

CHEMISTRY 263 - Section A2

MIDTERM – October 24, 2013 - Dr. John C. Vederas

150 Points - 80 Minutes

Part	Points		KEEP THIS QUESTION BOOKLET
I	80		Do NOT Turn In This Booklet
II	24		
III	44		PUT ANSWERS ON COLOUR ANSWER SHEET
IV	30		
V	22		
Total	200		

Before you begin be sure that your exam has **13** consecutively numbered pages including this cover sheet. **Do not begin until told to do so.** When you begin, please **print** your name **on the colour answer sheet** in the correct slot. Illegible answers will be marked as incorrect. No books, notes, or unauthorized communications are permitted. If you have any questions or problems, please raise your hand. Do not leave your seat without permission. **Models are permitted but may not be handed to another and NO calculators, phones or other electronic devices are to be used.** **Turn in only the coloured answer sheet when you are finished.**

GOOD LUCK

You will keep this question booklet – Place all answers on coloured Answer Sheet in correct slot

I. Structure and Nomenclature - 80 Points

A. Draw structures for which names are given, or name the given structures by any correct (systematic or common) nomenclature. Be sure to give cis or trans (Z or E), or if appropriate R or S, assignment to the isomer where indicated by asterisks (***) . **(4 points each – 40 points total)**

1. allyl vinyl ether

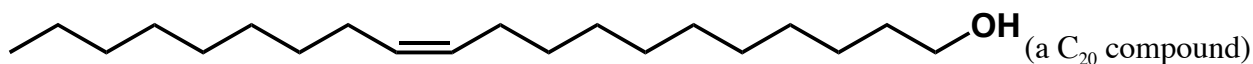
This is NOT your answer sheet : the space here is for preliminary work / scratch paper only

2. pyridine

3. glycerol

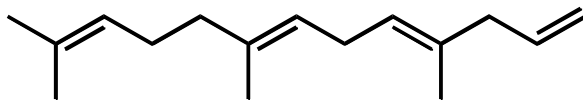
4. Teflon (polytetrafluoroethylene) (use bracket notation)

- *** 5.



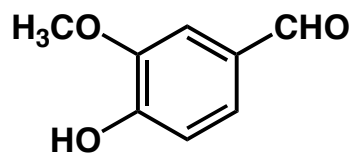
Place all answers on coloured Answer Sheet

*** 6. (a perfume)



This is NOT your answer sheet : the space here is for preliminary work / scratch paper only

7.



*** 8. (R)-3-(4-chlorophenyl)-1-pentene (use part structure as below in your drawing to assist grading)



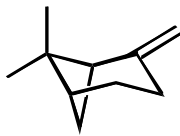
9. p-nitrotoluene

10. Aniline

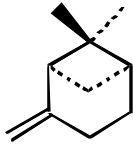
Place all answers on coloured Answer Sheet

B. Determine whether the following pairs of structures are identical, structural isomers, diastereomers or enantiomers. (4 points each – 20 points total)

11.

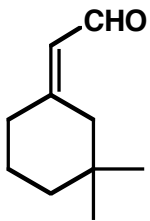


and

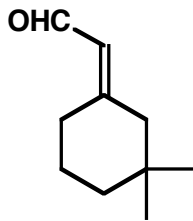


 Use Answer Sheet

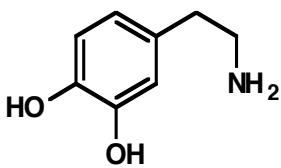
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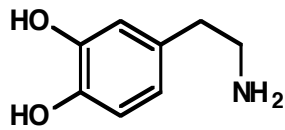
and



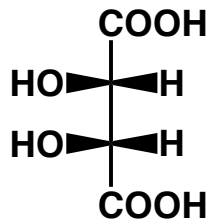
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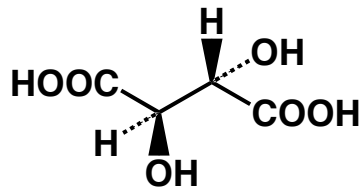
and



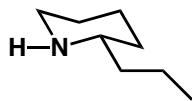
14.



