**1**. Provide structures for these compounds.

(a) *p*-nitrobenzoic acid (b) 3, 5-dimethylcychohexanone

(c) N-methyl-2,3-dimethylhexanamide (d) 4-ethyl-2-propyloctanoic acid

**2**. Arrange the following compounds in order of **increasing** reactivity towards eletrophilic substitution reactions (**1** being the most reactive).

(a) fluorobenxzene \_\_\_\_\_\_\_ benzaldehyde \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1,2-dimethylbenzene \_\_\_\_\_\_

(b) *p*-bromonitrobenzene\_\_\_\_\_ nitrobenzene\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ phenol \_\_\_\_\_\_\_\_\_\_

**3**. Order the following compounds in order of **increasing** reactivity (**1** being the most reactive.

(a) CH3CONH2 \_\_\_\_\_\_ CH3COCl\_\_\_\_\_\_\_ CH3COOCH3\_\_\_\_\_\_\_\_

(b) CH3COH\_\_\_\_\_\_\_ CH3CH2COH\_\_\_\_\_\_\_ (CH3)2CHCOH \_\_\_\_\_\_\_

**4.** For the following groups, provide whether the substituent is activating (**A**) or deactivating (**D**) as well as ortho-para (**O-P**) or meta (**M**) directing. Write **A, D, O-P,** or **M** in the appropriate spaces.

**Group Activating/Deactivating O-P** or **M** directing

-NO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Cl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

-CH2CH3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

-CN \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

-OH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

-NH2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**5**. Cycloheptatrienone is a stable polar compound, but cyclopentadienone, although polar, is so reactive that it cannot be isolated. Briefly explain.



**6**. **Circle** which of the following is more stable. Explain



**7**. **Circle** which of the following is more acidic. Explain



**8**. Provide the reagents (**at the arrows**) for accomplishing the following transformations (in some cases more than one step may be necessary). The reagents should be in the **correct order** of sequence



**9**. Provide the product(s) of the following reactions. Show stereochemistry where appropriate.





**10**. Provide a mechanism for each of the following transformations. Proper use of curved and equilibrium arrows are required for full credit. Please show all steps and intermediates.



**11**. Provide the reagent(s), products and reactant(s) as indicated by the question mark(**?**)



**continued:**



**12**. Fill in the missing reagents a-d in the following synthetic scheme. Place your answer in the box provided..

