Problem 1. (30 points) Give the products for the following reactions. If there is more than 1 step, just give the final product. **Circle your answer.** If no reaction occurs, state so.

A) (2-methylcyclohexanone) + $H_3C-C(=O)-OOH$ ⟶ (7-membered lactone with CH_3) + $CH_3-C(=O)OH$

B) (cyclohexanone) $\xrightarrow[\text{H}_2\text{O}]{\text{CH}_3\text{CH}_2\text{NH}_2}$ (imine: $:N-CH_2CH_3$)

C) (cyclohexanone) $\xrightarrow[\text{H}_2\text{O}]{(\text{CH}_3\text{CH}_2)_2\text{NH}}$ (enamine: $CH_3CH_2-\ddot{N}-CH_2CH_3$)

D) $H_3C-\overset{O}{\overset{\|}{C}}-CH_3$ $\xrightarrow[\text{NaOH}]{\text{Br}_2}$ $CH_3-\overset{O}{\overset{\|}{C}}-O^-Na^+ + H-CBr_3$

E) (cyclohexenone) $\xrightarrow[\text{2) H}_2\text{O}]{\text{1) LiAlH}_4/\text{ether}}$ (cyclohexenol: HO H)

F) (cyclohexanone) $\xrightarrow[\text{H}_2\text{SO}_4]{\text{HOCH}_2\text{CH}_2\text{OH}}$ (cyclic acetal / dioxolane)

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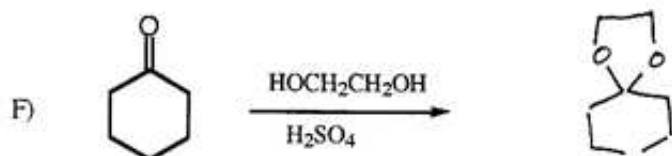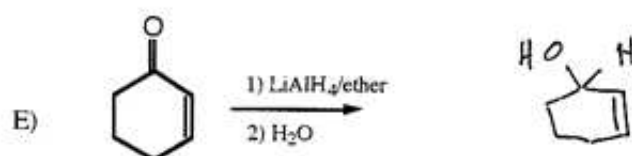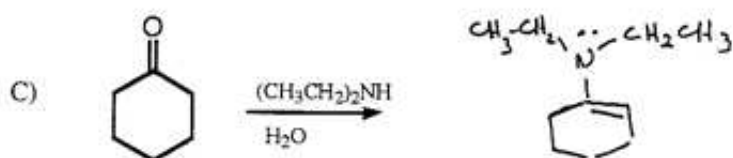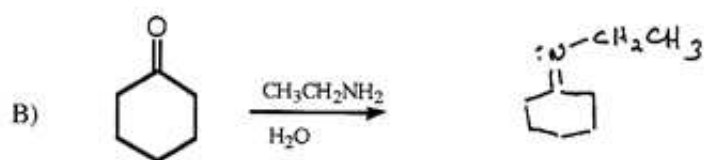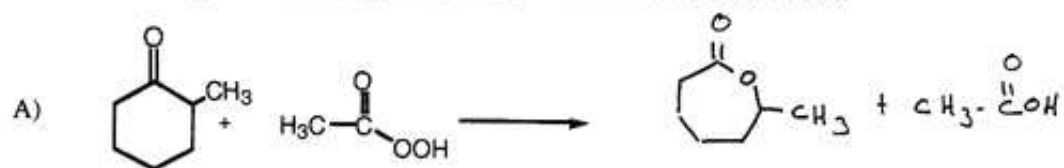
Problem 2. (40 points) What reagents would you use to carry out the following reactions. More than one step may be required. If more that one step is required, number each step. **Circle the reagents. DO not give intermediate products. Do not give the synthesis of the reagents.**

A)

1) LDA, ether
2) CH_3CH_2Br

B)

1) $(CH_3CH_2)_2CuLi$ /ether
2) H_3O^+

C)

1) Br_2 / H_3O^+
2) to^-Na^+

D)

