Spring 2006

CHM 202E. **Exam 1 Key. Answers on last page.** Feb 17, 2006

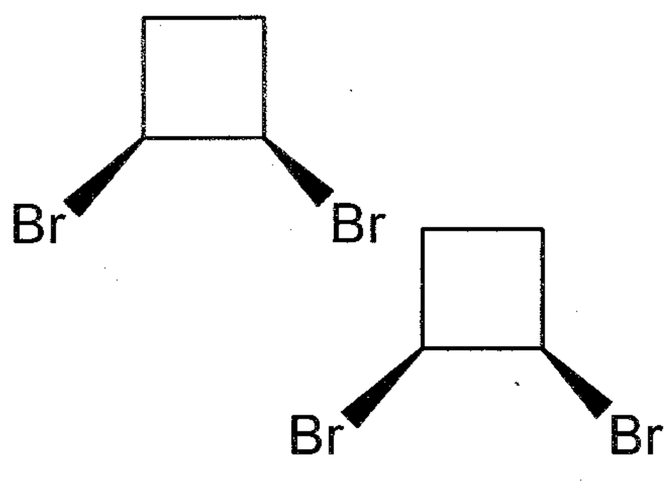
For each of the following compounds indicate the number of ^{1}H NMR and ^{13}C NMR signals you would expect to see (ignoring splitting and assuming no overlap of signals).

