



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

a) Which compounds undergo nucleophilic substitution? (Problem 20.2, p 727)



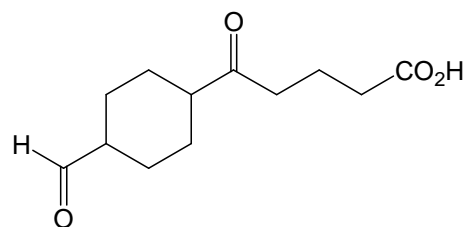
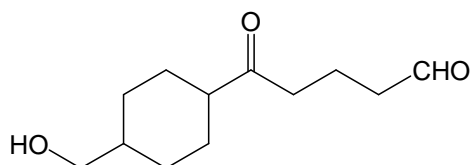
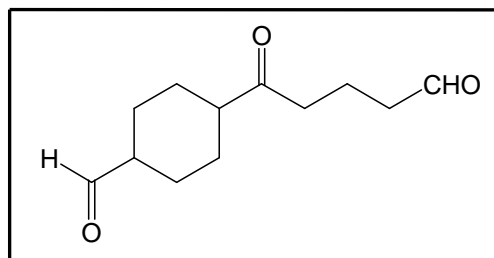
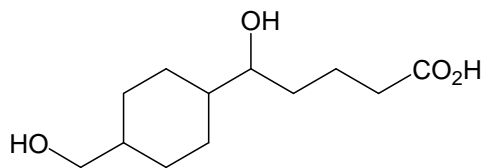
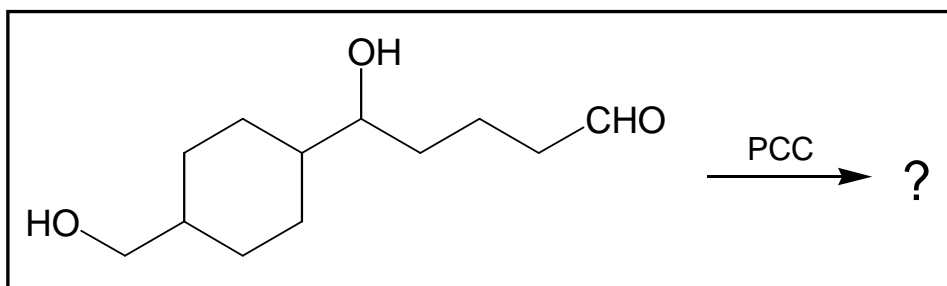
A and B

A and D

**B and C**

All of them

b) What is the product of the reaction in the box? (Problem 20.16c, p 739)



Name: **KEY**

- c) What product is formed when a Grignard reagent reacts with an ester, followed by addition of H<sub>2</sub>O?

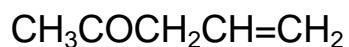
tertiary  
alcohol

secondary  
alcohol

ketone

acetal

- d) Which molecule is methyl vinyl ketone? (Problem 21.6b, p 779)



- e) Which molecule has the highest boiling point?

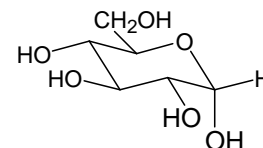
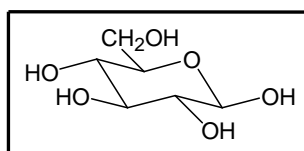
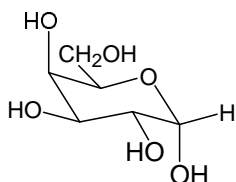
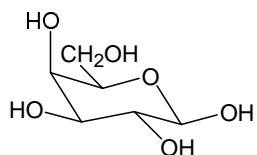
pentane

