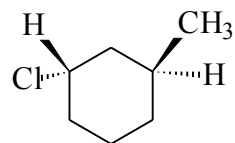


**Organic Chemistry 32-235**  
**Practice Questions for Exam #2**

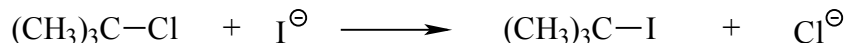
Part 1: (Circle only **ONE** choice, circling more than one will be counted as wrong!)  
4 points each

1. The correct IUPAC name for the following compound is:

- (A) (1R, 3R)-1-chloro-3-methylcyclohexane  
(B) (1R, 3S)-1-chloro-3-methylcyclohexane  
(C) (1S, 3S)-1-chloro-3-methylcyclohexane  
(D) (1S, 3R)-1-chloro-3-methylcyclohexane  
(E) None of the above.



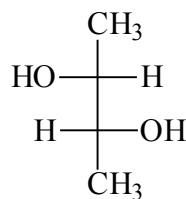
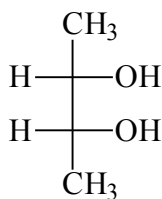
2. Consider the  $S_N1$  reaction of tert-butyl chloride with iodide ion:



If the concentration of iodide ion is doubled, the rate of forming tert-butyl iodide will:  
(hint: consider mechanism, i.e. how is the product formed?)

- (A) Double.                      (B) Increase 4 times.                      (C) Remain the same.  
(D) Decrease.                      (E) None of the above.

3. The relationship between the following two structures is:



- (A) enantiomers                      (B) diastereomers                      (C) structural isomers  
(D) identical                      (E) none of the above

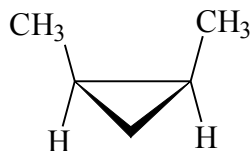
4. The specific rotation of pure (R)-2-butanol is  $-13.5^\circ$ . What % of a mixture of the two enantiomeric forms is (S)-2-butanol if the specific rotation of this mixture is  $-5.4^\circ$ ?

- (A) 40%                      (B) 30%                      (C) 60%                      (D) 70%                      (E) None of the above

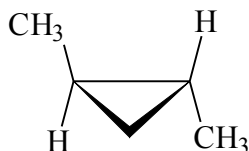
5. Which of the following alkyl halides would undergo  $S_N2$  reaction most rapidly?

- (A)  $\text{CH}_3\text{CH}_2-\text{Br}$                       (B)  $\text{CH}_3\text{CH}_2-\text{Cl}$                       (C)  $\text{CH}_3\text{CH}_2-\text{I}$   
(D)  $\text{CH}_3\text{CH}_2-\text{F}$                       (E) they react at the same rate

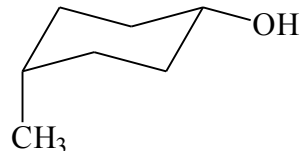
6. Which of the following molecules is chiral ?



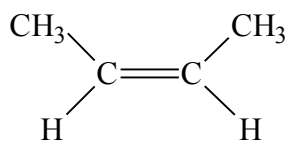
(A)



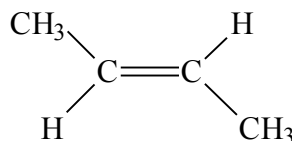
(B)



(C)



(D)

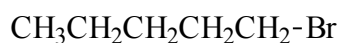


(E)

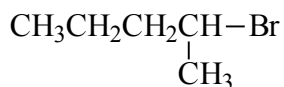
7. The relationship between (A) and (B) structures in the previous question is:

- A) identical
- B) structural isomers
- C) diastereomers
- D) enantiomers
- E) None of the above

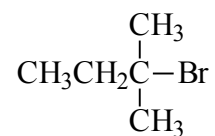
8. Which of the following alkyl halides would you expect to undergo  $S_N1$  reaction most rapidly ?



(A)



(B)

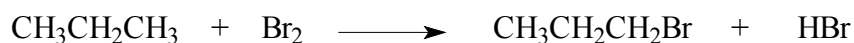


(C)

(D) They will not undergo  $S_N1$  reaction

(E) They react at the same rate

9. For the following reaction, the overall enthalpy change is:



(A) -12 kcal/mol

(B) +12 kcal/mol

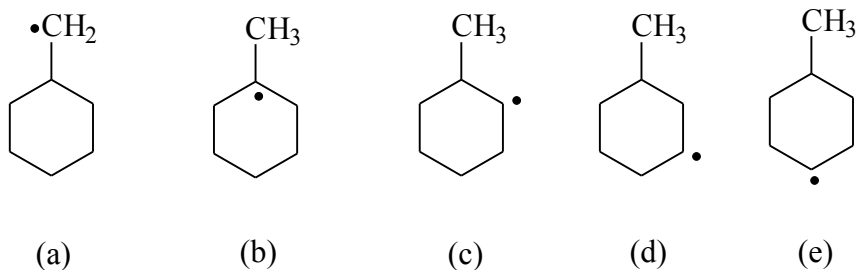
(C) -300 kcal/mol

(D) +300 kcal/mol

(E) +15 kcal/mol



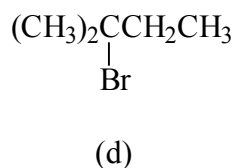
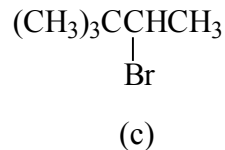
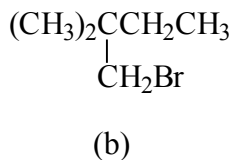
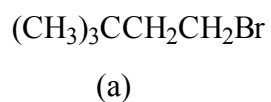
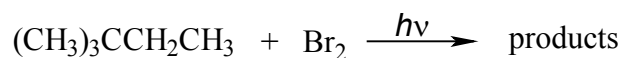
13. Which of the following free radical is the most stable ?



14. Which of the above drawing is the most stable if the radical carbon is changed to a carbocation?

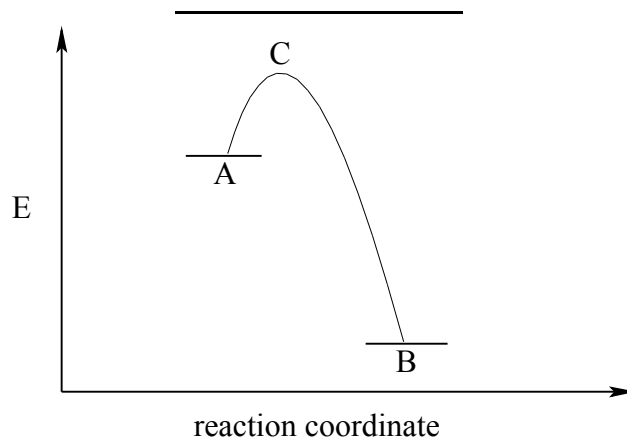
15. Which is the least stable in these structures if the radical carbon is changed to a carbanion?

16. The major monobromination product in the following reaction is



(e) none of the above

17. According to the following energy profile, the rate of reaction from A to B is determined by

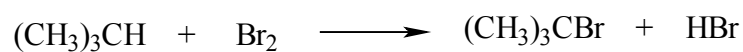


- (a) the energy of A only
- (b) the energy of B only
- (c) the energy difference between C and A
- (d) the energy difference between B and A
- (e) the energy of C only

18. The bond dissociation energy is the amount of energy required to break a bond

- a) so as to produce the more stable pair of ions
- b) heterolytically
- c) homolytically
- d) via hydrogenation
- e) none of the above

19. Given the bond dissociation energies below (in kcal/mol), calculate the overall  $\Delta H^\circ$  for the following reaction:



$(\text{CH}_3)_3\text{C-H}$	91
$(\text{CH}_3)_3\text{C-Br}$	65
Br-Br	46
H-Br	88
CH <sub>3</sub> -Br	70

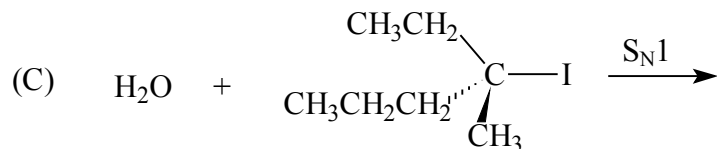
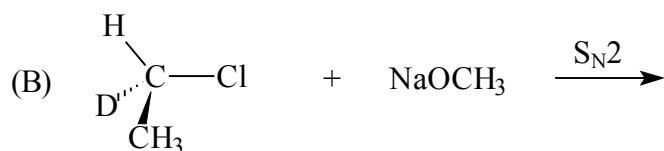
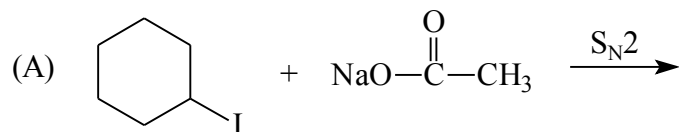
$\Delta H^\circ =$

Write chain propagation steps for the above bromination reaction.