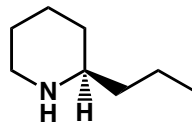
and



15.



and



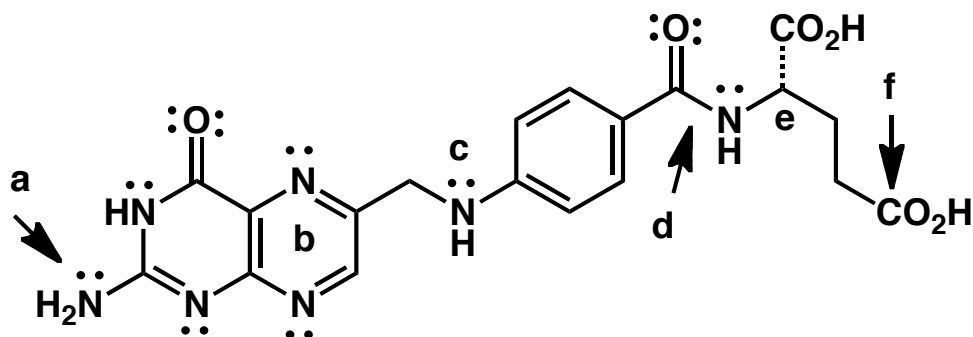
 Place all answers on coloured Answer Sheet

Place all answers on coloured Answer Sheet

C. Folic acid (Vitamin B₉) shown below is essential in the diet of humans for a variety of functions including DNA synthesis and repair, as well as production of healthy red blood cells. It occurs in leafy vegetables and is added to cereal and bread. Examine its structure and answer the questions that follow.

(20 points total - 2 points each)

This is NOT your answer sheet : the space here is for preliminary work / scratch paper only



2 points each

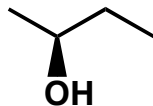
16. The number of carbons in folic acid is: _____
17. The number of hydrogens in folic acid is: _____
18. The number of pi (π) electrons in ring **b** of folic acid is: _____
19. The functional group labeled **a** in folic acid is called: _____
20. The functional group labeled **d** in folic acid is called: _____
21. The total number of possible stereoisomers of folic acid is _____
(include folic acid in the number)
22. The stereochemistry of the centre labeled **e** is _____
23. The lone pair of electrons at site **c** is conjugated (true or false) _____
24. The functional group labeled **f** in folic acid is called: _____
25. The lone pair on the bottom nitrogen of ring **b** is conjugated _____
(true or false)

Place all answers on coloured Answer Sheet

II. NMR Spectrometry, Physical Properties and Reactivity - 24 points

A. This based on problem 9.5 in text. Examine 2-butanol and answer the NMR questions that follow.

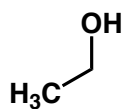
(2 points each – 10 points total)



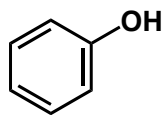
1. How many types of hydrogens does 2-butanol have ? _____
2. Hydrogens on carbon 1 would appear as a (singlet, doublet, triplet or ?) _____
3. Which carbon in ^{13}C NMR would be the least shielded (give its number) _____
4. Shielded means upfield (true or false) _____
5. ^{17}O NMR is possible based on the number of neutrons and protons (T or F) _____

B. 6. In the group below provide the letters for all compounds that have a pKa below (less than) that of water.

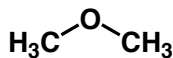
2 pts (must get all correct – no partial credit this question)



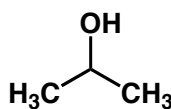
a



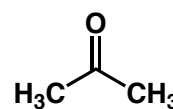
b



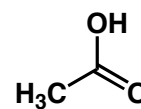
c



d

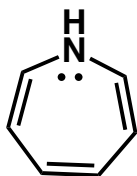


e



f

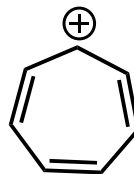
C. Examine the structures below to determine if they are aromatic.



g



h



k

7. Provide the letters for all aromatic compounds in the group above _____

2 pts (must get all correct - no partial credit this question)

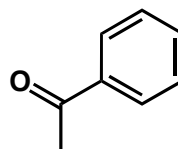
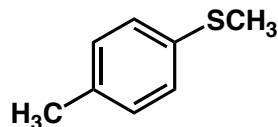
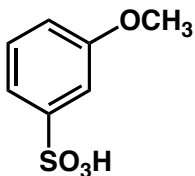
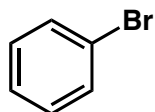
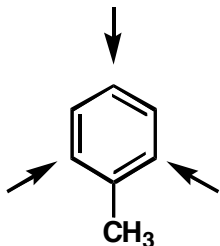
8. Provide the number of π electrons compound **h** has (1 pt) _____

9. Provide the number of π electrons compound **k** has (1 pt) _____

Place all answers on coloured Answer Sheet

D. In this section, draw arrows on the answer sheet to indicate position(s) on the aromatic ring that would be most likely to be attacked by chlorine in the presence of FeCl_3 (**8 pts - 2 pts each**)

Example:



Place all answers on coloured Answer Sheet

Place all answers on coloured Answer Sheet

III. Definitions and Applications - 44 Points

A. Define each of the following terms in 10 words or less (no example) – 3 points each – 24 pts

1. concerted reaction

2. LUMO

3. enantiomer

4. atomic number

5. molecule

6. Lewis acid

7. steric effect

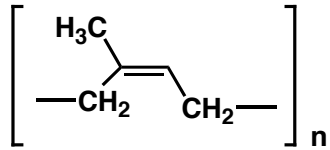
8. resonance forms

Place all answers on coloured Answer Sheet

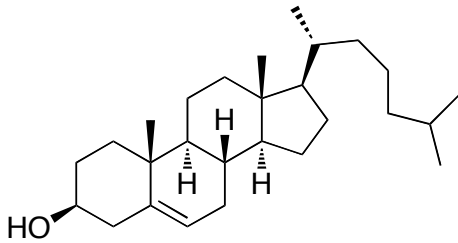
B. The compounds shown below were discussed in class. Identify them by common name.

(20 points total - 4 pts each)

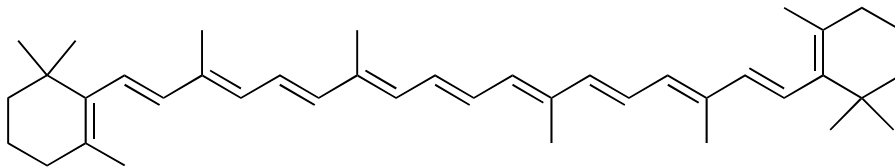
9.



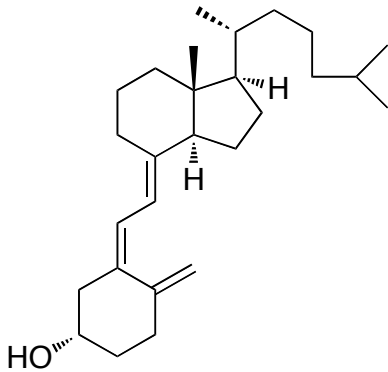
10.



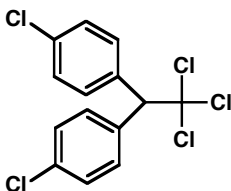
11.



12.



13.

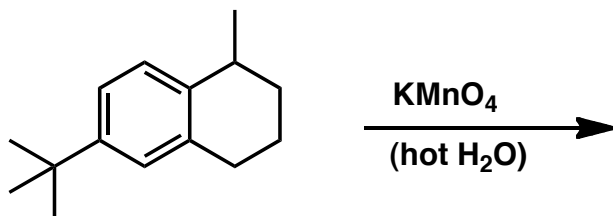


Place all answers on coloured Answer Sheet

IV. Reactions - 30 Points

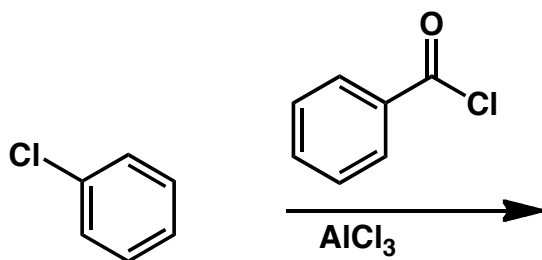
A. Show the structure of the major organic product of each of the following reactions. Show stereochemistry where indicated by asterisks (***) . (3 points each - 15 points total)

1.

