350 Organic Chemistry I
Exam #2B, October 21, 2011

Winona State University
Professor T. Nalli

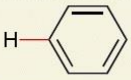
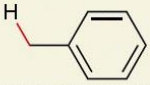
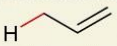
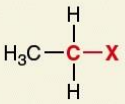
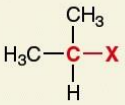
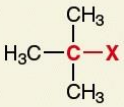
Name_____

General Instructions: Write your name in the space provided above and on the provided Scantron form. ***Do not put your name anywhere else in this exam book.***

Make sure that you read each question carefully and provide complete answers. Time limit is 55 min.

Grading: Grading will be on the basis of a highest possible score of 100 points.
I. Multiple Choice – 2 points each, 50 points total
II. Draw Structures - 4 points each, 12 points total
III. Priority Rules - 10 points
IV. Reaction Products – 7 points each, 28 points total
Extra credit sustainability initiative – 5 points

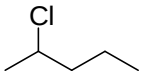
TABLE 6.1 BOND DISSOCIATION ENERGIES (ΔH°) OF COMMON BONDS

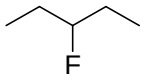
	KJ/MOL	KCAL/MOL
Bonds to H		
H—H	435	104
H—CH_3	435	104
H—CH_2CH_3	410	98
H—$CH(CH_3)_2$	397	95
H—$C(CH_3)_3$	381	91
	473	113
	356	85
	464	111
	364	87
H—F	569	136
H—Cl	431	103
H—Br	368	88
H—I	297	71
H—OH	498	119
H—OCH_2CH_3	435	104
C—C bonds		
CH_3—CH_3	368	88
CH_3CH_2—CH_3	356	85
$(CH_3)_2CH$—CH_3	351	84
$H_2C{=}CH$—CH_3	385	92
HC≡C—CH_3	489	117
Bonds to methyl		
CH_3—H	435	104
CH_3—F	456	109
CH_3—Cl	351	84
CH_3—Br	293	70
CH_3—I	234	56
CH_3—OH	381	91
		
CH_3CH_2—H	410	98
CH_3CH_2—F	448	107
CH_3CH_2—Cl	339	81
CH_3CH_2—Br	285	68
CH_3CH_2—I	222	53
CH_3CH_2—OH	381	91
		
$(CH_3)_2CH$—H	397	95
$(CH_3)_2CH$—F	444	106
$(CH_3)_2CH$—Cl	335	80
$(CH_3)_2CH$—Br	285	68
$(CH_3)_2CH$—I	222	53
$(CH_3)_2CH$—OH	381	91
		
$(CH_3)_3C$—H	381	91
$(CH_3)_3C$—F	444	106
$(CH_3)_3C$—Cl	331	79
$(CH_3)_3C$—Br	272	65
$(CH_3)_3C$—I	209	50
$(CH_3)_3C$—OH	381	91
X—X bonds		
F—F	159	38
Cl—Cl	242	58
Br—Br	192	46
I—I	151	36
HO—OH	213	51

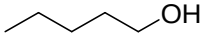
I. Multiple Choice

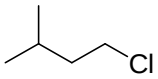
1. A 50:50 mixture of a pair of enantiomers is called a _____ mixture and is optically_____.
   A. racemic; active B. chiral; active C. racemic; inactive D. chiral; inactive

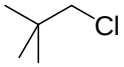
2. Which of the following compounds is(are) chiral?
   I. 1-chloropentane II. 2-chloropentane III. 3-chloropentane
   A. III only B. II only C. II and III D. I and II

3. Which of the following compounds is chiral?
   A. 

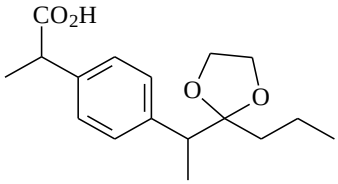
   B. 

   C. 

   D. 

   E. 

4. How many chirality centers are present in the molecule shown at right?
   A. two B. one C. three D. zero

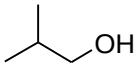


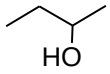
5. How many total stereoisomers can exist for a compound with 4 chirality centers?
   A. 32 B. 16 C. 8 D. 4

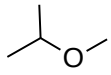
6. The $[\alpha]_D$ of the natural product derivative, β-butylene di(phenylurethane), is +20.0°. Assume a laboratory synthesis of this compound gives a product with $[\alpha]_D$ = +12.0°. What is the ratio of the (+) to the (-) enantiomer in this synthetic sample?
   A. 70:30 B. 60:40 C. 90:10 D. 80:20

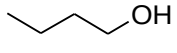
7. Which of these compounds can exist as a meso compound?
   A. 1,2-dichlorohexane B. 2,3-dichlorohexane C. 2,5-dichlorohexane D. 1,6-dichlorohexane

