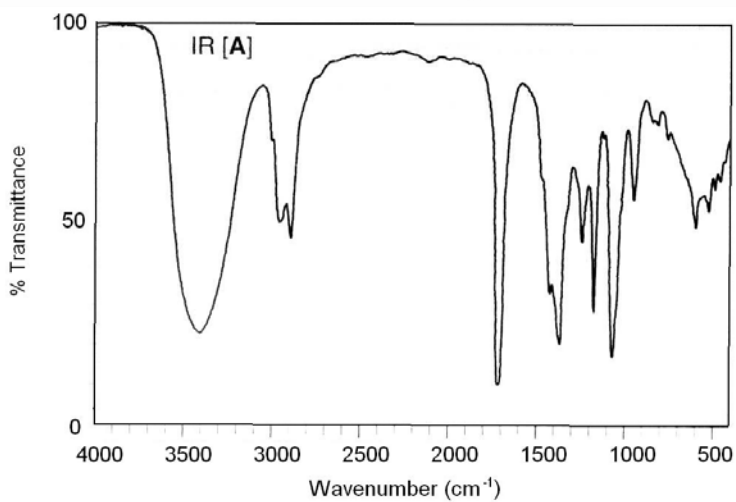
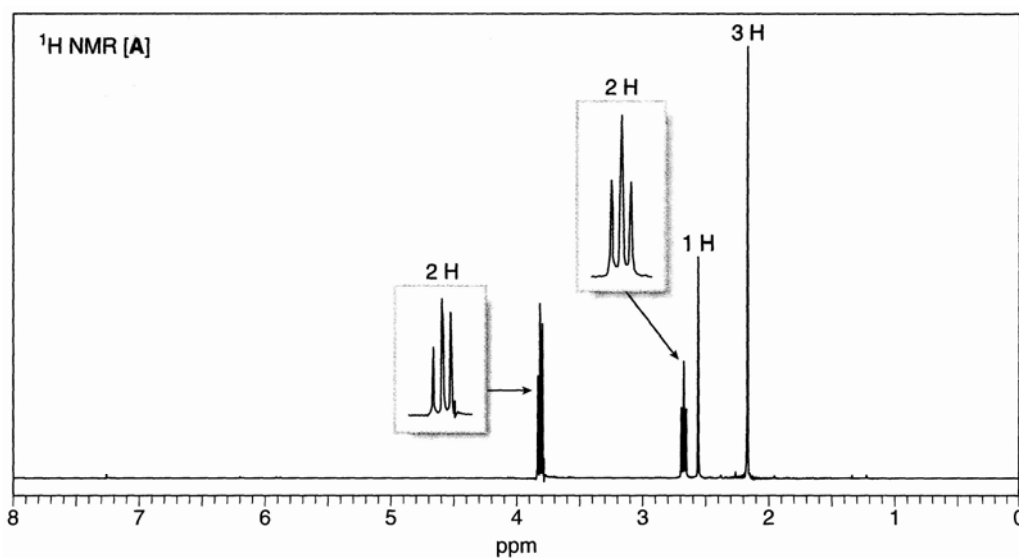
$^1\text{H NMR}$ :  $\delta$  2.87 ppm (triplet, 2H),  $\delta$  3.76 ppm (triplet, 2H),  $\delta$  11.8 ppm (singlet, 1H)



- c) What is the structure of a compound  $C_8H_9Br$  that gives the following  $^1H$  NMR data:  
 $\delta$  1.2 ppm (3H, triplet),  $\delta$  3.6 ppm (2H, quartet),  $\delta$  7.1 ppm (2H, doublet),  $\delta$  7.4 ppm (2H, doublet)



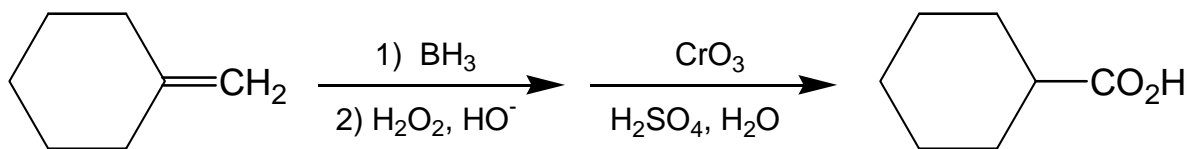
- d) Provide the structure of the compound  $C_4H_8O_2$  that gives the following  $^1H$  NMR and IR spectra. (Problem 19.52a, p 718)