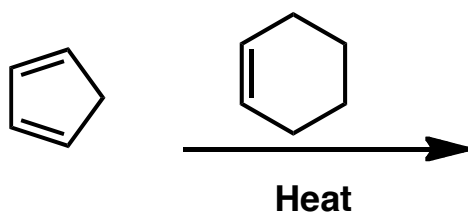


all answers on Answer Sheet

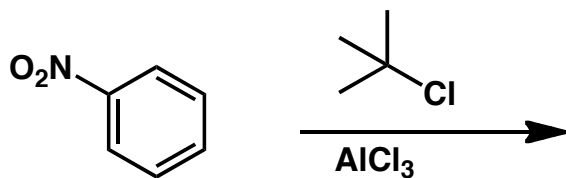
2.



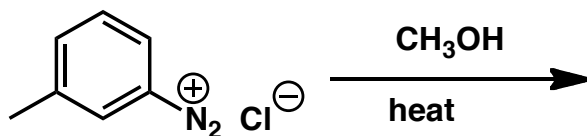
*** 3.



4.



5.

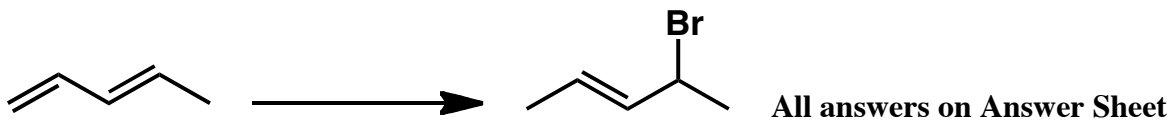


Place all answers on coloured Answer Sheet

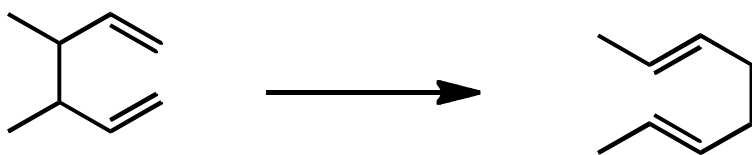
B. Show reagents that will do the required transformations. In some cases 2 or 3 steps may be necessary.

(3 pts each - 15 pts total)

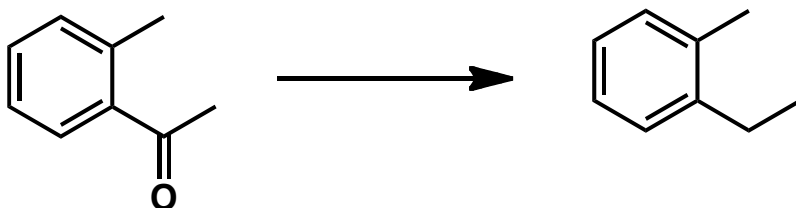
6.



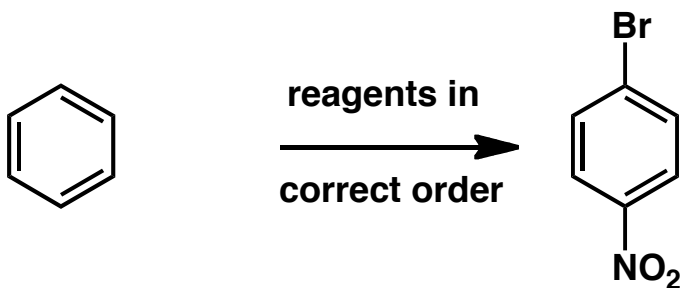
7.



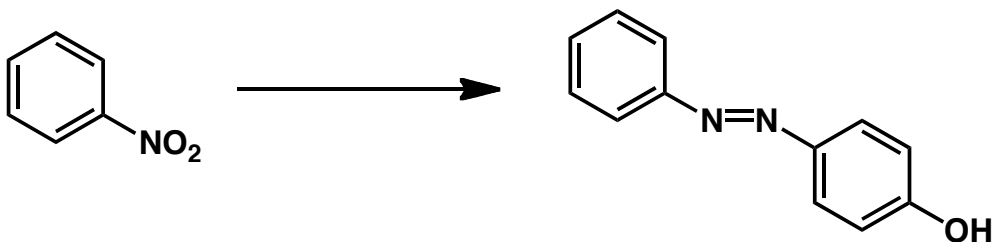
8.



9.



10.