1-butanol

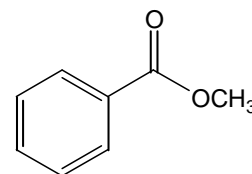
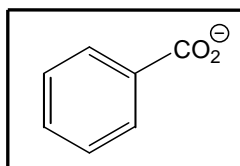
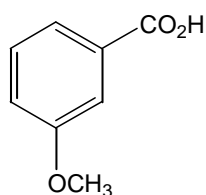
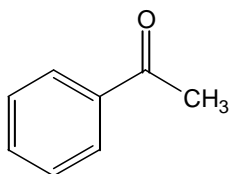
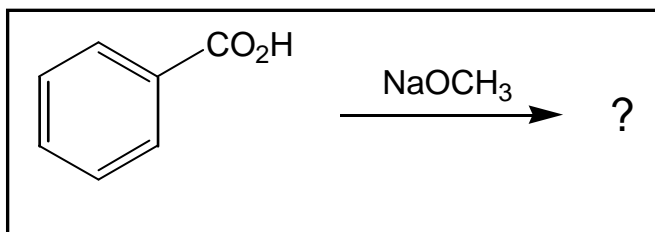
butanal

ethyl methyl  
ketone

- f) Which molecule is β-D-glucose? (Problems 21.41 and 21.42, p 813)



g) What is the product of the reaction in the box? (Problem 22.19c, p 850)



h) Which carboxylic acid derivative has the lowest C=O stretching frequency?

acetic  
anhydride

acetyl  
chloride

acetamide

methyl  
acetate

i) What reagent converts  $\text{C}_6\text{H}_5\text{CH}_2\text{CN}$  to  $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ ? (Problem 22.40c, p 868)

$\text{LiAlH}_4$ , then  $\text{H}_2\text{O}$

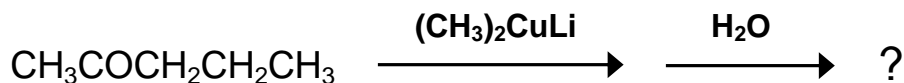
$\text{H}_3\text{O}^+/\text{H}_2\text{O}$

PCC in  $\text{CH}_2\text{Cl}_2$

DIBAL-H, then  $\text{H}_2\text{O}$

Name: **KEY**

j) What is the product of the following reaction? (Problem 20.38i, p 764)



3-methyl-2-pentanone

2-methyl-2-pentanol

3-methyl-2-pentanol

no reaction

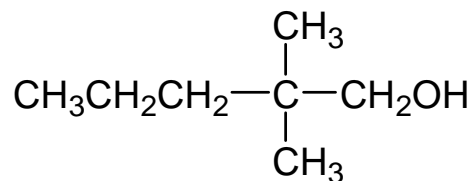
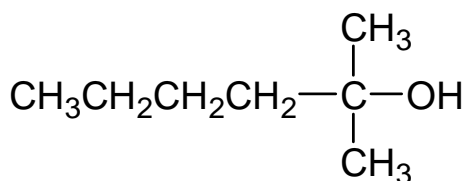
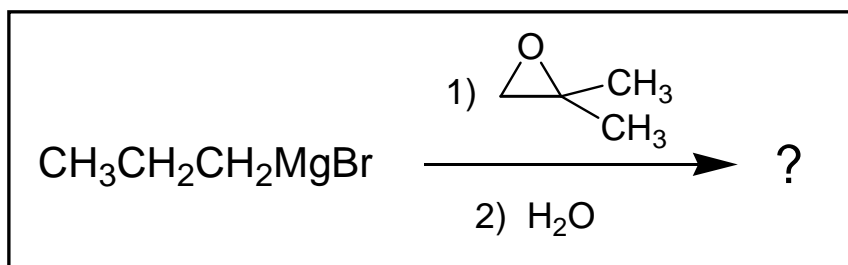
2. Comparison Questions. Clearly circle your chosen answer. (14 points; 2 apiece)

a) Which reagent is used to convert  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{COCl}$  to  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{OH}$ ? (Problem 20.44d, p 766)

$\text{LiAlH}[\text{OC}(\text{CH}_3)_3]_3$

$\text{LiAlH}_4$

b) What product is formed in the following boxed reaction? (Problem 20.40j, p 766)



- c) Which reagents are used to convert  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_2\text{CH}_3$  into butanal?  
(Problem 21.11d, p 785)

