

Name: \_\_\_\_\_

**CHEM 322. Midterm 1**  
**Spring 2011**  
**Prof Bruce Heitbrink, Prof Mary Watson**

Please write your answers clearly in the boxes provided. If your answer is illegible or outside the box, it will not be graded. You may use the back of test pages for scratch work.

You may use molecular models.

Use of calculators, cell phones, headphones, or any other electronic device during this exam is prohibited.

No notes or books may be used during this exam.

You may raise your hand to ask a question if you are not sure what is being asked of you.

There are 9 pages in this exam. Please check that your test has 9 pages before you begin. The last 2 pages are blank and may be used as scratch paper.

**Please circle your lecture section:**

010 (Heitbrink): MWF 11am

011 (Watson): TuTh 2pm

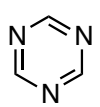
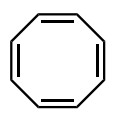
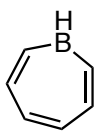

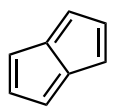
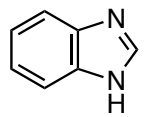
012 (Heitbrink): MWF 8am

Question	Points
1	____ /60
2	____ /30
3	____ /50
4	____ /40
5	____ /30
6	____ /40
<b>Total</b>	____ /250

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1. (60 points) Are the following molecules aromatic, anti-aromatic, or non-aromatic? Assume each molecular is planar. Please circle your answer below.

Please also list how many electrons are in the  $\pi$  system. No explanation is necessary.

		Circle your answer: Aromatic, Anti-Aromatic or Non-Aromatic			How many electrons in $\pi$ system?
(a)		Aromatic	Anti-Aromatic	Non-Aromatic	
(b)		Aromatic	Anti-Aromatic	Non-Aromatic	
(c)		Aromatic	Anti-Aromatic	Non-Aromatic	
(d)		Aromatic	Anti-Aromatic	Non-Aromatic	
(e)		Aromatic	Anti-Aromatic	Non-Aromatic	
(f)		Aromatic	Anti-Aromatic	Non-Aromatic	

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2. (30 points)

(a) Is cyclopropenyl anion aromatic?