1. # of ^{1}H NMR signals

   a.2 b.3 c.4 d.5 e.6

2. # of ^{13}C NMR signals

   a.2 b.3 c.4 d.5 e.6

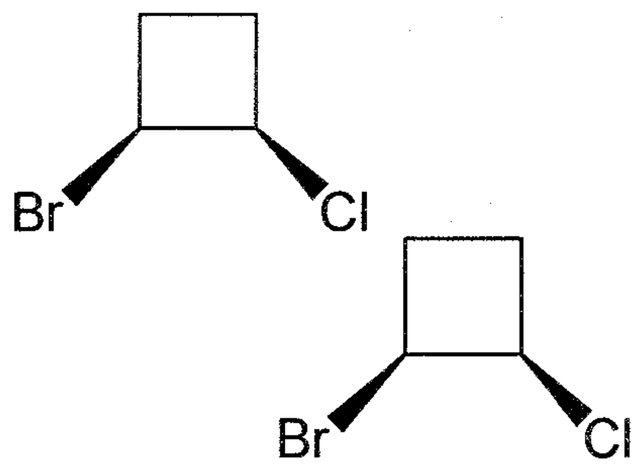


3. # of ^{1}H NMR signals

   a.2 b.3 c.4 d.5 e.6

4. # of ^{13}C NMR signals

   a.2 b.3 c.4 d.5 e.6

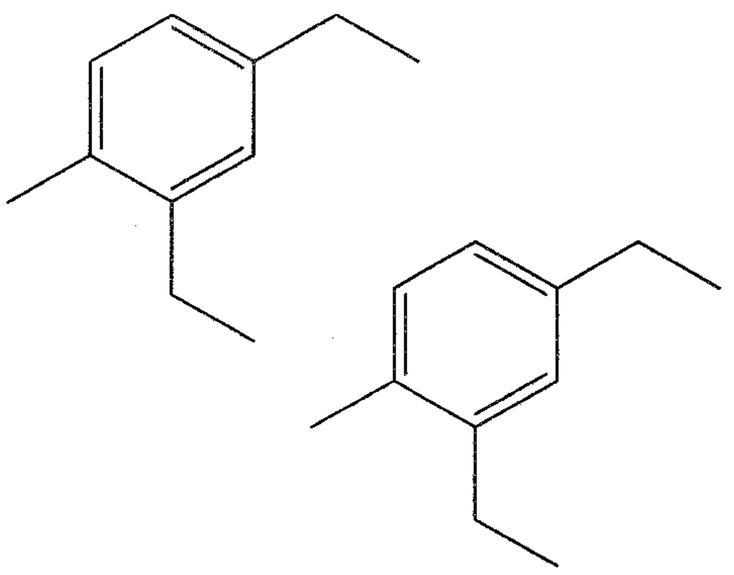


5. # of ^{1}H NMR signals

   a.5 b.6 c.7 d.8 e.9

6. # of ^{13}C NMR signals

   a.7 b.8 c.9 d.10 e.11

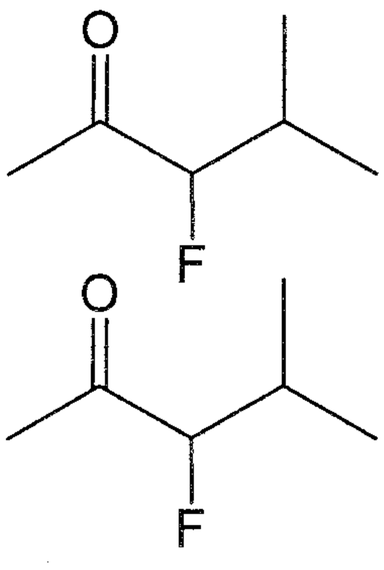


7. # of ^{1}H NMR signals

   a.2 b.3 c.4 d.5 e.6

8. # of ^{13}C NMR signals

   a.2 b.3 c.4 d.5 e.6

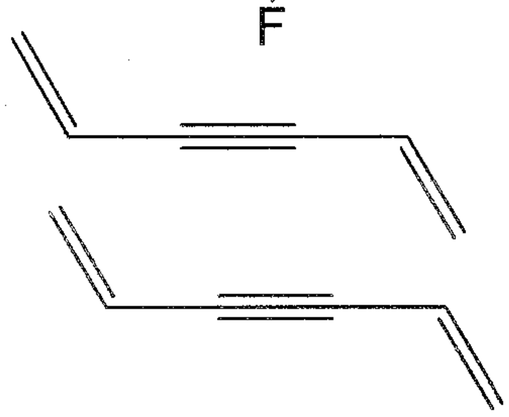


9. # of ^{1}H NMR signals

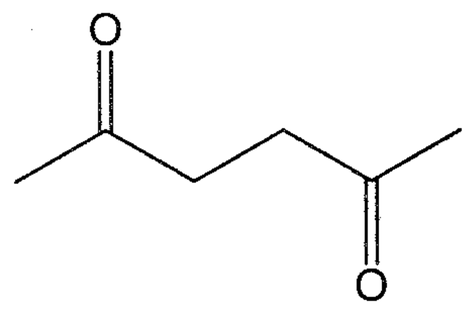
   a.2 b.3 c.4 d.5 e.6

10. # of ^{13}C NMR signals

    a.2 b.3 c.4 d.5 e.6

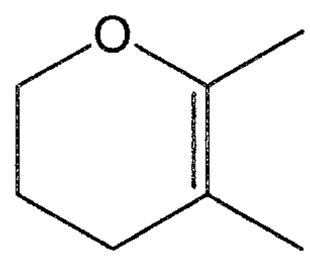


11. ^{1}H NMR of the following would expect to exhibit:
(assume all splitting, if any, is fully resolved; ie, no overlap of peaks)



a. two triplets and a quartet
b. a singlet and two triplets
c. two singlets and two doublets
d. two singlets
e. none of the above

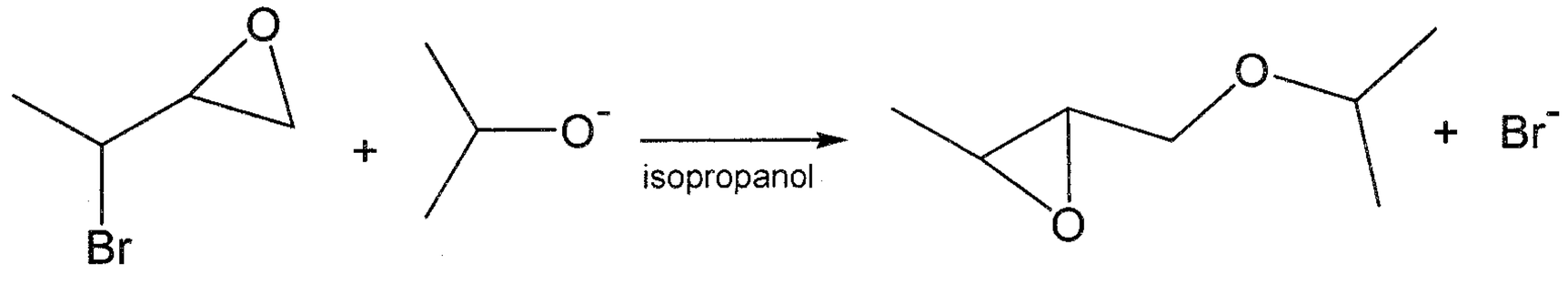
12. ^{1}H NMR of the following would expect to exhibit:
(assume all splitting, if any, is fully resolved; ie, no overlap of peaks)



a. two singlets, two triplets and a quartet
b. two singlets, two triplets and a quintet
c. two singlets, two triplets and a triplet of triplets
d. one singlet, two triplets, and a quintet
e. two singlets, a doublet of doublets, and two triplets

