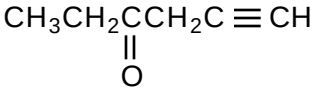
Final Exam, Chem 2210 (Organic Chemistry Lecture). -- Answer All Questions -- Fall 1999 *A*

1. For the molecule shown, what are the hybridization of the oxygen atom and the approximate C-C-O bond angle, respectively?

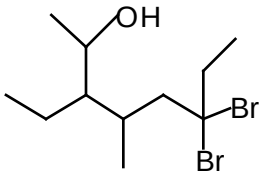


A. sp^3, 109.5˚ B. sp^3, 120˚ C. sp^2, 120˚ D. sp^2, 180˚

2. What functional group is present in the molecule shown?

A. alcohol B. ester C. amide D. ether

3. What is the IUPAC name of the compound shown?

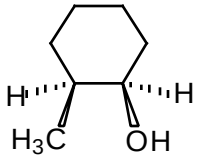


A. 3,3-dibromo-6-ethyl-5-methyl-7-octanol
B. 6,6-dibromo-3-ethyl-4-methyl-2-octanol
C. 5,5-dibromo-2-ethyl-1,3-dimethyl-1-heptanol
D. 2-ethyl-1,3-dimethyl-5,5-dibromo-1-heptanol

4. The most stable conformation of *cis*-2-*tert*-butylcyclohexanol is a chair with the OH group:

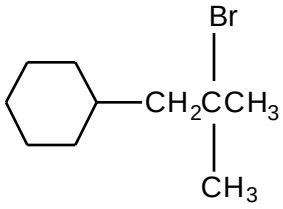
A. equatorial and the *tert*-butyl group equatorial
B. axial and the *tert*-butyl group axial
C. equatorial and the *tert*-butyl group axial
D. axial and the *tert*-butyl group equatorial

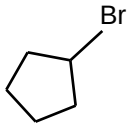
5. What are the configurations of the carbons 1 and 2 in the compound shown?

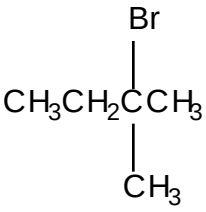


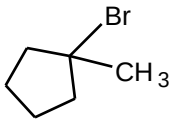
A. 1R, 2S B. 1S, 2R C. 1R, 2R D. 1S, 2S

6. Which of the following alkyl halides gives only one alkene as the product in the E2 reaction?

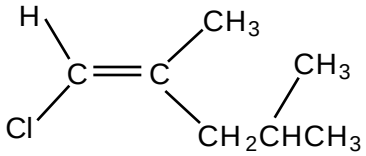
A. 

B. 

C. 

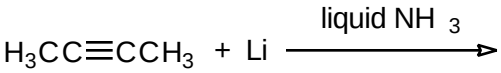
D. 

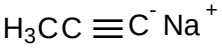
7. What is the name of the alkene shown?



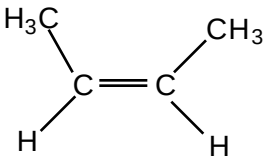
A. (Z)-1-chloro-2,4-dimethyl-1-pentene
B. (E)-1-chloro-2,4-dimethyl-1-pentene
C. *cis*-1-chloro-2,4-dimethyl-1-pentene
D. *trans*-1-chloro-2,4-dimethyl-1-pentene

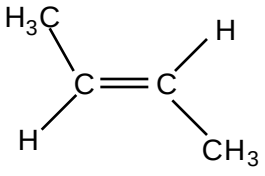
8. What is the major organic product of the following reaction?



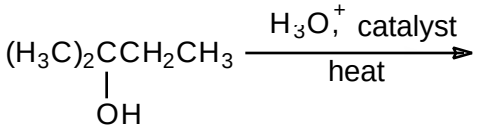
A. 

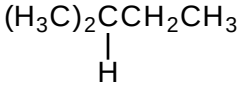
B. 

C. 

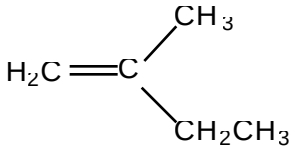
D. 

9. What is the major organic product of the following reaction?



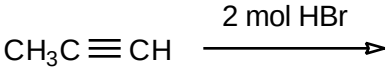
A. 

B. $(H_3C)_2C = CHCH_3$

C. 

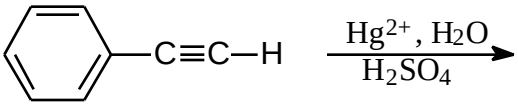
D. $(H_3C)_2CHCH = CH_2$

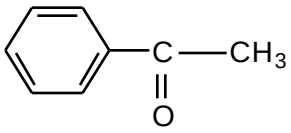
10. What is the major organic product of the reaction shown?

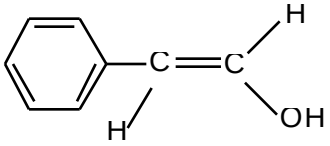


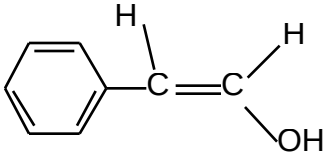
A. $BrCH_2CH_2CH_2Br$
B. $CH_3CBr_2CH_3$
C. $CH_3CH_2CHBr_2$
D. $CH_3CHBrCH_2Br$

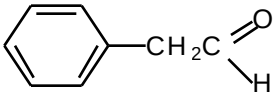
11. What is the major organic product of the reaction shown?



A. 

B. 

C. 

D. 