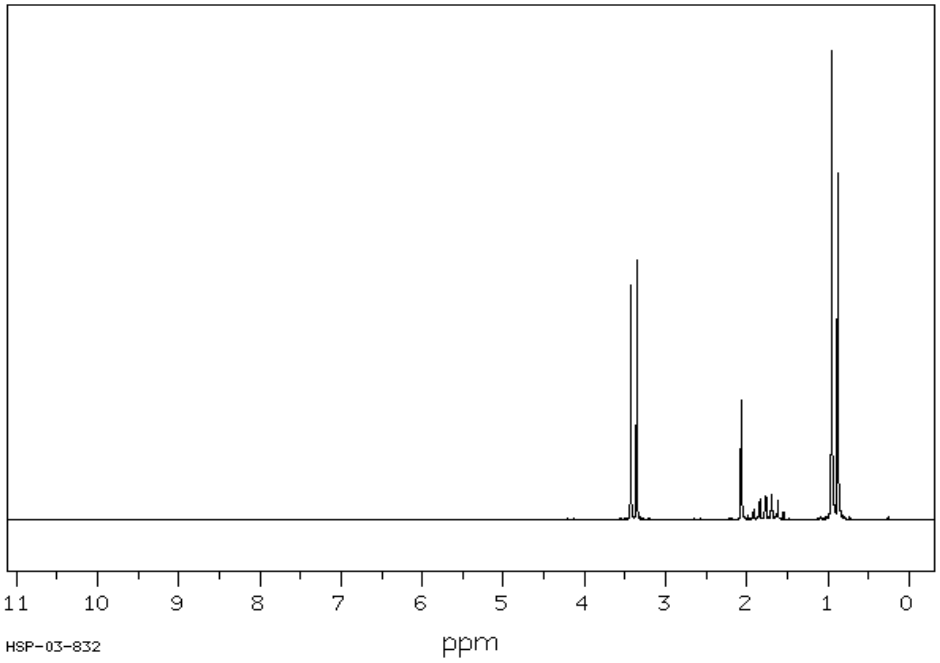
8. How many signals are present in the ^{1}H NMR spectra of diethyl ether, $CH_3CH_2OCH_2CH_3$ and methyl propyl ether, $CH_3OCH_2CH_2CH_3$, respectively?
   A. 4, 4 B. 2, 2 C. 2, 4 D. 2, 3

9. Which compound gives the following ^{1}H NMR spectrum?
   A. 

   B. 

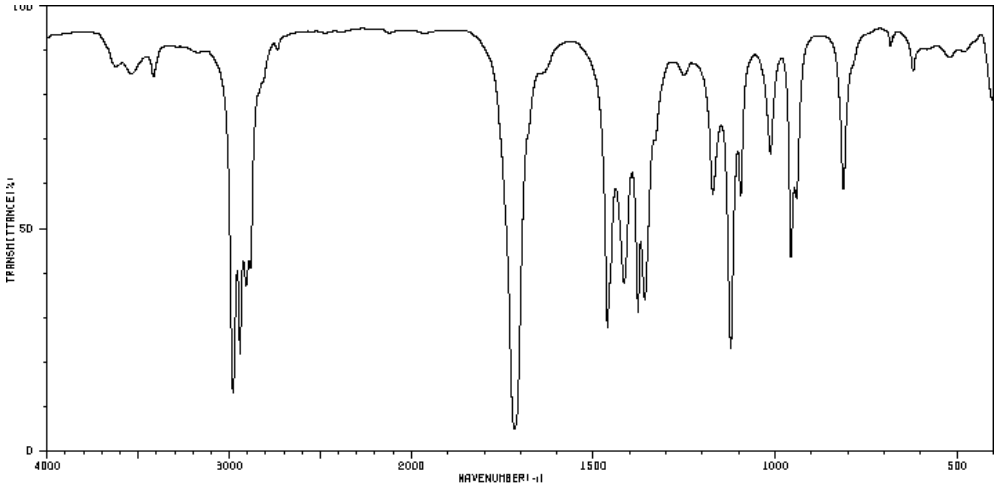
   C. 

   D. 



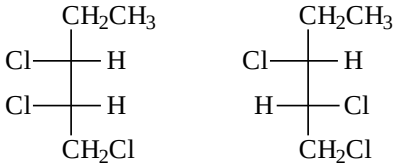
10. The IR spectrum shown below is consistent with which of these functional group families?

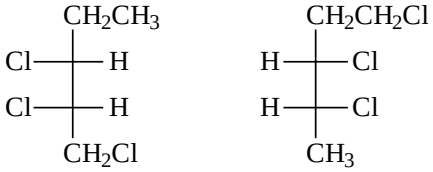
A. alcohol
B. alkyne
C. alkene
D. ketone
E. amine

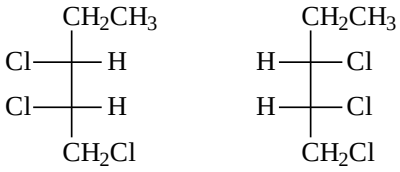


For questions 11-14 indicate the relationship between the two structures shown as:
A. identical B.constitutional isomers C. enantiomers D. diastereomers

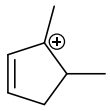
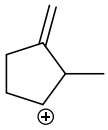
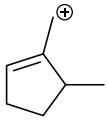
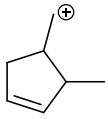
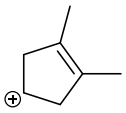
11. 