What mechanism(s) account for the following transformations:

13.

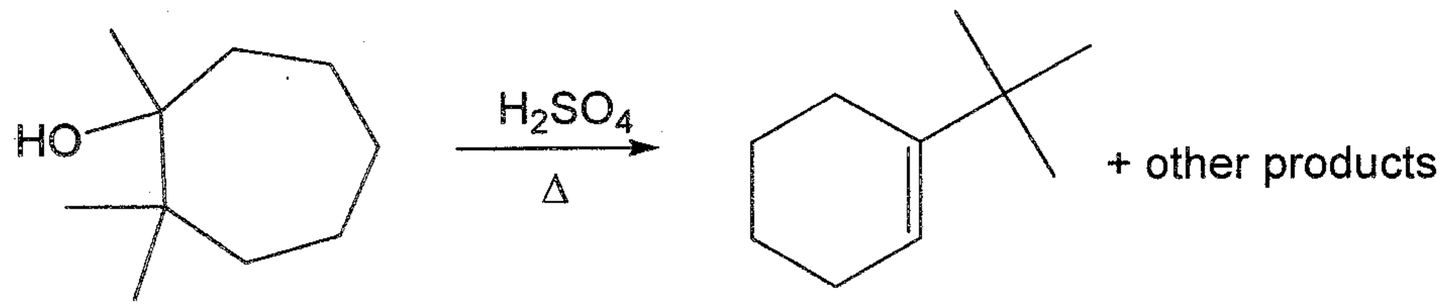


a. intermolecular partial S_N1 / partial S_N2
b. intermolecular partial S_N1 / partial S_N2, followed by intramolecular S_N2
c. intramolecular S_N2 followed by intermolecular S_N2
d. intermolecular S_N2 followed by intramolecular S_N2
e. none of the above

14.

a. protonation, S_N2 attack, protonation, S_N2 attack
b. S_N2 attack, protonation, S_N2 attack, protonation
c. protonation, S_N1 ionization followed by attack, protonation, S_N1 ionization followed by attack
d. protonation, S_N1 ionization, carbocation rearrangement, followed by a double attack.
e. None of the above

15.



(mechanism for the product shown only)

a. protonation, loss of water, ring contraction
b. protonation, loss of water, ring contraction, deprotonation
c. protonation, loss of water, ring contraction, 1,2-hydride shift, deprotonation
d. protonation, loss of water, ring contraction, 1,2-methyl shift, deprotonation
e. none of the above

16. Reaction of cyclopentene oxide with dimethylamine produces:

a. the R,R isomer only
b. the S,S isomer only
c. the S,R isomer only
d. a racemic mixture of R,R and S,S
e. a racemic mixture of R,S and S,R

17. Principle fragmentation of the molecular ions of 2-methyl-2-chlorobutane would be expected to produce how many peaks in the mass spectrum?

In other words, how many observable peaks do the molecular ions themselves produce when they fragment (we're not concerned here with subsequent fragmentation of smaller fragments, nor with the molecular ion peaks themselves).

a.2 b. 3 c. 4 d. 5 e. 6

18. The data b elow from the molecular ion region of the mass spectrum of a halogen-containing compound are consistent with the presence of what halogen(s) in the original compound?