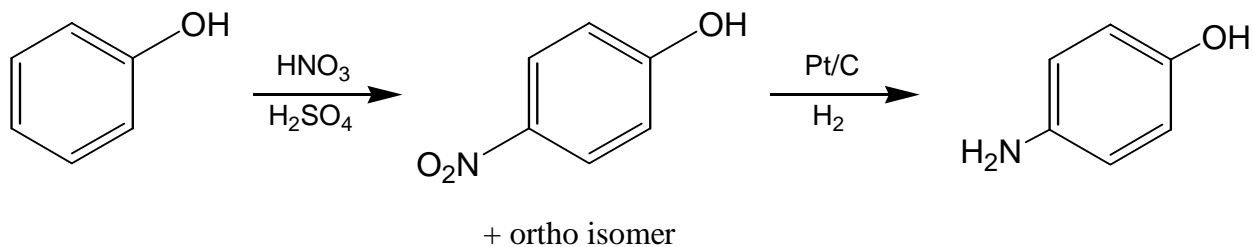
Name: **KEY**

5. Provide the missing products or reactants for the following reactions. If more than one product is formed, indicate which is the major and which the minor product. If there is no reaction, so indicate. If multiple steps are required, clearly show reagents for each step. (20 points; 4 apiece)

a) Problem 19.33a, p 715



b) Problems 18.32a and 18.32h, p 681



Other ways to do the second step: 1) Sn/HCl 2) HO<sup>-</sup>

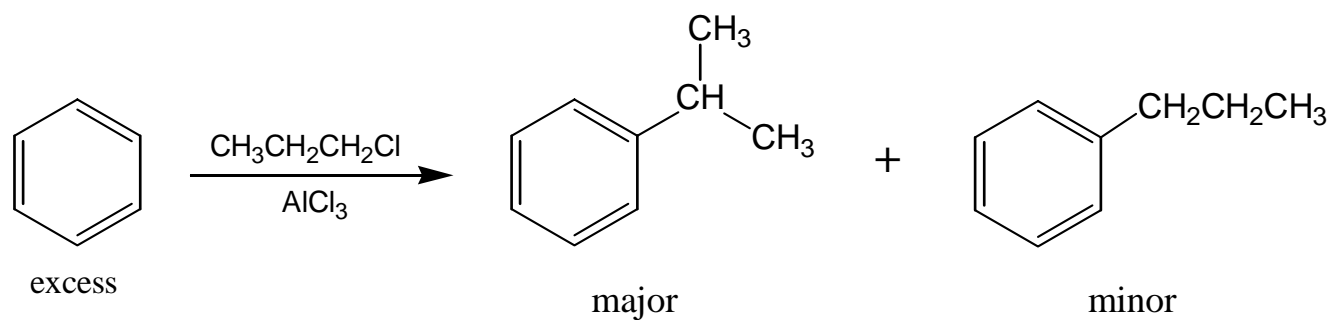
1) Zn/HCl 2) HO<sup>-</sup>

1) Fe/HCl 2) HO<sup>-</sup>

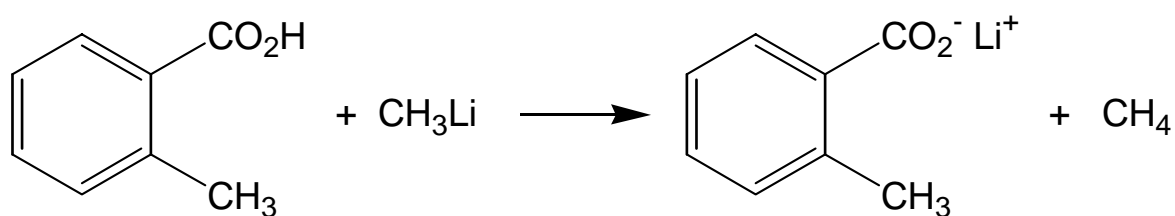
1) SnCl<sub>2</sub>/HCl 2) HO<sup>-</sup>