$\text{O}_3$ , then  $\text{CH}_3\text{SCH}_3$

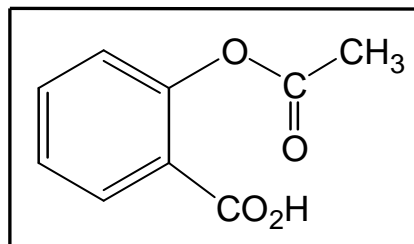
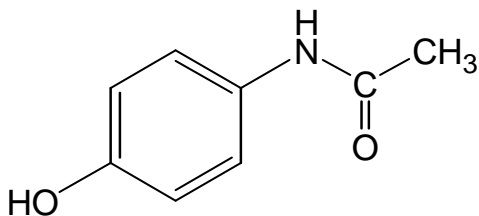
$\text{CrO}_3$  in aqueous  $\text{H}_2\text{SO}_4$

- d) Which is the preferred alkyl halide for synthesizing  $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{CH}_3$  by a Wittig reaction?  
(Problem 21.21a, p 796)

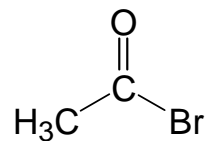
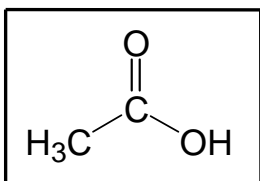
$\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

$(\text{CH}_3)_2\text{CHBr}$

- e) Which molecule is aspirin?

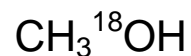
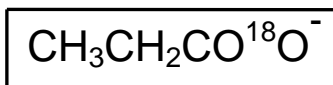
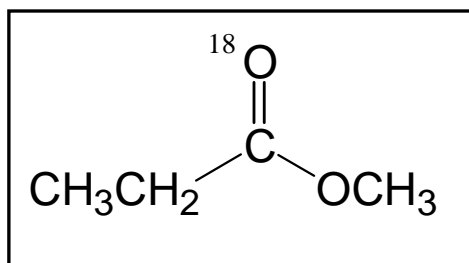


- f) Which molecule has a carbonyl stretching vibration in the IR at lower frequency?  
(Problem 22.2, p 830)



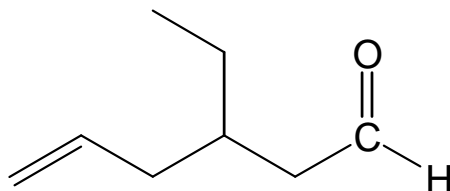
Name: \_\_\_\_\_

- g) When the compound in the box is hydrolyzed with aqueous  $\text{HO}^-$ , where does the label end up in the product? (Problem 22.26b, p 854)

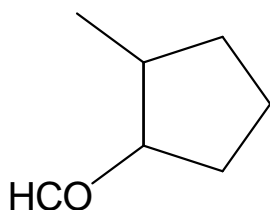


3. Draw structures or provide names for the following compounds. Names are right or wrong. No partial credit. (12 points; 4 apiece)

- a) 3-ethyl-5-hexenal (Problem 21.6f, p 779)



- b) Problem 21.43d, p 816



**2-methylcyclopentanecarbaldehyde**  
**Or**  
**1-formyl-2-methylcyclopentane**

- c)  $(\text{CH}_3)_2\text{CHCO}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

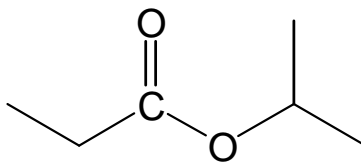
**isobutyl isobutyrate**  
**or**  
**2-methylpropyl-2-methylpropanoate**

4. Structures from Spectroscopic Data (8 points; 4 apiece)

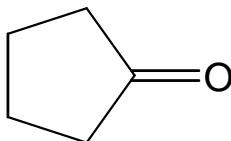
- a) Propose a structure for a compound  $C_6H_{12}O_2$  that give the following spectroscopic data.  
(Problem 22.80a, p 877)