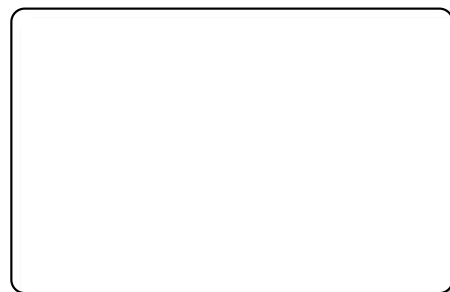
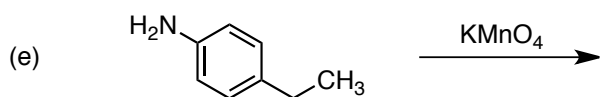
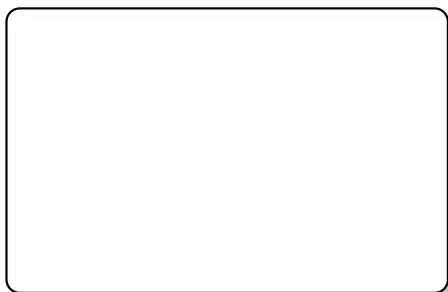
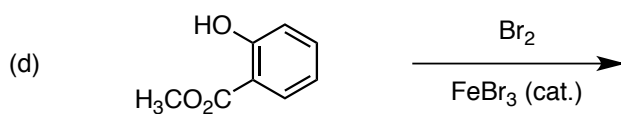
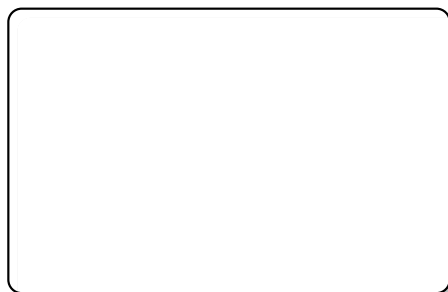
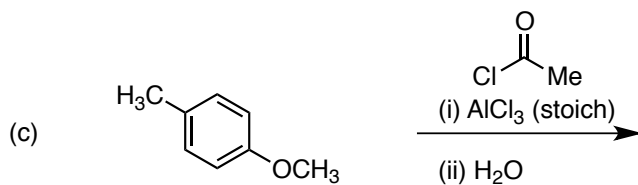
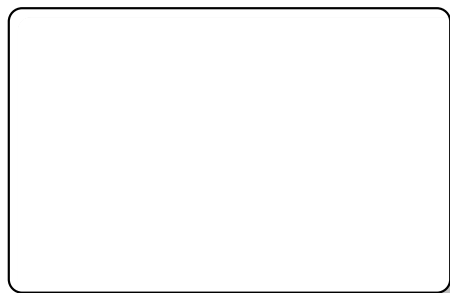
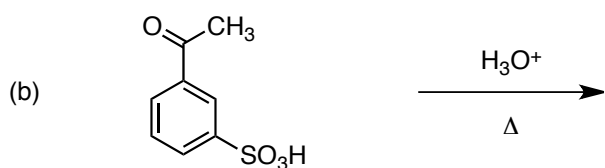
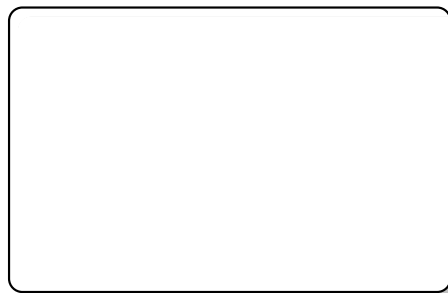
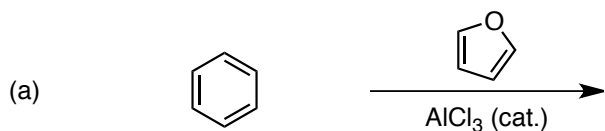


cyclopropenyl  
anion

(b) Using a Frost circle, draw a molecular orbital diagram (also called an orbital energy diagram) for the  $\pi$  system of the cyclopropenium anion that explains your answer to part (a). You do *not* need to draw pictures of each molecular orbital.