Pd/CaCO<sub>3</sub> and H<sub>2</sub>

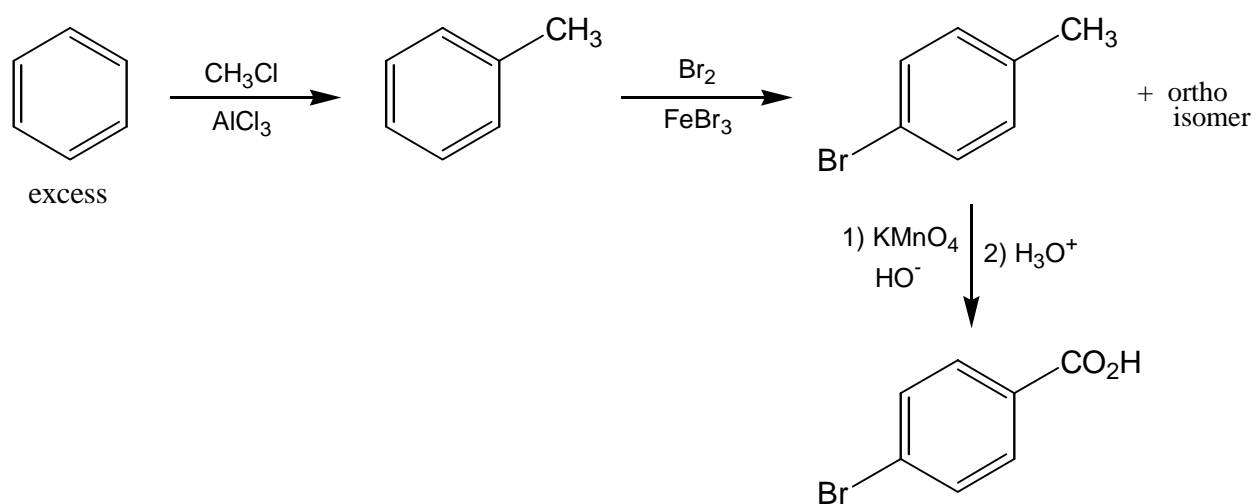
c)



d) Problem 19.35d, p 715

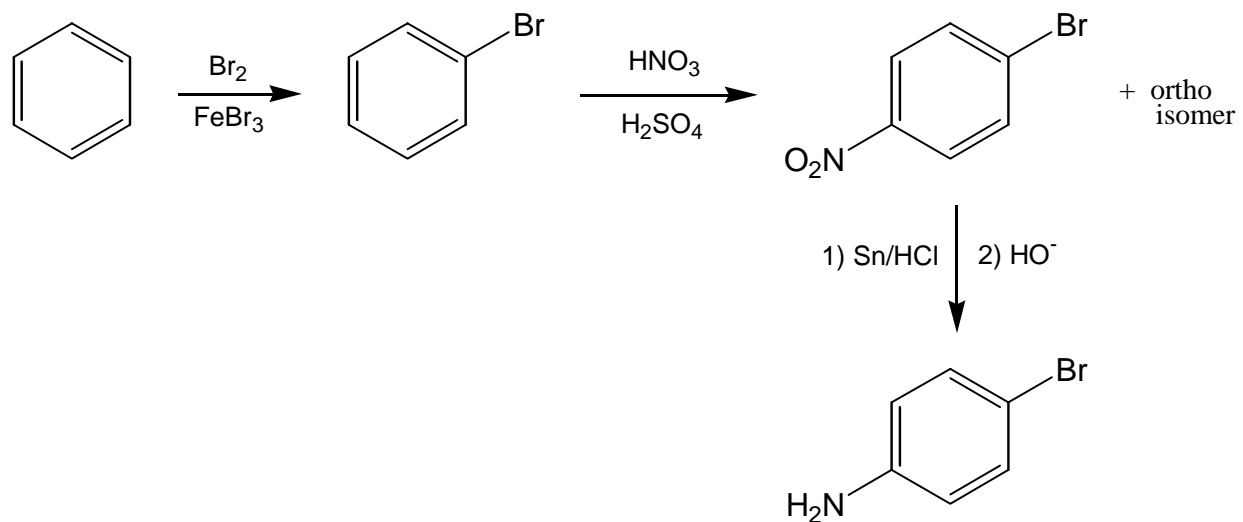


e) Problem 18.54h, p 684



Name: KEY

6. Synthesize p-bromoaniline from benzene and other appropriate organic and inorganic reagents. (Problem 18.55a, p 684; 8 points)



Other ways to do the last step: 1)  $\text{SnCl}_2/\text{HCl}$  2)  $\text{HO}^-$

1)  $\text{Zn/HCl}$  2)  $\text{HO}^-$

1)  $\text{Fe/HCl}$  2)  $\text{HO}^-$

$\text{Pt/C}$  and  $\text{H}_2$

$\text{Pd/CaCO}_3$  and  $\text{H}_2$