12. 

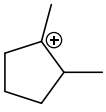
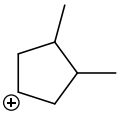
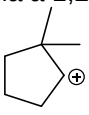
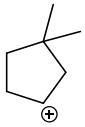
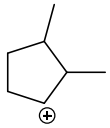
13. 

14. 

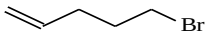
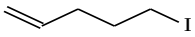
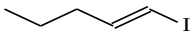
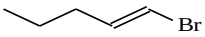
15. Which of the following is the ***least*** stable carbocation?

A.  B.  C.  D.  E. 

16. Which carbocation is expected to rearrange via a 1,2-hydride shift?

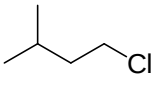
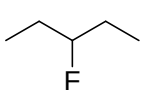
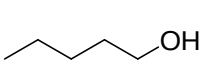
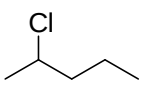
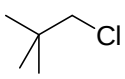
A.  B.  C.  D.  E. 

17. Which of the following substrates gives the ***fastest*** S_N2 reactions?

A.  B.  C.  D. 

18. Which of the following is the weakest nucleophile?
A. CH_3S^- B. CH_3O^- C. CH_3NH^- D. $CH_3CH_2^-$

19. Which of the following substrates gives the ***fastest*** S_N2 reactions?

A.  B.  C.  D.  E. 

20. Use the data from the table on the front page of this exam to calculate ΔH for the reaction shown.

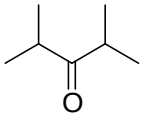
$CH_3CH_2CH_3 + Br_2 \longrightarrow CH_3CHBrCH_3 + HBr$

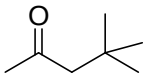
A. –25 kcal/mol B. +25 kcal/mol C. +15 kcal/mol D. –15 kcal/mol

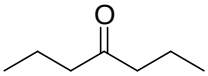
21. Which of these can exist as either an E or a Z isomer?
A. 2-methyl-2-pentene B. cyclopentene C. 3-methyl-1-pentene D. 3-methyl-2-pentene

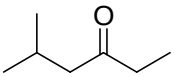
22. What is the chemical shift of the proton of C**H**Cl_3 on a 300 MHz NMR?
A. 7.26 ppm B. 0.9 ppm C. 77 ppm D. 0.0 ppm E. 1.55 ppm

23. Which of the following compounds gave the ^{1}H NMR spectrum summarized below?
(a) 2.36 ppm, 4H, triplet (b) 1.59 ppm, 4H, multiplet (c) 0.92 ppm, 6H, triplet

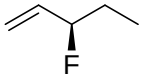
A. 

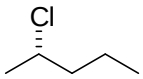
B. 

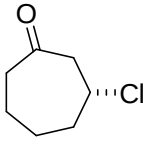
C. 

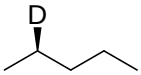
D. 

24. Which of these is not an *R* enantiomer?

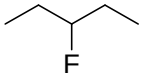
A. 

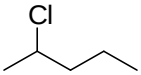
B. 

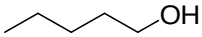
C. 

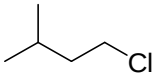
D. 

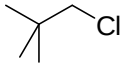
25. Which of these compounds shows only singlets in the ^{1}H NMR spectrum?

A. 

B. 

C. 

D. 

E. 

II. Give the structure of each of the following.

1. dichloromethane

2. *2S*-1,2-dibromobutane

3. *Z*-3-chloro-3-octene

III. Use the Cahn-Ingold-Prelog rules to assign the following ten substituents relative priorities. (Label each with a number from 1 to 10.) Draw out structures of each as necessary and show reasoning directly below them.
$-CD_3$ $-CH_2Cl$ $-CH_3$ $-SH$ $-CH(CH_3)_2$ $-CH{=}CH_2$ $-C_6H_5$ $-NHCOCH_3$ $-CN$ $-CH_2(CH_2)_8CH_3$

IV. (a) Predict the mechanism (S_N1 or S_N2) and give the product of each of the following nucleophilic substitution reactions. In the cases where the product can exist as stereoisomers, show specifically the stereoisomer or stereoisomers actually formed.(b) Only one of these occurs by a stepwise mechanism. For full credit on the one that does, identify it and write out the full mechanism, showing each step separately and using curved arrows to show electron flow.