“...my brain is like a sieve, but it knows when it's being messed with…” Thomas Dolby
1. Look at each of the following reactions. Give the type of reaction class to which the indicated steps belong (S_N1, S_N2, E1, E2) in the space provided. (2 pts each) Then, give the product or products for the following reactions. Be aware of details like rearrangements, Z&E, cis and trans, stereochemistry, regiochemistry, etc. (5 pts each)

a. 

\[ \text{CHO} \quad \text{(CH}_3\text{)}_2\text{C}-\text{OH} \rightarrow 1) \text{TsCl, py} \]
\[ 2) \text{KOEt, EtOH} \]

**STEP 2:** ________

b. 

\[ \text{CHO} \]
\[ \text{1) SOCl}_2 \]
\[ 2) \text{HOrBu, heat} \]

**STEP 2:** ________

c. 

\[ \text{CHO} \]
\[ \text{1) Cl}_2, \text{light} \]
\[ \text{2) MeOH, heat} \]
\[ \text{3) H}_2, \text{Lindlar's catalyst} \]

**STEP 2:** ________

d. 

\[ \text{Br-Br} \]
\[ \text{1) NaOMe (1 eq), DMSO} \]
\[ \text{2) NaN}_3, \text{CH}_3\text{CN} \]

**EITHER STEP:** ________

2. What would the starting material or reagents be to carry out the following transformations? Be sure to include all pertinent details! (4 pts each)

a. 

\[ \text{NaOCH(CH}_3\text{)}_2 \]
\[ \text{HOCH(CH}_3\text{)}_2 \]

\[ \text{Br-Br} \]
\[ \text{1) NaOMe (1 eq), DMSO} \]
\[ \text{2) NaN}_3, \text{CH}_3\text{CN} \]

**EITHER STEP:** ________
3. Given the following road maps, give structures for A, B, and C shown. (3 pts each)

a.  
\[ \text{Br} \text{Br} \]
1) NaNH, NH$_3$ (l), -33°C  
2) H$_2$O  
\[ \text{A} \]

1) NaH  
2) isobutyl bromide  
THF  
\[ \text{B} \]

1) Na$^+$, NH$_3$ (l), -33°C  
2) OsO$_4$, NMO  
\[ \text{C} \]

A =  
B =  
C =

b.  
\[ \text{octag} \]
1) O$_3$  
2) H$_2$O  
\[ \text{A} \]

1) KOH (2 eq), H$_2$O  
2) \( \text{CO}_2 \) (2 eq), acetone  
\[ \text{B} \]

1) Br$_2$ (xs), CCl$_4$  
2) KOtBu (xs)  
DMSO  
\[ \text{C} \]

A =  
B =  
C =
4. Draw step by step mechanisms to account for the products shown. There may be other products formed, but you do not need to account for them in your mechanisms. Be sure to draw arrows to account for the flow of electrons and show all steps. (11 pts each)

a. 

b. 

\[
\begin{align*}
\text{OMs} & \xrightarrow{\text{MeOH, heat}} \text{products} \\
\text{b. } & \xrightarrow{\text{NaNH}_2} \text{products}
\end{align*}
\]
5. Synthesize two out of the three following targets. You may use monofunctional compounds of four carbons or less, bases for elimination or deprotonation, any inorganic reagent, and any solvent you need. Be sure to use good chemical steps that produce high yields for maximum points. Do not leave this question blank! (10 pts each)

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(3) BONUS: Name three other Butler chemistry professors (aside from the one teaching this course).