IR absorption at  $1738\text{ cm}^{-1}$

$^1\text{H NMR}$ : 1.12 ppm (triplet, 3H); 1.23 ppm (doublet, 6H); 2.28 ppm (quartet, 2H); 5.00 ppm (septet, 1H)



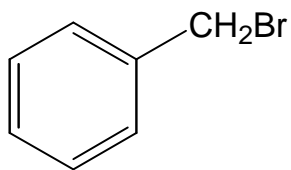
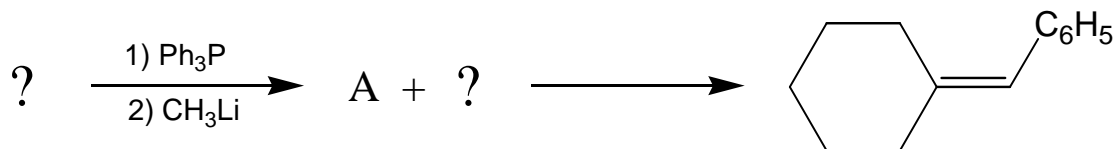
- b) A compound  $C_5H_8O$  has a strong IR absorption at  $1745\text{ cm}^{-1}$  and peaks in the  $^{13}\text{C NMR}$  spectrum at 23 ppm, 28 ppm and 220 ppm. What is the structure of this compound?



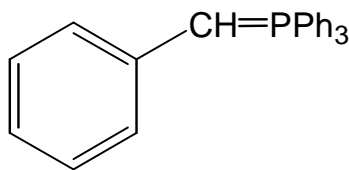
Name: \_\_\_\_\_

5. Provide the missing products or reactants for the following reactions, clearly indicating stereochemistry where appropriate. 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. (28 points; 4 apiece)

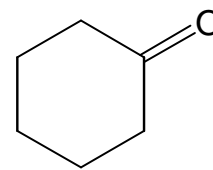
a) Identify the intermediate A and missing reactants noted by '?'s. (Problem 21.61d, p 818)



First Reactant

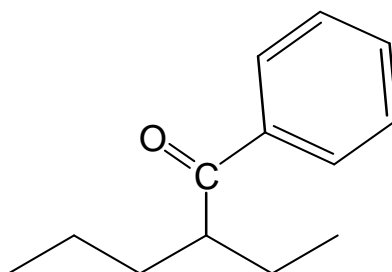
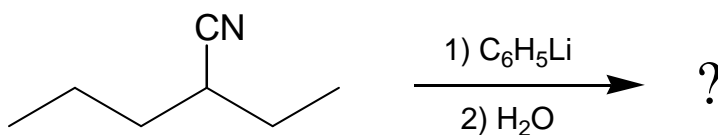


Intermediate A

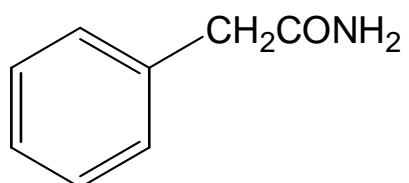
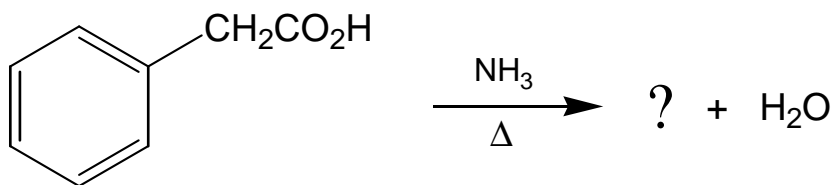


Second Reactant

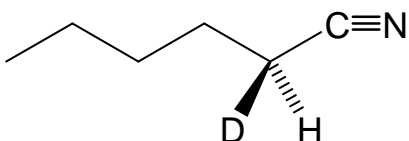
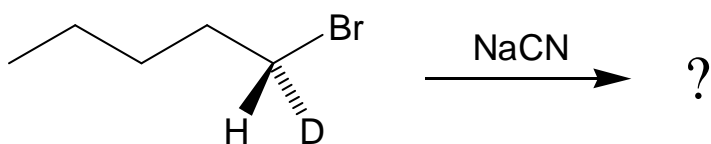
b) Problem 22.39b, p 868



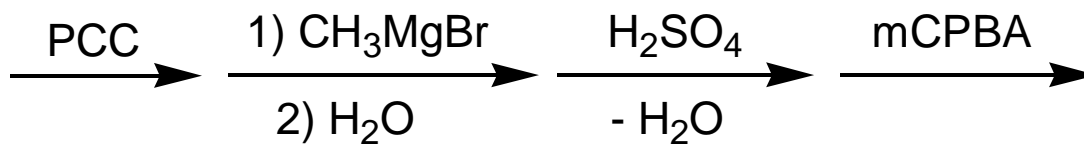
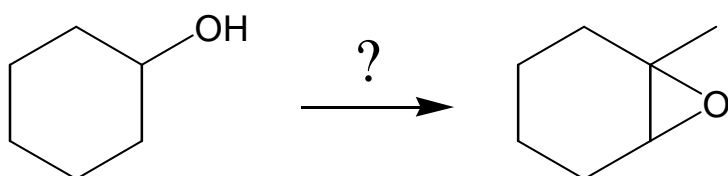
c) Problem 22.47d, p 872



d) Problem 22.55b, p 873

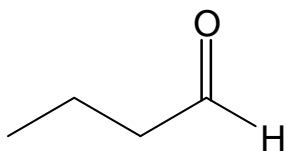
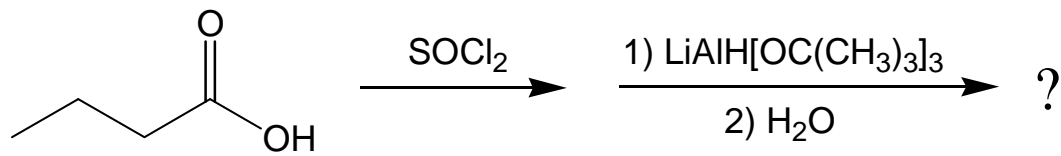


e) Problem 20.60c, p 770

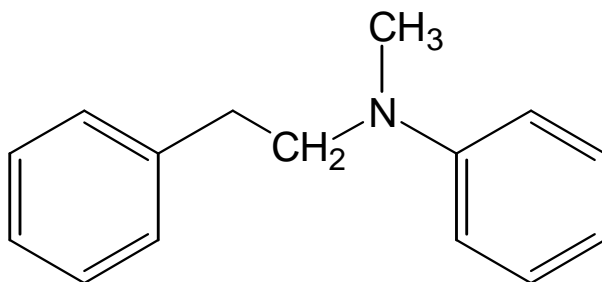
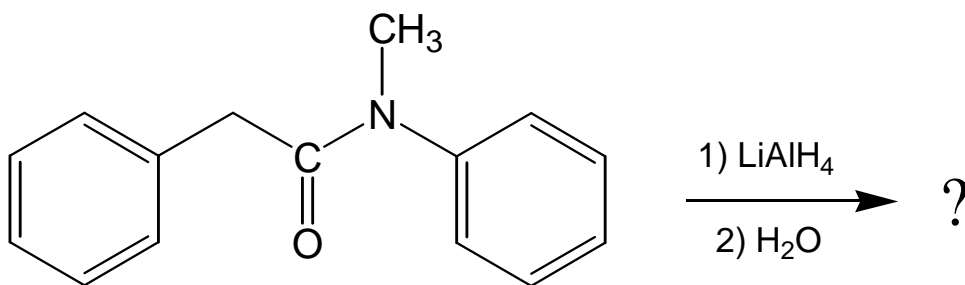


Name: \_\_\_\_\_

f) Problem 20.49g, p 767



g)



6. Draw a stepwise, electron-pushing mechanism for the following reaction. (Problem 21.76, p 820; 8 points)