		Relative intensity
$M^{+}\cdot$		51.0
$M^{+}\cdot$	+2	100.0
$M^{+}\cdot$	+4	49.0

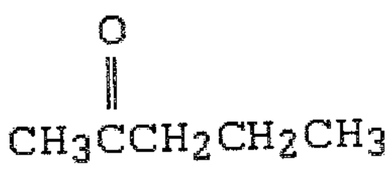
a) one Br b) one Cl c) one Br and one Cl d) two Br e) two Cl

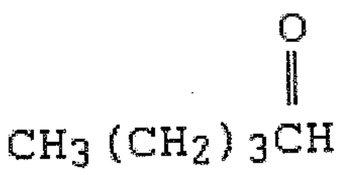
19. A compound $C_5H_{10}O$ gave the following spectral data:

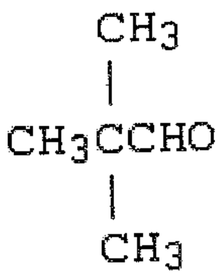
^1H NMR spectrum
doublet, δ 1.10
singlet, δ 2.10
septet, δ 2.50

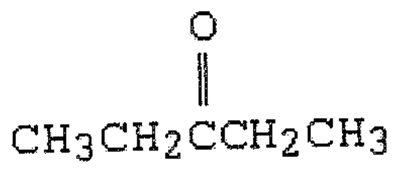
IR spectrum,
strong peak near 1720 cm^{-1}

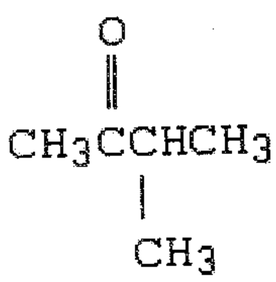
Which is a reasonable structure for the compound?

A) 

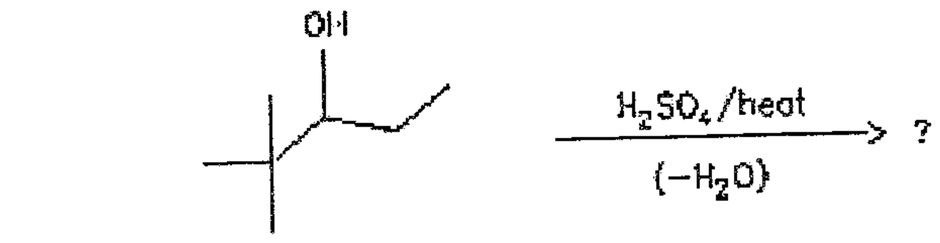
B) 

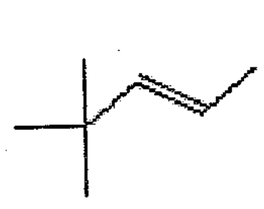
C) 

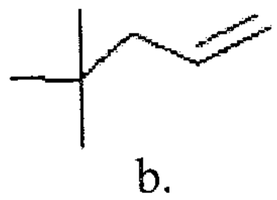
D) 

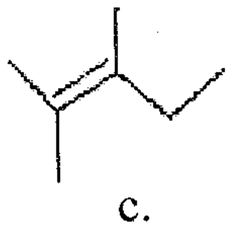
E) 

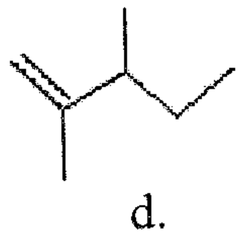
20. Which alkene would you expect to be the major product of the following dehydration?

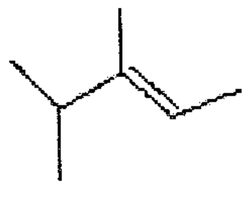



a


b.


c.


d.

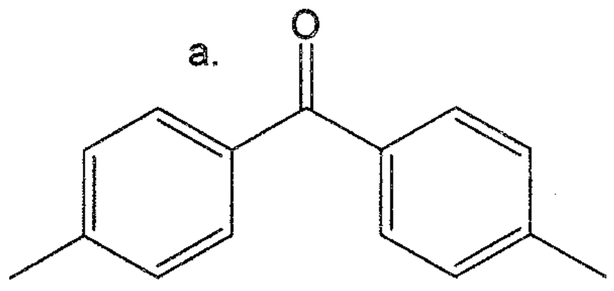

e.