Place all answers on coloured Answer Sheet

V. Mechanism - 22 Points

A. During one class various aspects of thermodynamic and kinetic control were discussed with respect to 1,2- or 1,4- addition reactions of conjugated systems such as butadiene with acid. The diagram below was presented and is also in the assigned reading. Examine and answer the questions that follow.

2 points each - 10 points total - no partial credit for these questions



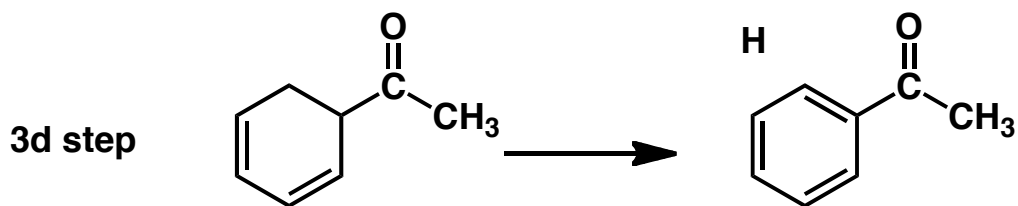
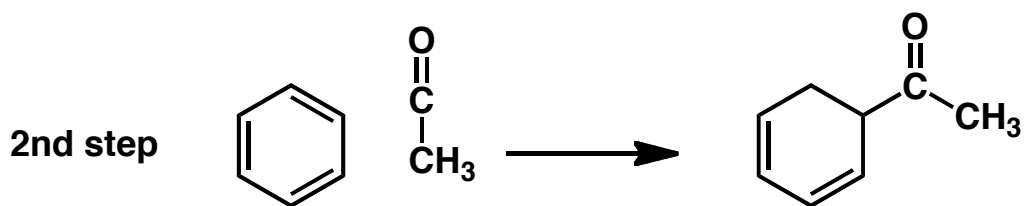
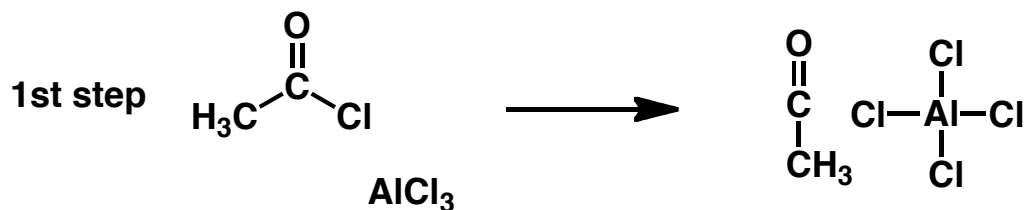
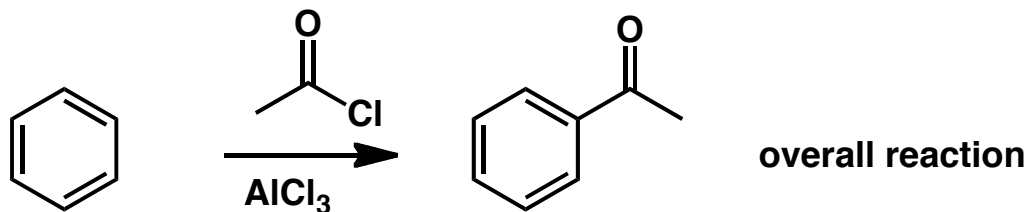
1. provide the letter(s) that correctly label(s) the activation energy for the thermodynamic product
2. provide the letter(s) that correctly label(s) the activation energy for the kinetic product
3. provide the letter(s) that correctly label(s) the ΔG for the thermodynamic product
4. provide the letter(s) that correctly label(s) the ΔG for the kinetic product
5. provide the letter(s) that correctly label(s) the resonance-stabilized conjugated cation

Place all answers on coloured Answer Sheet

Place all answers on coloured Answer Sheet

C. The mechanism for an electrophilic aromatic substitution, namely acylation of benzene, is shown below as a set of 3 steps. However, it is missing curved arrows to indicate the movement of electrons as well as all of the charges. Complete the mechanism by putting in the correct arrows and charges. It may help you to draw in all of the hydrogens on benzene and the intermediates. Check carefully – each one is worth points.

(4 points for each step - 12 Points Total)



Place all answers on coloured Answer Sheet