1) CH_3CH_2Li /ether
2) H_3O^+

E) H_2C

1) CH_3-$\overset{O}{\overset{\|}{C}}OOH$
2) $CH_3O^-Na^+$ / CH_3OH
3) H_3O^+
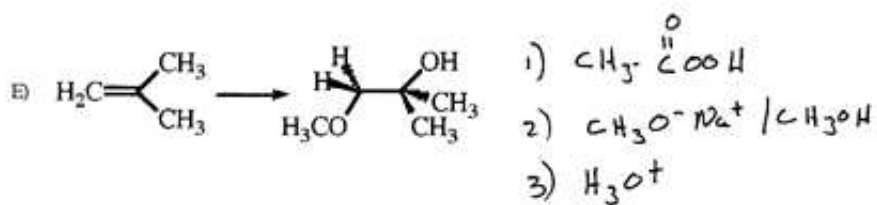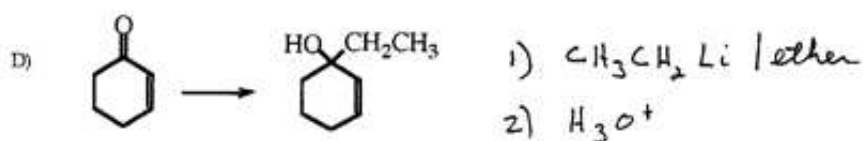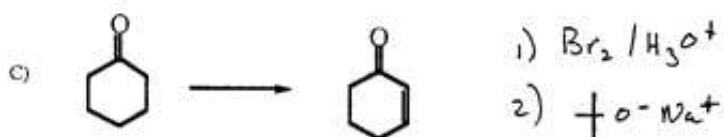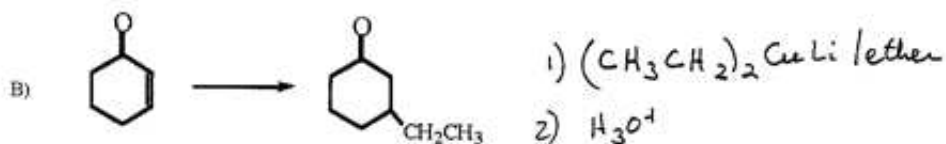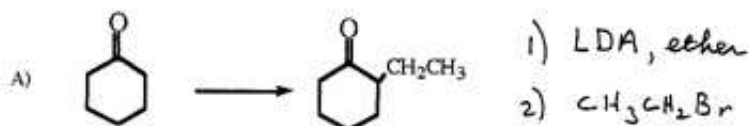
Problem 3. (15 points) How would you carry out the following transformation?

$$2X \quad \underset{H_3C}{\overset{H}{\diagdown}} C = CH_2 \longrightarrow \underset{H_3C}{\overset{H_3C}{\diagdown}} C = C \underset{H}{\overset{CH_3}{\diagup}} \overset{O}{\overset{\|}{C}} - CH_3$$

$$\downarrow H_3O^+$$

$$\uparrow NaOH \quad aldol$$

$$2x \quad CH_3 - \overset{OH}{\underset{H}{\overset{|}{\underset{|}{C}}}} - CH_3 \quad \xrightarrow{K_2Cr_2O_7} \quad 2x \quad CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$$
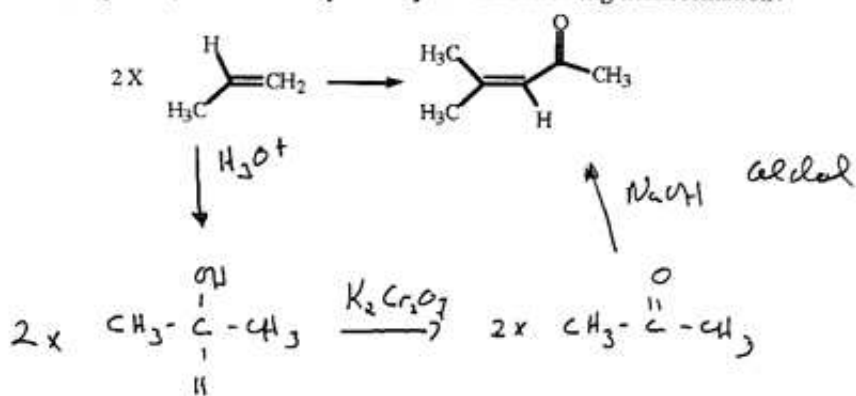
Problem 4. (15 points) Using acetic acid as your **only** source of carbon in the shown product, develop a synthesis for the following compound using the Wittig reagent.

$$2x \quad H_3C - \overset{O}{\overset{\|}{C}} - OH \longrightarrow \underset{H_3C}{\overset{H}{\diagdown}} C = C \underset{H}{\overset{CH_3}{\diagup}} + (C_6H_5)_3 PO$$

$$\downarrow \begin{array}{l} 1)Li:AlH_4/ether \\ 2)H_3O^+ \end{array}$$

$$2x \quad CH_3 - CH_2OH \xrightarrow{K_2Cr_2O_7}$$

$$PBr_3 \diagup \qquad \qquad CH_3 CH = O$$

$$\qquad \qquad +$$

$$CH_3 CH_2 Br$$

$$\diagdown (C_6H_5)_3 \overset{..}{P}$$

$$CH_3 - CH_2 - \overset{+}{P} (C_6H_5)_3 \quad \overset{BuLi}{\underset{ether}{\nearrow}}$$

$$CH_3 - CH = P (C_6H_5)_3 \quad + \quad CH_3 CH_2 CH_2 CH_3$$

Witting ?

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