14.30 Predict the products of the reaction of (i) phenylacetaldehyde and (ii) acetophenone with the following reagents:

(a) NaBH$_4$, then H$_2$O$^+$

(b) 2CH$_3$OH, HCl catalyst

(c) NH$_2$CH(CH$_3$)$_2$, HCl catalyst

(d) CH$_3$MgBr, then H$_2$O$^+$

**PHENYLACETALDEHYDE REACTIONS:**

\[
\text{phenylacetaldehyde} \xrightarrow{\text{NaBH}_4, \text{then H}_2\text{O}^+} \text{phenethyl alcohol}
\]

\[
\text{phenylacetaldehyde} \xrightarrow{2 \text{CH}_3\text{OH}, \text{HCl catalyst}} \text{phenethyl acetal}
\]

\[
\text{phenylacetaldehyde} \xrightarrow{\text{H}_2\text{C-CH}_3, \text{NH}_2} \text{phenethyl imine}
\]

\[
\text{phenylacetaldehyde} \xrightarrow{\text{CH}_3\text{MgBr}, \text{then H}_2\text{O}^+} \text{phenethyl alcohol}
\]

**ACETOPHENONE REACTIONS:**
14.32 Show how the Wittig reaction might be used to prepare the following alkenes. Identify the alkyl halide and the carbonyl compound you would use in each case.

(a) \( \text{C}_6\text{H}_5\text{CH} = \text{CH-CH} = \text{CHC}_6\text{H}_5 \)

(b) 

(c) 

(d) 

\[ \text{O} \quad \text{O} \quad \text{O} \]
14.34 How would you synthesize the following substances from benzaldehyde and any other reagents needed?

(a) \[
\text{Ph-CO} \]

(b) \[
\text{Ph-CH}_2-\text{N}\]

(c) \[
\text{Ph-CH} = \text{CH}_2 \]
14.35 Carvone is the major constituent of spearmint oil. What products would you expect from reaction of carvone with the following reagents?

(a) HOCH₂CH₂OH, HCl
(b) LiAlH₄, then H₃O⁺
(c) CH₃NH₂
(d) C₆H₅MgBr, then H₂O⁺
(e) 2 eq. H₂/Pd
(f) CrO₃, H₂O⁺

14.38 The SN₂ reaction of (dibromomethyl)benzene, C₆H₅CHBr₂, with NaOH yields benzaldehyde rather than (dihydroxymethyl)benzene, C₆H₅CH(OH)₂. Explain.
14.40 How would you synthesize the following compounds from cyclohexanone?

(a) 1-methylcyclohexene
(b) 2-phenylcyclohexanone
(c) cis-cyclohexane-1,2-diol
(d) 1-cyclohexylcyclohexanol

a. 

b.
14.45 Tamoxifen is a drug used in the treatment of breast cancer. How would you prepare tamoxifen from benzene, the following ketone, and any other reagents needed?
14.48 Propose a mechanism to account for the formation of 3,5-dimethylpyrazole from hydrazine and pentane-2,4-dione. What has happened to each carbonyl carbon in going from starting material to product?

14.55 Compound A, MW = 86, shows an IR absorption at 1730 cm\(^{-1}\) and a simple \(^1\)H NMR spectrum with peaks at 9.7 δ (1H, singlet) and 1.2 δ (9 H, singlet). Propose a structure for A.

IR spectrum means that there is a carbonyl in the molecule. The NMR peak at 9.7 ppm means that it is an aldehyde. The singlet at 1.2 ppm means that there is likely a tert butyl group which has no neighboring protons. The structure that fits all of these requirements is shown below:

14.57 The \(^1\)H NMR spectrum shown is that of a compound with formula C\(_9\)H\(_{10}\)O. If the unknown has an IR absorption at 1690 cm\(^{-1}\), what is a likely structure?

IR spectrum means that there is a carbonyl group. The lack of a proton around 9 ppm means that it is not an aldehyde. No singlets in the NMR means that it is not a methyl ester. The triplet at 1.2 ppm that
corresponds to 3 protons and quartet at 2.97 that corresponds to 2 protons means that it is likely an ethyl group (CH\textsubscript{2}CH\textsubscript{3}). The compound also has an aromatic ring in it, likely monosubstituted based on the splitting patterns in the aromatic ring. A structure that fits all of these requirements is shown below: