1.) Propose an efficient synthesis for the following transformation

\[ \text{1.} \text{B}_3\text{H}_3 - \text{THF} \]  
\[ \text{2.} \text{NaOH,} \text{H}_2\text{O} \]  
\[ \text{3.} \text{PCC, CH}_2\text{Cl}_2 \]

2.) Identify all resonance structures including the major contributor and why.

3.) Which of the following is the correct name for this Newman projection?

a. (3S, 4R) - 1 - Bromo - 4 - chloro - 3 - ethyl - 3 - methylpentane
b. (3R, 4R) - 1 - Bromo - 4 - chloro - 3 - ethyl - 3 - methylpentane
c. (2S, 3S) - 5 - Bromo - 2 - chloro - 3 - ethyl - 3 - methylpentane
d. (3R, 4R) - 5 - Bromo - 2 - chloro - 3 - ethyl - 3 - methylpentane
e. (2R, 3S) - 2 - Chloro - 3 - methyl - 3 - (2-bromoethyl)pentane

4.) Which of the following is the correct name for this structure?

a. (Z) - 6 - Bromo - 3,3 - dimethyloct-6 - en-1 - yne
b. (Z) - 3 - Bromo - 6,6 - dimethyloct-2 - en-6 - yne
c. (E) - 3 - Bromo - 6,6 - dimethyloct-2 - en-6 - yne
d. (E) - 6 - Bromo - 3,3 - dimethyloct-6 - en-1 - yne
5.) What would the final product be if you reacted the compound below with 1) LiAlH₄ 2) H₂O 3) PCC?

- a. Ether
- b. Alcohol
- c. **Aldehyde**
- d. Carboxylic acid
- e. Ketone

6.) What would the final product be if you reacted the compound from Q5 with 1) xs(CH₃)₂CHMgBr 2) H₃O+ 3) HBr?

- a. Secondary bromide
- b. **tertiary bromide**
- c. bromo hydrid
- d. acyl bromide
- e. alpha-bromo ketone

7.) Which of the following compounds will produce only one elimination product in the presence of t-BuOK?

- a. (1R, 2S, 3S) – 2 – Bromo – 1 – ethyl – 3 -methylcyclohexane
- b. (3R, 4R) – 3 – Bromo – 2,4 -dimethylhexane
- c. (1S, 2S, 3S) – 2 – Bromo – 1 – ethyl – 3 -methylcyclohexane
- d. 2 – Chloro – 1,1,3,3 – tetramethylcyclohexane

8.) What is the relationship between these two compounds below?

- a. Meso
- b. Constitutional isomers
- **c. Diastereomers**
- d. Enantiomers
- e. Tautomers

The following structure represents cortisol and will be used for the for questions 9 - 11
9.) How many \( \text{Sp}^2 \) hybridized atoms are on the structure of cortisol?
   a. 5
   b. 6
   c. 2
   d. 7

10.) How many hydrogens on the structure of cortisol?
   a. 28
   b. 27
   c. 30
   d. 24

11.) How many chiral centers exist on the structure of cortisol?
   a. 7
   b. 8
   c. 5
   d. 9

12.) Which of the following structures represent the product of cyclohexanol reacted with 1) \( \text{Na}_2\text{Cr}_2\text{O}_7 \), \( \text{H}_2\text{SO}_4 \), \( \text{H}_2\text{O} \) 2) \( \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} \) 3) \( \text{H}_2\text{O} + 4 \) conc \( \text{H}_2\text{SO}_4 \) 5) \( \text{BH}_3 \), THF 6) \( \text{NaOH} \), \( \text{H}_2\text{O}_2 \)

13.) Which chair represents the most stable confirmation of the following structure?
14.) In which direction is the following reaction favored and why?

\[
\text{O} = \text{CH}_2 \text{NH} \quad \text{F} \quad \text{C} \quad \text{O} \quad \text{Na} \quad \longleftrightarrow \quad \text{O} \quad \text{C} \quad \text{NNa} \quad \text{F} \quad \text{C} \quad \text{OH}
\]

15.) Which of the following groups of reagents would best yield the reaction below?

a. 1) MCPBA, CH₂Cl₂ 2) H₂O⁺
   b. 1) HCl 2) NaOEt, heat 3) RCO₂H, CH₂Cl₂
   c. 1) HBr 2) t-BuOK, heat 3) MCPBA, CH₂Cl₂
   d. 1) O₂ 2) DMS 3) EtMgBr 4) H₂O⁺

16.) Draw all products from the following reaction:

\[
\text{Br} \quad \text{OH} \quad \text{H} \quad \text{Cl} \quad \text{OCl} \quad \text{H} \quad \text{Cl}
\]
17.) Which of the following represents the major product of the reaction below?

\[
\text{HO-CH} \quad \text{HO-CH} \\
\text{HO-CH} \quad \text{HO-CH}
\]

18.) Which of the following best represents the major product of the reaction below?

\[
\text{Br} \quad \text{Br} \\
\text{Br} \quad \text{Br}
\]
19.) Propose an efficient synthesis for the following reaction.

\[
\begin{align*}
\text{[conc]} H_2SO_4 \\
\text{(racemic)}
\end{align*}
\]