End of Part 1

Part 2:

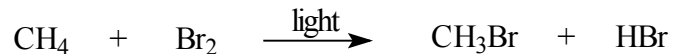
1. (14 pt) Draw the organic product expected from each of the following reactions. Be sure to indicate stereochemistry where appropriate and to include stereoisomers if any. In case two or more stereoisomers are formed, label their relationship as diastereomers, enantiomers, structural isomers, or conformers.



2. (10 pt) (A) Draw Fisher projections for (2R, 3S)-2-bromo-3-chlorobutane and (2S, 3R)-2-bromo-3-chlorobutane, with the carbon chain on the vertical line. Label each structure as (2R, 3S) or (2S, 3R).

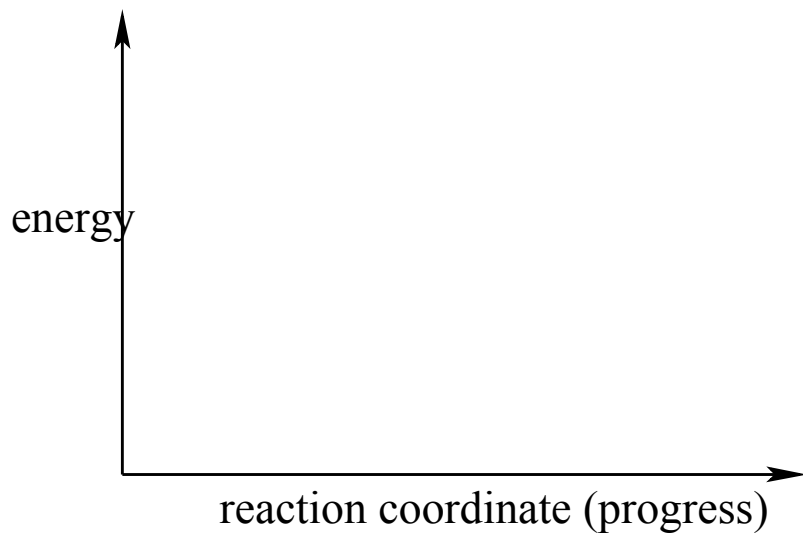
(B) Assume that you have a mixture of equal amount of each of the above compounds. Can they be separated into two containers based on physical properties such as b.p., m.p., etc.? If yes, which technique would you use? If no, briefly explain why not.

3.(14 pt) The following equation shows the bromination of methane:

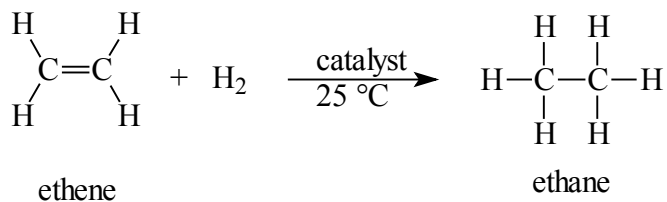


1) Propose a mechanism (initiation and propagation steps) to account for the product formation. Label the steps as A, B, C... and calculate the  $\Delta H^\circ$  for each step.

2) Draw an energy diagram (using the  $\Delta H^\circ$  for each step to set appropriate energy levels) for the two **propagation** steps, and decide which step is more likely the rate-determining step? (label this step as rds)



4. (14pt) At the room temperature (25 °C), ethene can be hydrogenated (add one mole of H<sub>2</sub> to the double bond) to give ethane in the presence of a catalyst, as shown below:



It is known from the experiment that  $\Delta G^\circ = -30\text{kcal/mol}$ . Answer the following questions:

(A) Calculate the equilibrium constant for this reaction if there is sufficient data. If there is not enough data to allow for such calculation, simply state so.

(B) Predict the sign of this  $\Delta S^\circ$  for this reaction. Briefly explain your reasoning.

(C) Predict the sign of  $\Delta H^\circ$  for this reaction. Explain briefly how you arrive at this conclusion.