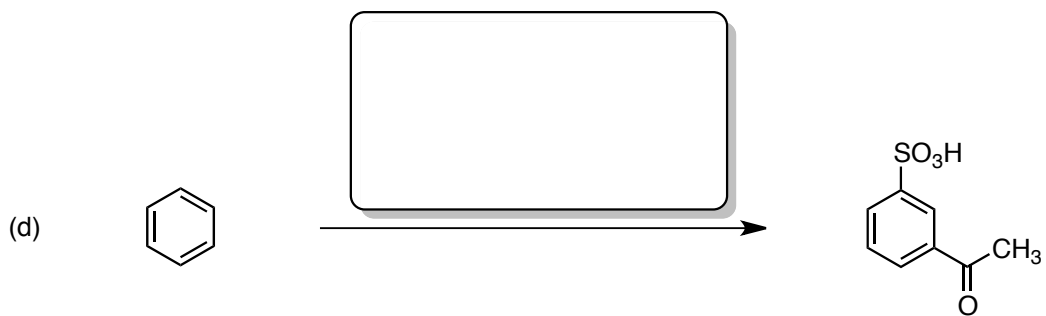
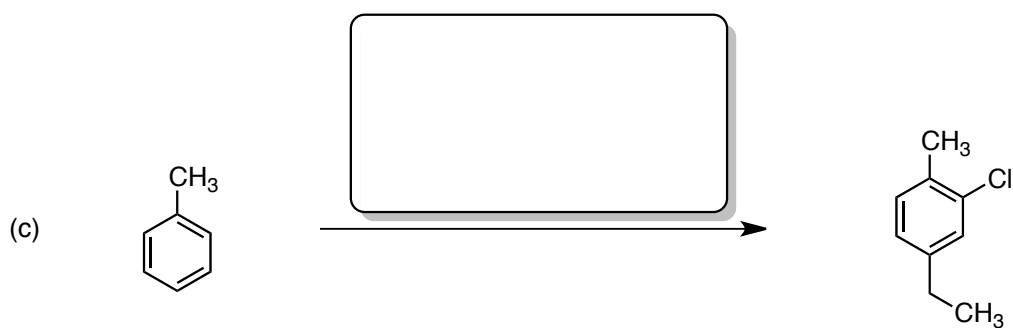
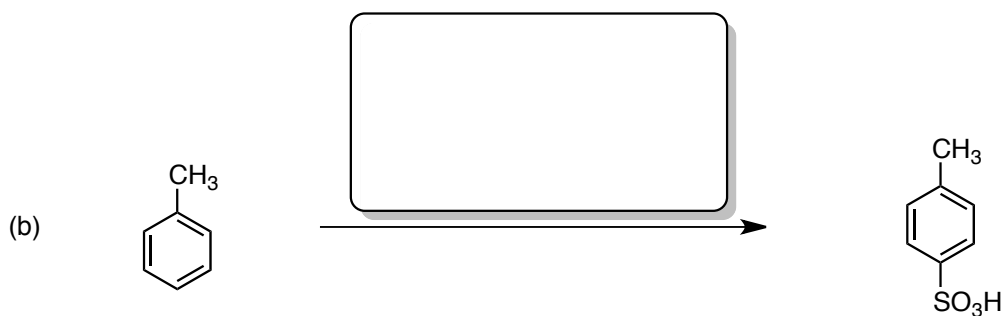
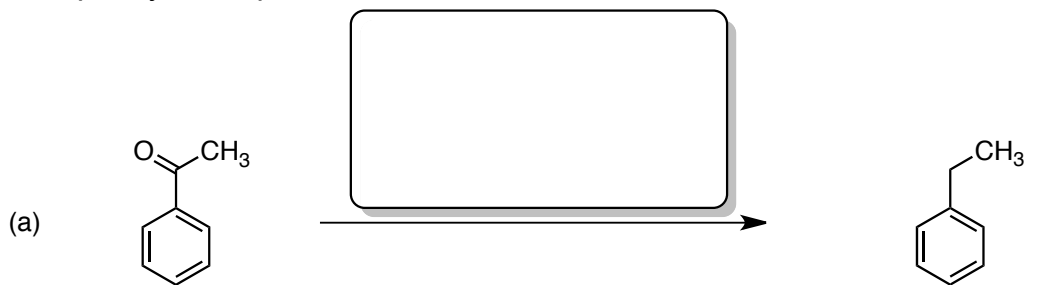
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3. (50 points) Please draw the expected major product for each of the following reactions. If no reaction is expected, write "No Reaction."



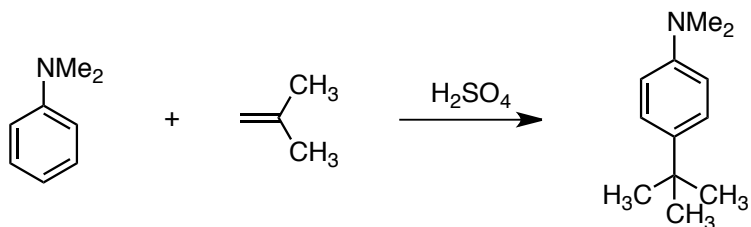
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4. (40 points) Provide reagents for the following transformations. In some cases, more than one step may be required.



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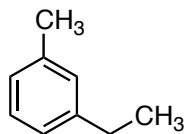
5. (30 points) Using your knowledge of electrophilic aromatic substitution and carbocations, please draw a reasonable arrow-pushing mechanism for the following reaction.



Blank area for drawing the arrow-pushing mechanism.

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6. (40 points) Provide a synthesis of the following molecule from benzene. You may use any inorganic reagents and any organic reagents with less than 3 carbons.



A large empty rectangular box with rounded corners, intended for the student to write their synthesis scheme.

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**Name:** \_\_\_\_\_

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