I(24) Circle the letter of the correct answer for each multiple choice question.

1.) What is the final product of the reaction sequence below.

\[
\begin{align*}
\text{CH}_3\text{COOH} & \quad \text{O} \\
& \xrightarrow{\text{CH}_3\text{OH}} \quad \text{B} \\
\text{CH}_3\text{OH} & \quad \text{OCH}_3
\end{align*}
\]

A) \( \text{CH}_3\text{OCH}_3 \)  
B) \( \text{CH}_3\text{O} \)  
C) \( \text{OCH}_3 \)  
D) \( \text{OCH}_3 \)  
E) \( \text{OH} \)

2.) Which feature in the IR will allow you to distinguish between \( \text{CH}_3\text{CH}_2\text{OH} \) (A) and \( \text{CH}_3\text{C}–\text{H} \) (B)

A) Only A will show a peak at 2990cm\(^{-1}\)  
B) Only B will have peaks above 3000cm\(^{-1}\)  
C) Only B will have peak at 1730cm\(^{-1}\)  
D) Only A will have peaks near 3200-3400cm\(^{-1}\)  
E) Both C & D are correct.  
F) Both A & B are correct

3.) A compound with the formula \( \text{C}_3\text{H}_10\text{O} \) shows the following peaks in the \(^1\text{H}-\text{NMR}\) spectrum: a doublet, a singlet, and multiplet. What is a reasonable structure for this compound?

A) \( \text{CH}_3\text{CH}_2\text{CCH}_2\text{CH}_3 \)  
B) \( \text{CH}_3\text{CHCH}_2\text{CH}_2\text{CH}_3 \)  
C) \( \text{CH}_3\text{CCH}–\text{CH} \)  
D) \( \text{CH}_3\text{OCHCH}_2\text{CH}_3 \)  
E) \( \text{CH}_3\text{CCH}–\text{CH}_3 \)  

Name: _____________________________

Chemistry 232- Organic II
Exam 1- Dr. Gallo (Brown & Foote)
September 27, 2004
4.) When 1-chloropropane is subjected to electron impact MS (high energy electron collision), the reaction products formed are:

A) \([C_3H_7Cl]^+ + 2e^-\)  

B) \([C_3H_7Cl]^{++} + 2e^-\)  

C) \([C_3H_7Cl]^+ + 1e^-\)  

D) \([C_3H_7Cl]^+ + \text{proton}\)  

E) \([C_3H_7]^+ + Cl^- + 2e^-\)

5.) Which of the following isomers of heptane would give only 3 signals in the proton decoupled (no C-H splitting) \(^{13}\text{C}\) NMR spectrum.

A) Heptane  

B) 3,3-dimethylpentane  

C) 2,4-dimethylpentane  

D) 2-methylhexane  

E) 2,2,3-trimethylbutane

6.) The term resonance in NMR refers to:

A) Structures that differ only in the placement of electrons.  

B) Changes in the vibrational modes of the bonds of the sample.  

C) Nuclei flipping from an aligned to nonaligned orientation when the energy difference between those states is matched in a magnetic field.  

D) Protons in the sample with excess energy that react with high energy electrons.  

E) Radioactive nuclei that decay in a strong magnetic field and give off radiation.

II(35). Complete each question as indicated.

1.) Provide the correct IUPAC name with stereo chemistry (R/S) for the compound below:

\[
\begin{array}{c}
\text{O} \\
\text{H} \\
\text{Br}
\end{array}
\]

2.) Provide a step by step mechanism with e\(^-\), arrows, intermediates, and products for the reaction of the epoxide below with water labeled with oxygen-18. Be sure to show where the \(^{18}\text{O}\) label is in the product. The reaction is acid catalyzed.

\[
\begin{array}{c}
\text{CH}_3\text{CH}_2
\end{array} + \text{H}_2\text{O}^{18} \xrightarrow{\text{H}^+} \text{CH}_3\text{CH}_2
\]

\[
\begin{array}{c}
\text{O}
\end{array}
\]
3.) What peaks in the IR spectrum could you use to distinguish between the following compounds. Tell what group is responsible for the peak and where it occurs in the IR spectrum.

a) 

\[ \begin{align*} &\text{vs} \\
&\text{O} \\
\end{align*} \]

b) 2-butyne vs 3-pentyne

4.) The mass spectrum of 2-chlorobutane shows the following peaks at m/z values:

94, 92 (M+), 77, 63, 56 (100%), 27

a.) What is the structure of the species causing the peak at 92.

b.) Provide a possible structure of the species causing the base peak.

c.) Explain why there is a peak past the molecular ion and what is causing it (be specific).

5.) Show the intermediate and product(s) produced when the cyclic ether reacts with excess concentrated HBr.

\[ \begin{align*} &\text{O} \\
&\text{HBr} \\
\end{align*} \]
III(41)

1.) Provide reactions to show how you can synthesize the following compound starting from alkyl halides or alcohols. Be sure to show the necessary reagents required for each step.

a) 

\[ \text{OCH}_2\text{CH}_3 \]

b) How can you carry out the following conversion:

\[ \text{CH}_3\text{CH}_2 \text{C} - \text{C} - \text{CH}_3 \to \text{CH}_3\text{CH}_2 \text{O} \]

2.) Consider the compound below and predict the $^1$H NMR spectrum for it by labeling each different type of hydrogen and giving its approximate chemical shift and splitting pattern.

\[ \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_3 \]
3.) A compound with the formula C\textsubscript{4}H\textsubscript{7}BrO gives the following peaks in the \textsuperscript{13}C NMR spectrum.

- \textsuperscript{13}C NMR- proton decoupled, 4 single lines
- \textsuperscript{13}C NMR- with splitting
  - 1 quartet
  - 2 triplets
  - 1 singlet at \( \delta \text{209} \)

Propose a structure consistent with this data.

4.) Consider the sample whose formula is C\textsubscript{7}H\textsubscript{14} which exhibits the following spectral data:

- IR: 3050 cm\textsuperscript{-1}
  - 1640 cm\textsuperscript{-1}
- \textsuperscript{1}H NMR (First Order):
  - \( \delta \text{1.1, 9H, S} \)
  - \( \delta \text{2.0, 3H, d} \)
  - \( \delta \text{4.9, 1H, m} \)
  - \( \delta \text{5.3, 1H, d} \)

- \textsuperscript{13}C NMR (proton decoupled) 5 single lines