

**Chemistry 212**

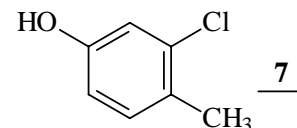
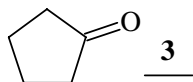
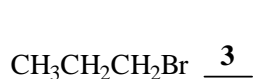
**Test 1** (Chapters 13, 15, & 16, exc. 16.7 & 16.8)

Name \_\_\_\_\_ **Answer Key** \_\_\_\_\_

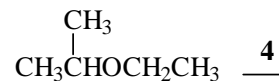
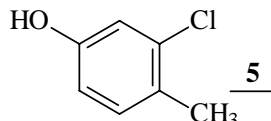
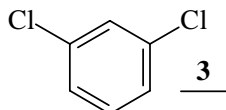
9 am Mon. Sept. 14, 2009

60 points

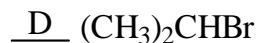
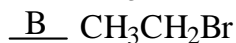
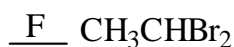
1. (4) Write on the line provided the number of **carbon** resonance lines you would expect in the  $^{13}\text{C}$  NMR spectrum of the following:



2. (4) Write on the line provided the number of unique **proton** environments in each of the following:



3. (4) Match the letter of the expected proton NMR splitting pattern with the structure:



A. doublet and triplet

B. quartet and triplet

C. two triplets

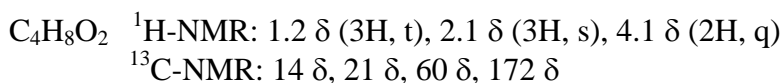
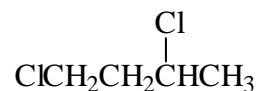
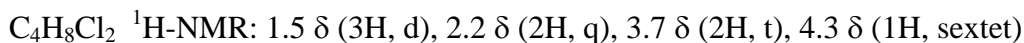
D. septet and doublet

E. two doublets

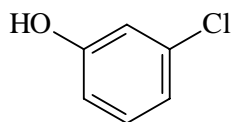
F. quartet and doublet

G. none of the above

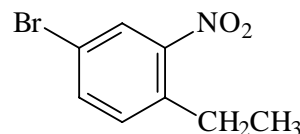
4. (6) Draw structures consistent with the following data:



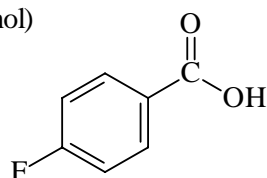
5. (6) Write the correct name under each of the following:



m-chlorophenol (or 3-chlorophenol)

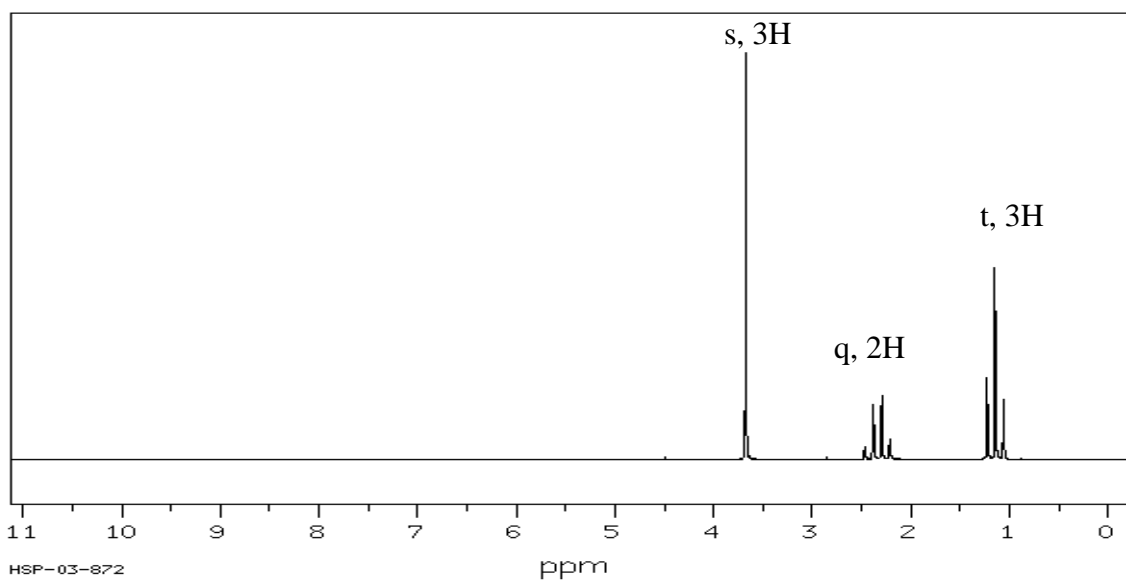
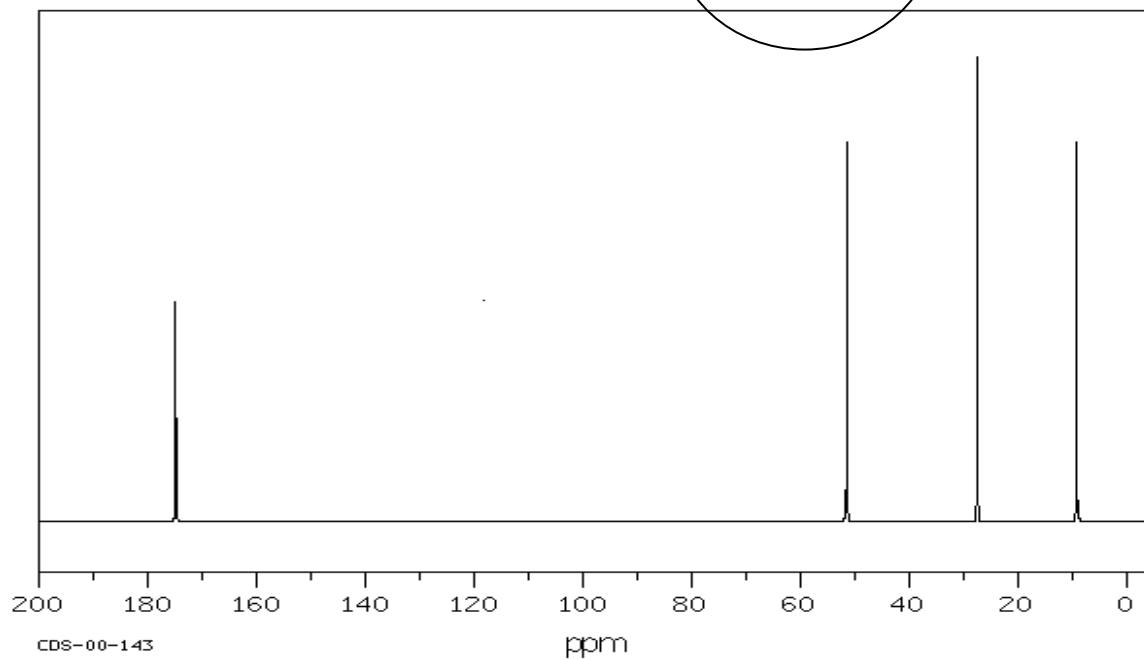
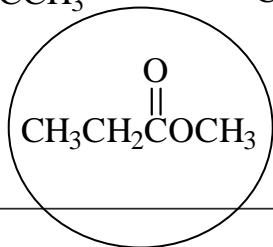
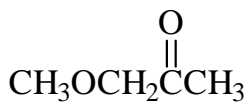
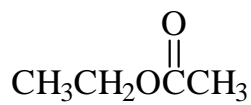
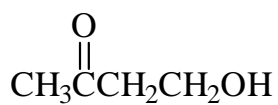


4-bromo-1-ethyl-2-nitrobenzene

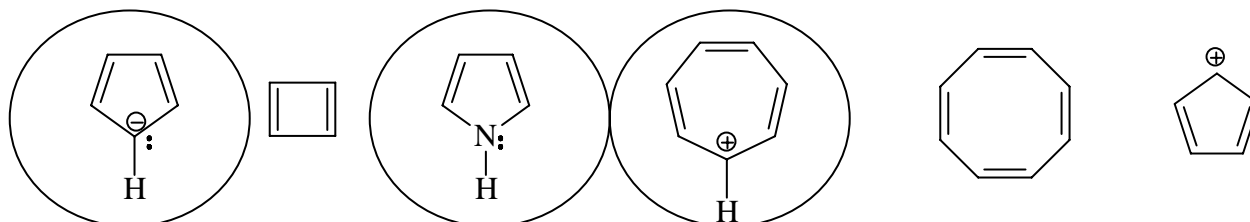


p-fluorobenzoic acid (or 4-fluorobenzoic acid)

6. (4) Circle the structure that corresponds the following  $^{13}\text{C}$  NMR and  $^1\text{H}$  NMR spectra:

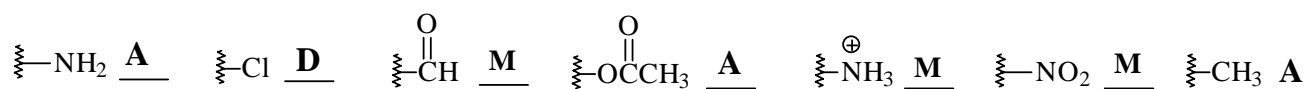


7. (6) Circle all the structures below that are **aromatic** according to Hückel's rule:

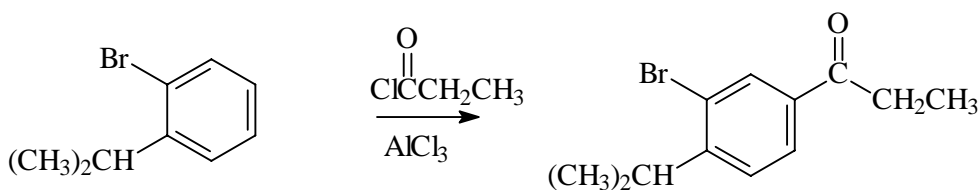
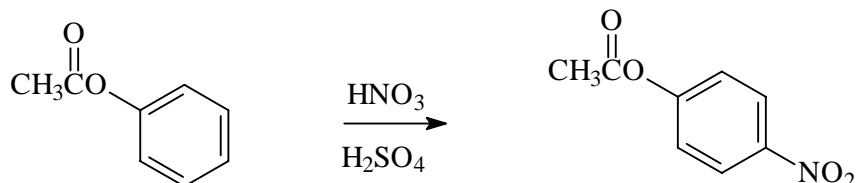
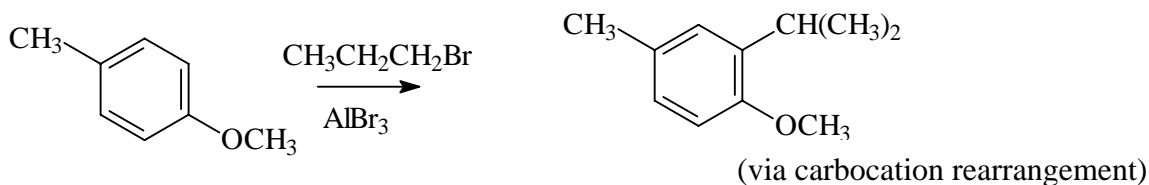
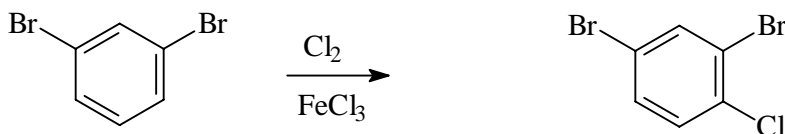


8. (7) Classify the substituents (on an aromatic ring) below according to their directing and reactivity effects toward electrophilic aromatic substitution, using the following abbreviations:

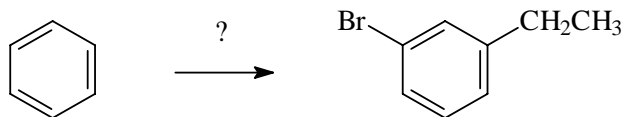
**A** = o- and p- directing Activators  
**D** = o- and p- directing Deactivators  
**M** = m- directing deactivators



9. (10) Draw the structure of the major organic product of each of the following:

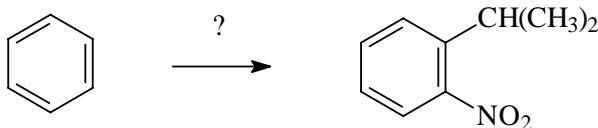


10. (3) Circle your choice of the following reaction sequences as the best method to perform the indicated transformation:



- a. alkylation, bromination
- b. alkylation, sulfonation, bromination, desulfonation
- c. bromination, acylation, reduction
- d. bromination, sulfonation, acylation, reduction, desulfonation
- e. bromination, alkylation
- f. acylation, bromination, reduction

11. (3) Circle your choice of the following reaction sequences as the best method to perform the indicated transformation:



- a. nitration, alkylation
- b. nitration, sulfonation, alkylation, desulfonation
- c. alkylation, nitration
- d. alkylation, sulfonation, nitration, desulfonation
- e. nitration, alkylation, oxidation-reduction
- f. sulfonation, nitration, alkylation, desulfonation

12. (3) Indicate with an arrow where an incoming electrophile would be most likely to attack each of the following (only one arrow per structure)