21. Indicate the structure of compound, $C_{15}H_{14}O$, whose ^1H NMR data is as shown.

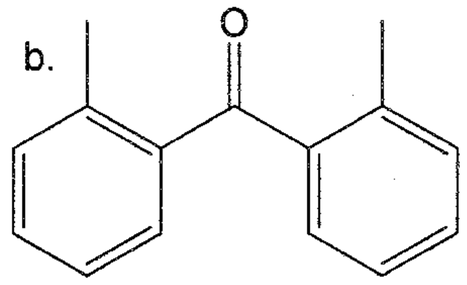
IR:
1720 cm^{-1}. (strong)

δ	# hydrogens	splitting
2.20	3	singlet
5.08	1	singlet
7.25	10	multiplet

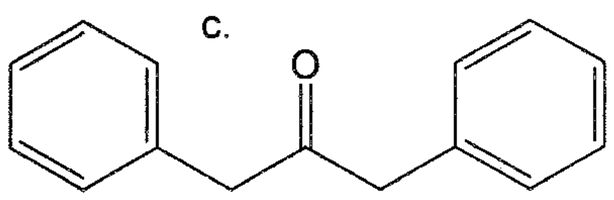
a.



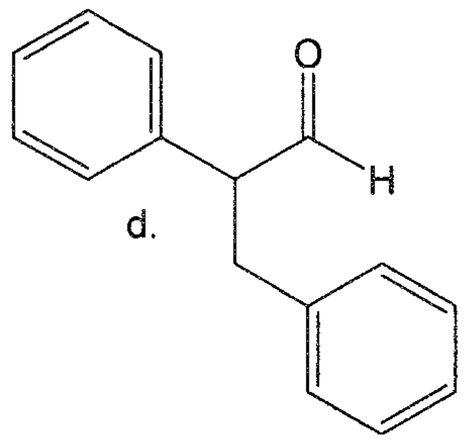
b.



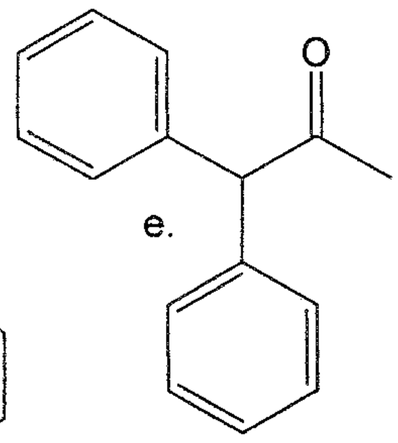
c.



d.



e.

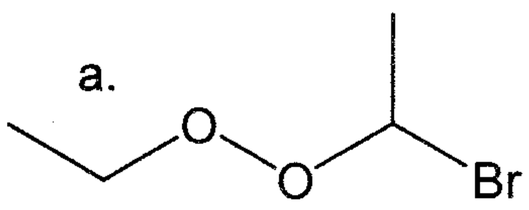


22. Indicate the structure of compound, $C_4H_7BrO_2$, whose ^1H NMR data is as shown.

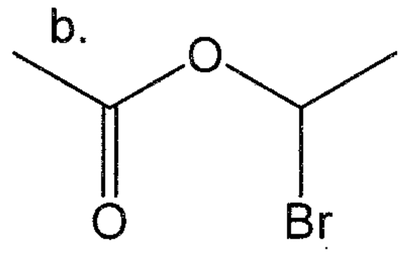
IR:
2800-3300 cm^{-1}. (strong, very broad)
1715 cm^{-1}. (strong)

δ	Integration (mm)	# hydrogens	splitting
1.08	16		triplet
2.07	9		multiplet
4.23	5		triplet
10.97	5		singlet

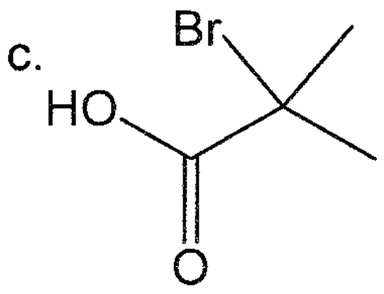
a.



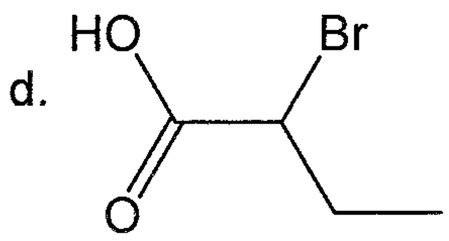
b.



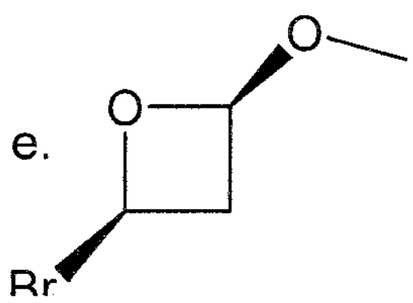
c.



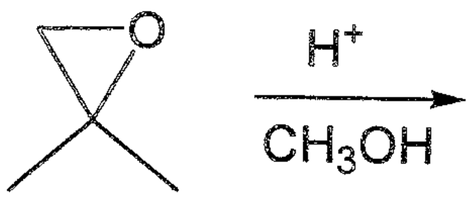
d.

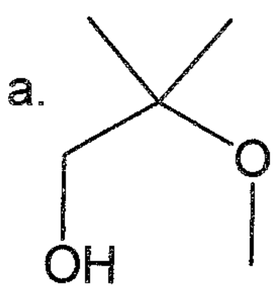


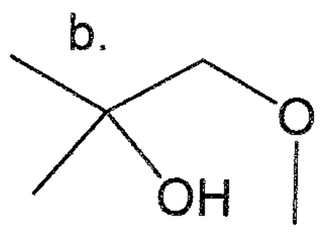
e.

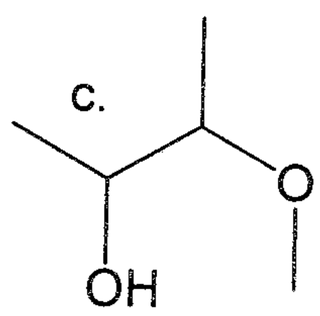


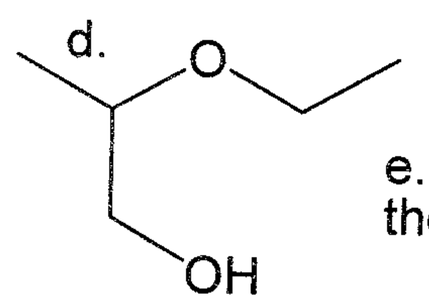
23. Indicate the major product:



a. 

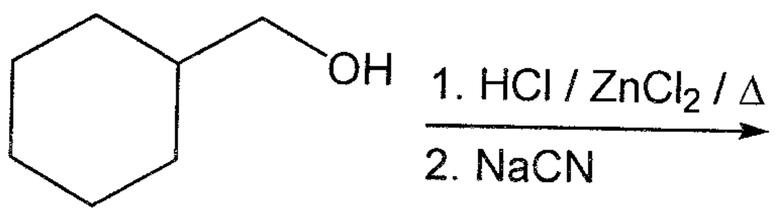
b. 

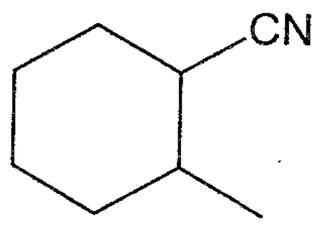
c. 

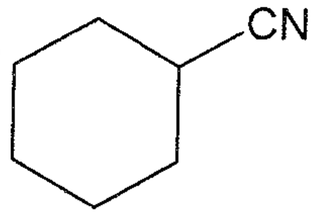
d. 

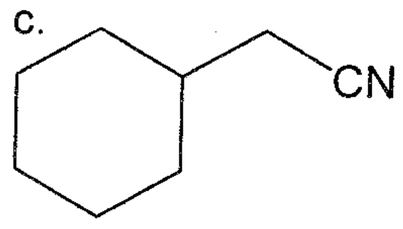
e. none of the above

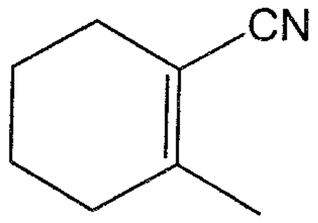
24. Indicate the major product

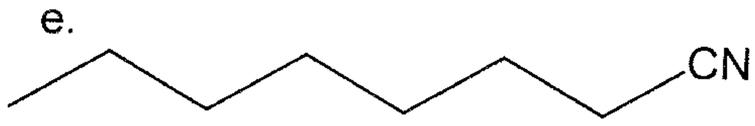


a. 

b. 

c. 

