CH 242 Organic Chemistry Final Exam Winter 2002 Name _____

1. Give the products of the following Diels-Alder reactions. (10 pts)

a. $CH_2=CHC(CH_3)=CH_2$ + $HC\equiv CH$

b.  +

2. What is the major product formed when trans-1-bromo-2-ethylcyclohexane undergoes an E2 elimination? Why? (5 pts)

3. Would it be better to use ^{1}H NMR or ^{13}C NMR to distinguish among 1-butene, cis-2-butene, and 2-methylpropene? Explain your answer.

4. Show, using any necessary reagents, how the following compounds could be prepared using ethylene oxide as one of the reactants:

a. $CH_3CH_2CH_2CH_2OH$

b. $CH_3CH_2CH_2CH_2Br$

c. $CH_3CH_2CH_2CH_2D$

5. What carbon is protonated in the first step of the reaction of 3-methyl-2,4-heptadiene with one equiv of HBr?

a. C-2
b. C-1
c. C-3
d. C-4
e. C-5

6. Why do many S_N1 reactions produce more of the product with inverted configuration than with retained configuration?

a. Reaction occurs by way of a Walden inversion. The product with retained configuration comes from racemization after the S_N1 reaction.
b. The leaving group partially blocks the side of the carbocation from which it leaves.
c. The solvent-separated ion pair results in more of the product with retained configuration.
d. The nucleophile attacks the free carbocation.

7. Which of the following statements describes the reaction coordinate diagram for an E_1 reaction?
a. a one step reaction with one transition state
b. a two step reaction with 1 intermediate and 1 transition state
c. a one step reaction with 2 transition states
d. a one step reaction without a transition state
e. a two step reaction with 1 intermediate and 2 transition states

8. Why does cis-1-bromo-4-tert-butylcyclohexane react faster in an E_2 reaction than does trans-1-bromo-4-tert-butylcyclohexane?
a. Since the Br is in an equatorial position, syn elimination can occur.
b. When Br and H are in the required equatorial positions, the large tert-butyl group is in the more stable axial position.

c. The required syn elimination can occur with all the substituents in the most stable equatorial position.
d. When Br and H are in the required axial positions, the large tert-butyl group is in the more stable equatorial position.
e. When Br and H are in the required equatorial positions, the large tert-butyl groups is in the more stable equatorial position.

9. Which of the following best describes the carbon-lithium bond?
a. The carbon-lithium bond is covalent and somewhat polar.
b. The carbon-lithium bond is covalent and nonpolar.
c. The carbon-lithium bond is almost ionic with carbon negative and lithium positive.
d. The carbon-lithium bond is almost ionic with carbon positive and lithium negative.
e. A carbon-lithium bond is less polar than a carbon-oxygen bond.

10. Which of the following is **not** true about electromagnetic radiation?
a. Energy is directly proportional to the velocity of light.
b. Frequency is directly proportional to wavelength.
c. Frequency is directly proportional to wavenumber.
d. Energy is inversely proportional to wavelength.
e. Energy is directly proportional to wavenumber.

11. The ^{1}H NMR spectrum of a compound shows methyl and methylene signals with relative intensities of 3:1. Identify the compound.

CH_3CH_2Br
$(CH_3)_3CCH_2Br$
$(CH_3)_2CBrCH_2Br$
$(CH_3)_2C(CH_2Br)_2$
$CH_3C(CH_2Br)_3$

12. How many peaks would be observed in the ^{1}H and ^{13}C NMR spectra respectively of 4-bromotoluene?

7 and 7
2 and 2
5 and 5
3 and 5
4 and 7

13. What is "ferrocene"?

a complex of Fe^{3+} and 1 cyclopentadienyl dianion
a complex of Fe^{2+} and 2 benzene anions
a complex of Fe^{3+} and 2 cyclopentadienyl anions
a complex of Fe^{2+} and 1 cyclopentadienyl dianion
a complex of Fe^{2+} and 2 cyclopentadienyl anions

14. Which of the following compounds cannot be converted to benzoic acid by heating with an acidic solution of sodium dichromate?

