“Luck favors the prepared.”

Edna Mode, from the Incredibles
What are the products of the following reaction sequences. Think logically and write out intermediates if you need to. Be aware of details like stereochemistry and regiochemistry. (5 pts each)

1. 5-iodo-1-phenyl-1-pentanone
   1) $\text{PPh}_3$, THF
   2) $\text{nBuLi}$, hexanes
   3) heat

2. 4-oxo-butanal
   1) ethan-1,2-diol (1eq), TsOH
   2) LAH, EtOH
   3) $\text{H}_3\text{O}^+$

3. Benzaldehyde
   1) $\text{EtMgCl}$, Et$_2$O
   2) $\text{H}_3\text{O}^+$
   3) PDC, CH$_2$Cl$_2$
   4) $\text{H}_2\text{NOH}$, TsOH

4. 4-hydroxy-cyclooctanone
   1) 
   2) $\text{H}_2\text{NNH}_2$, KOH
   3) $\text{H}_3\text{O}^+$

5. 1-bromo-3-hexanone
   1) MeOH (xs), TsOH
   2) Li°, hexanes
   3) CuBr
   4) Ph-Br
2. What is the mechanism of two out of the following three transformations? Please choose only two and clearly indicate which ones you would like graded. Show all arrows, resonance structures, formal charges, etc. for full credit. (15 pts each)

a. 

\[
\begin{array}{c}
\text{O} \\
\text{O} \\
\text{O} \\
\end{array}
\quad \xrightarrow{\text{H}_3\text{O}^+} 
\begin{array}{c}
\text{OH} \\
\text{OH} \\
\text{+} \\
\text{O} \\
\end{array}
\]

b. 

\[
\begin{array}{c}
\text{O} \\
\end{array}
\quad + 
\begin{array}{c}
\text{HNPh}_2 \\
\end{array}
\quad \xrightarrow{\text{TsOH}} 
\begin{array}{c}
\text{Ph-} \\
\text{N-} \\
\text{Ph} \\
\end{array}
\]

c. 

\[
\begin{array}{c}
\text{O} \\
\end{array}
\quad \xrightarrow{\text{H}_2\text{NNH}_2} 
\begin{array}{c}
\text{} \\
\text{} \\
\text{} \\
\text{} \\
\text{} \\
\end{array}
\]

\[
\begin{array}{c}
\text{KOH} \\
\end{array}
\]

3. Given the following targets, choose two and synthesize them utilizing legal starting materials. Legal starting materials include: 1,3-dithiane; benzene; monofunctional compounds of 4 carbons or less; and any inorganic reagent (-CN, PPh$_3$, PDC, PCC, etc. are all inorganic) or solvent needed to carry out the transformation. Use good steps that give the desired product as the major product. (13 pts each)
(12) 4. Given the following roadmap and $^1$H NMR spectra, give structures to account for A, B, and C. (4 pts each)

- **A**: 
  1) nBuLi, hexanes
  2) ethanal
  3) $\text{H}_3\text{O}^+$
  4) $\text{Hg}^{2+}$, $\text{H}_2\text{O}$

- **B**: 
  1) $\text{CrO}_3$, $\text{H}_2\text{SO}_4$
  2) ethane-1,2-diol (1 eq), $\text{TsOH}$

- **C**: 
  1) $\text{PhMgBr}$, $\text{Et}_2\text{O}$
  2) $\text{H}_3\text{O}^+$
  3) $\text{Na}^+$, DMF

$^1$H NMR Spectrum of A:

![1H NMR Spectrum of A]

A = B = C =

(7) 5. The following structure appears on the MCAT (or choose your favorite multiple choice, post graduate entrance exam). What can you tell me about the structure before you even read the question? Three sentences MAX!

![Structure](attachment:image.png)

(4) Extra Credit: Give a “named” reaction (a reaction named after a dead, white guy) and an example of this reaction with a real substrate, real conditions, and a real product.