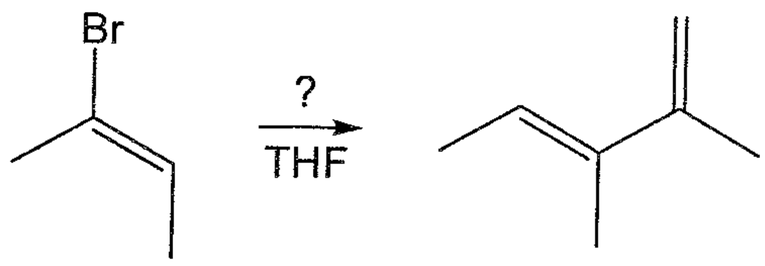
d. 

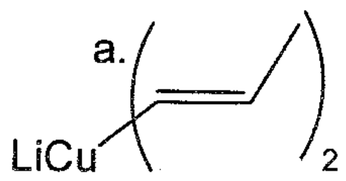
e. 

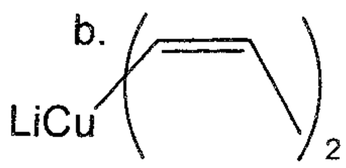
25. Treatment of *cis*-3-methylcyclohexanol with PBr_3 / pyridine, followed by sodium ethoxide yields which substitution product(s):

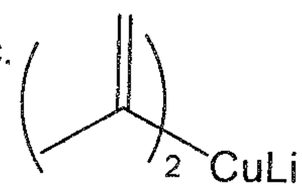
a. a mixture of *cis* and *trans* compounds
b. the *cis* compound only
c. the *trans* compound only
d. can not be determined from the information given

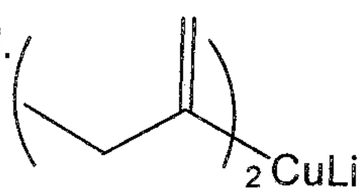
26.



a. 

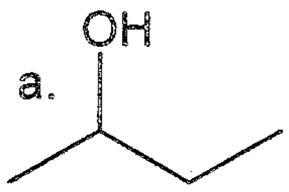
b. 

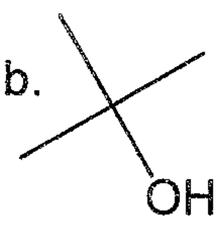
c. 

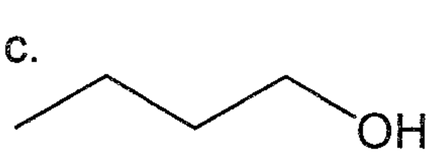
d. 

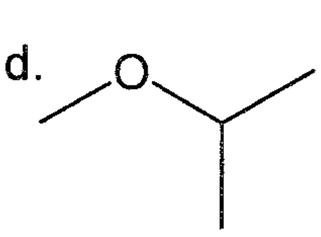
e. none of the above

27. The ^{13}C NMR of compound, $C_4H_{10}O$, shows three signals: δ18, δ30, and δ70.
The ^{1}H NMR of the same compound shows a total of four signals. The compound is:

a. 

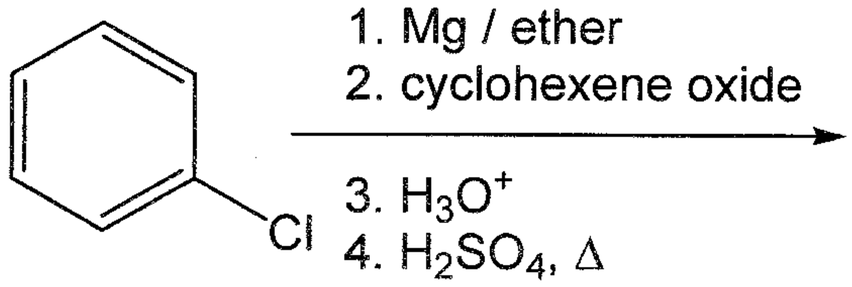
b. 

c. 

d. 

e. none of the above

28.



The above reaction yields a compound with molecular formula

a. $C_{12}H_{18}$ b. $C_{12}H_{16}$ c. $C_{12}H_{14}$ d. $C_{12}H_{16}Cl$ e. none of the above

1. b 2. a 3. e 4. c 5. d 6. e 7.c 8. d 9. b 10. b 11. d 12. c

13. d 14. a 15. d 16. d 17. d 18. d 19. e 20. c 21. e 22. d 23. a 24. c

25. b 26. c 27. e 28. c