2-methyl-2-phenylbutane
2-methyl-3-phenylbutane
ethylbenzene
2-phenylbutane
1-phenylpropane

15. What is the molecular formula of 3-methylcyclopentanecarboxylic acid?

$C_6H_{12}O_2$
$C_6H_{11}O_3$
$C_7H_{12}O_3$
$C_7H_{12}O_2$
$C_6H_{10}O_2$

16. Draw the structures of the following molecules:

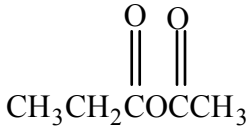
a. 6-methyl-2-cyclohexenol

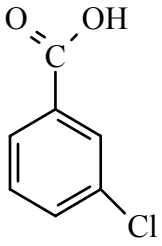
b. 2-propyloxirane

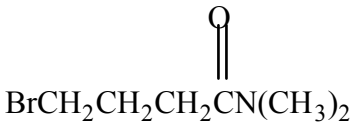
c. 5-bromo-2-nitrotoluene

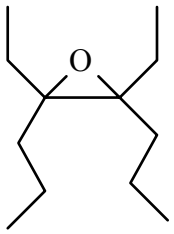
d. methyl 3-bromobutanoate

17. Name the following compounds:

a. 

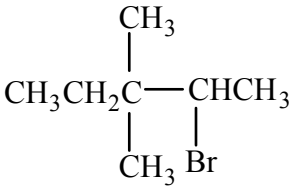
b. 

c. 

d. 

18. Give the major 1,2- and 1,4-addition products for the following reaction, and indicate which is the thermodynamic and which is the kinetic product.

19. The following alkyl halide forms a substitution product from an S_N1 reaction that is different from the substitution product formed from an S_N2 reaction. Show the alcohol products formed from an S_N1 and an S_N2 reaction.

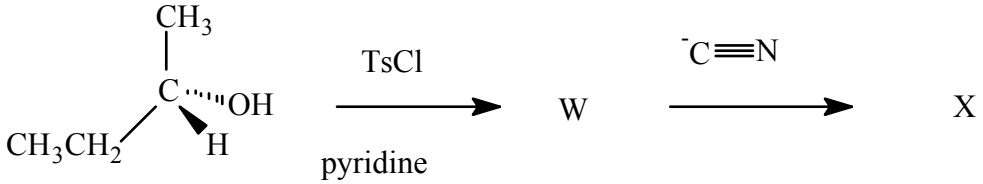


20. What alkene will be formed in an E2 reaction of the following compound. Indicate its configuration.

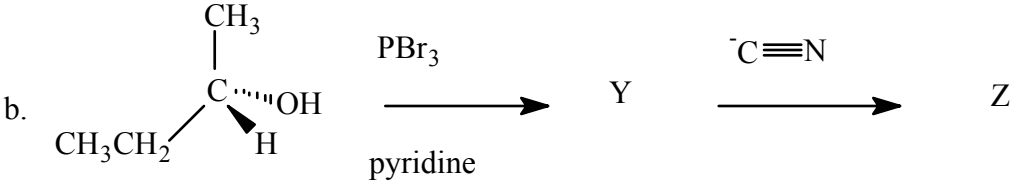
(1S, 2S)-1-bromo-1,2-diphenylpropane

21. Give the structures of W, X, Y, and Z.

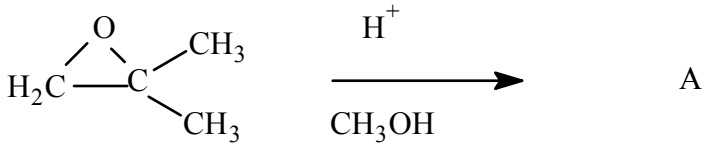
a.

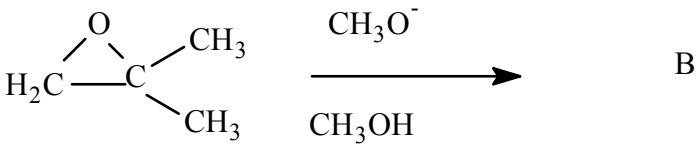


b.



22. Give the structures of A and B.

a. 

b. 

23. The mass spectra of two different cycloalkanes both show a molecular ion peak at m/z = 98. One spectrum shows a base peak at m/z = 69, and the other shows a base peak at m/z = 83. Identify the cycloalkanes. Explain!

24. Draw the π molecular orbital energy levels for the cyclopentadienyl anion, the cyclopentadienyl cation, and the cyclobutadiene. For each compound, show the distribution of the π electrons. Which of the compounds are aromatic? Which are antiaromatic?

25. Show how 1-bromo-2-phenylethane can be prepared from benzene.

26. Show how m-bromopropylbenzene can be prepared from benzene.

27. Write the mechanism for the reaction of acetyl chloride with water to form acetic acid.