

50 pts Multiple choice: Choose the one best answer.

1. Vinylic halides undergo:
  - a.  $S_N2$
  - b.  $S_N1$
  - c. E1
  - d. None of the above
2. Which of the following has no effect on reaction rate for  $S_N2$  reactions?
  - a. The leaving group
  - b. Nucleophile
  - c. Carbocation structure
  - d. The solvent
3. The  $pK_a$  of a terminal alkyne is:
  - a. 15
  - b. 5
  - c. 25
  - d. 35
4. Carrying out dehydrohalogenation with sodium ethoxide (small, unhindered base) favors formation of the:
  - a. More substituted alkene
  - b. Less substituted alkene
  - c. Less stable alkene
  - d. Both a and c
5. E1 elimination requires a(n):
  - a. Syn periplanar (or coplanar) transition state
  - b. Anti periplanar (or coplanar) transition state
  - c. Trigonal planar intermediate
  - d. None of the above
6.  $S_N1$  reactions result in:
  - a. Retention of configuration
  - b. Inversion of configuration
  - c. Racemic mixture of enantiomers
  - d. None of the above
7. The only pathway not possible with a tertiary alkyl halide is:
  - a.  $S_N2$  reaction
  - b.  $S_N1$  reaction
  - c. E1 reaction

- d. E2 reaction
8. Of the following, which is the worst leaving group?
- a. Iodide ion
  - b. Bromide ion
  - c. Chloride ion
  - d. Fluoride ion
9. Which is a poor solvent for SN2 reactions?
- a. DMF
  - b. DMSO
  - c. water
  - d. all of the above
10. Which is a poor solvent for SN1 reactions?
- a. DMF
  - b. Ethanol
  - c. Water
  - d. Methanol
11. How many intermediates are formed in a SN2 reaction?
- a. 0
  - b. 1
  - c. 2
  - d. 3
12. SN2 reactions result in:
- a. Retention of configuration
  - b. Inversion of configuration
  - c. Racemic mixture
  - d. None of the above
13. As discussed in class, planning an organic synthesis from simpler starting materials is called:
- a. An organic synthesis outline
  - b. A retrosynthetic analysis
  - c. An organic transformation plan
  - d. None of the above
14. Which of the following reactions gives the anti-Markovnikov product?
- a. Hydroboration-oxidation of alkenes
  - b. Electrophilic addition of hydrogen halides to alkenes
  - c. Oxymercuration-demercuration of alkenes
  - d. Hydration of alkenes
15. If electrophilic addition of an alkene to HBr results in a chiral compound, the result of the reaction is:
- a. inversion
  - b. retention
  - c. racemic mixture
  - d. none of the above

16. If two groups of higher priority are on the same side of a double bond, the alkene is designated:
- R
  - Z**
  - Trans
  - E
17. Which of the following is the best leaving group?
- $\text{TsO}^-$
  - $\text{H}_2\text{O}$
  - $\text{I}^-$**
  - $\text{Br}^-$
18. A carbocation has what type of hybridization?
- $\text{Sp}^3$
  - $\text{Sp}^2$**
  - sp
  - None of the above
19. Which of the following has the most steric hindrance?
- Ethyl Bromide
  - Methyl chloride
  - Ethyl chloride
  - Isopropyl chloride**
20. The E2 reaction occurs by elimination of alpha-hydrogens
- True
  - False**
21. Zaitsev's rule predicts that:
- The most stable carbocation will form in an elimination
  - The most substituted alkene will form in an elimination**
  - The hydrogen atom adds to the carbon atom of the double bond that has the greater number of hydrogen atoms
  - The hydrogen atom adds to the carbon atom of the double bond that has the lesser number of hydrogen atoms
22. The first intermediate formed during a dissolving metal reduction of an alkyne is called a:
- Vinylic anion
  - Vinylic radical
  - Radical anion**
  - Radical cation
23. If the concentration of both the substrate and base in a E2 reaction is doubled, the rate of the overall reaction:
- Stays the same**
  - Increases by a factor of two
  - Increases by a factor of four
  - Increases by a factor of eight
24. If the concentration of both the substrate and nucleophile in an  $\text{S}_{\text{N}}1$  reaction is doubled, the rate of the overall reaction:

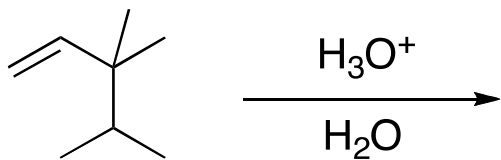
- a. Stays the same
- b. Increases by a factor of two
- c. Increases by a factor of four
- d. Increases by a factor of eight

25. Hydroboration-oxidation occurs via

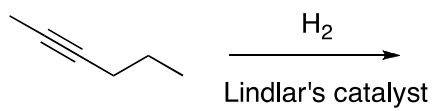
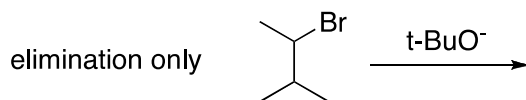
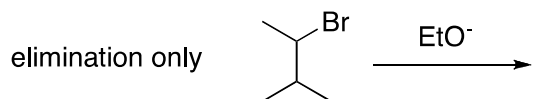
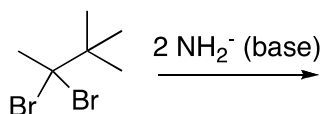
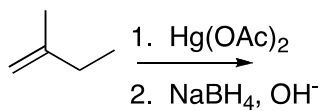
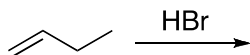
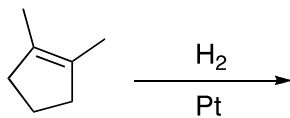
- a. Syn addition/Markovnikov
- b. Anti addition/Anti-Markovnikov
- c. Syn addition/Anti-Markovnikov
- d. Anti addition/Markovnikov

Fill in the answer.

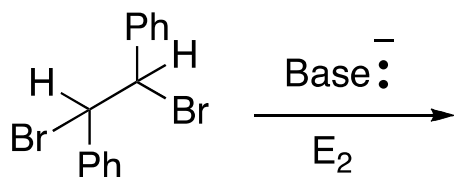
26. 10 pts Predict the major product and draw the mechanism of the reaction.



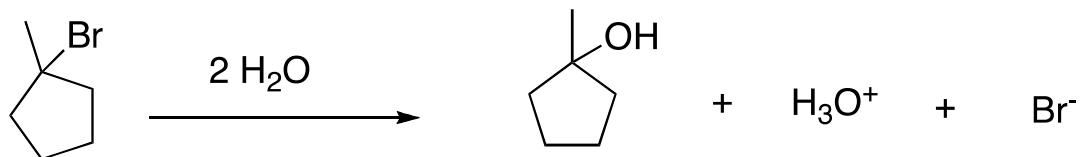
27. 2 pts each (total 14 pts) Predict the major product(s) for each reaction. Show stereochemistry where necessary using wedges and dashes. If there is no reaction, write NR.



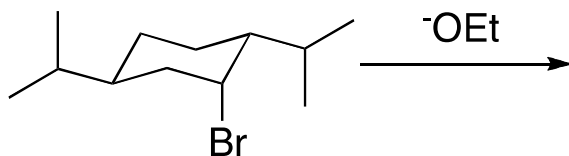
28. 4 pts Predict the product and draw the mechanism of the following reaction. Pay special attention to which stereoisomer is formed. Is the product E or Z?



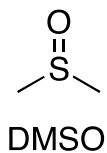
29. 4 pts Draw the full mechanism for the following SN1 reaction. Use arrows to show movement of electrons.



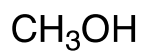
30. 8 pts What two elimination products can result from this reaction? Which is favored?



31. 3 pts Fully explain why polar aprotic solvents such as DMSO will increase the rate of reaction for SN2 reactions.

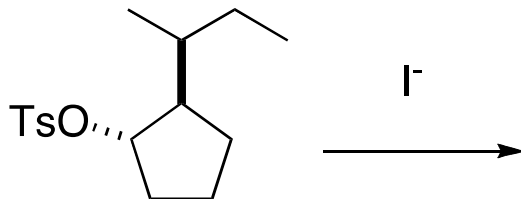


32. 3 pts Fully explain why polar protic solvents such as methanol will increase the rate of reaction for SN1 reactions.



Methanol

33. 2 pts Predict the major organic product(s) for the following SN2 reaction. Show stereochemistry using wedges and dashes.



34. 2 pts Predict the major organic product(s) for the following SN1 reaction. Show stereochemistry using wedges and dashes.