12. Which of the following reacts with $[Ag(NH_3)_2]OH$ giving a white precipitate?

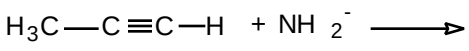
A. $CH_3CH_2CH=CHCH_3$

B. $CH_3CH_2C\equiv CCH_3$

C. $CH_3CH_2C\equiv CH$

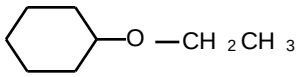
D. $CH_3CH_2CH_2CH_2OH$

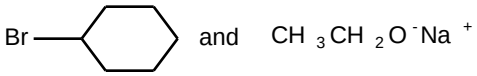
13. What is the major organic product of the reaction shown?

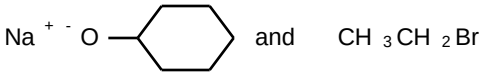


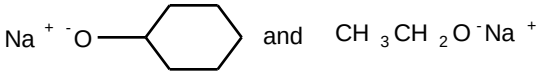
A. $CH_3C\equiv CNH_2$ B. $CH_3C\equiv C^{\ominus}$ C. $CH_3C\equiv CNH_3$ D. $CH_3C\equiv C^{\oplus}$

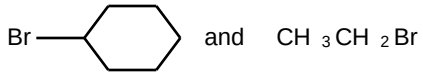
14. Which of the compounds below is the best set of starting materials for the synthesis of the compound shown?



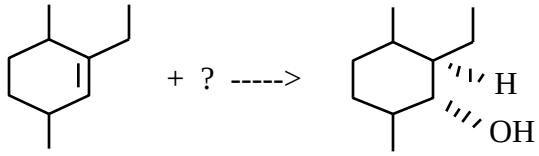
A. 

B. 

C. 

D. 

15. Which of the following will give the transformation shown?



A. Cl_2, H_2O
B. PBr_3 followed by H_3O^+
C. $Hg(OAc)_2/H_2SO_4$, water
D. BH_3, THF followed by H_2O_2, OH^-

16. Which of the following reactions proceeds through a free radical mechanism?

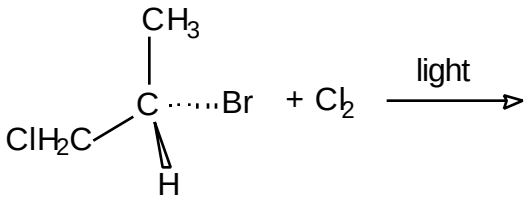
A. $(H_3C)_2CHCH=CH_2 + HBr \longrightarrow (H_3C)_2CBrCH_2CH_3$

B. $(H_3C)_2CHCH=CH_2 + Br_2 \longrightarrow (H_3C)_2CHCHBrCH_2Br$

C. $(H_3C)_2CHCH=CH_2 + HBr \xrightarrow{ROOR} (H_3C)_2CHCH_2CH_2Br$

D. $(H_3C)_2CHCH=CH_2 + Cl_2 + H_2O \longrightarrow (H_3C)_2CHCHCH_2Cl$ (OH)

17. The number of products that forms in the following reaction is _____; and the number of pairs of enantiomers formed is _____.

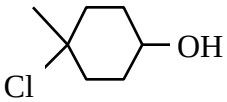


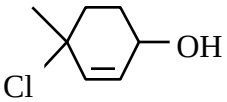
A. 2; 0 B. 3; 0 C. 4; 0 D. 4; 1

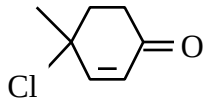
18. Which of the step(s) of a free radical chain reaction have an activation energy equal to zero?

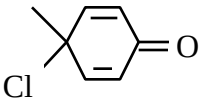
A. initiation only
B. propagation only
C. termination only
D. both termination and initiation

19. Which of the following molecules contains seven hydrogen atoms?

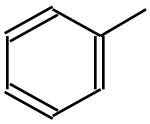
A. 

B. 

C. 

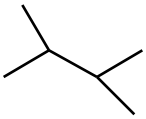
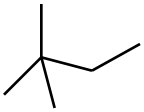
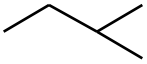
D. 

20. How many sigma bonds are present in the following molecule?

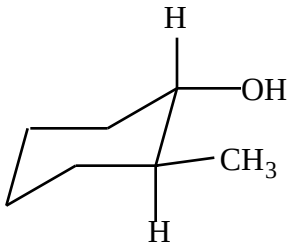


A. 3 B. 12 C. 15 D. 7

21. Which of the following compounds has the HIGHEST boiling point?

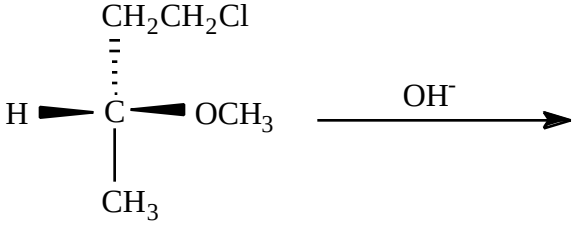
A.  B.  C.  D. 

22. What is the IUPAC name of the compound shown?



A. *trans*-2-methylcyclohexanol
B. *cis*-2-methylcyclohexanol
C. *trans*-1-methyl-2-cyclohexanol
D. *cis*-1-methyl-2-cyclohexanol

23. Which of the following statements is true about the reaction shown?



A. The product will have R configuration.
B. A meso compound is produced.
C. The product will have S configuration.
D. The reaction will happen with racemization.

24. Which of the following gives no reaction?

A. CH_3^- + $C_6H_5NH_2$ ⟶

B. $CH_3CH_2^-$ + CH_3OH ⟶

C. OH^- + CH_4 ⟶

D. OH^- + CH_3COOH ⟶

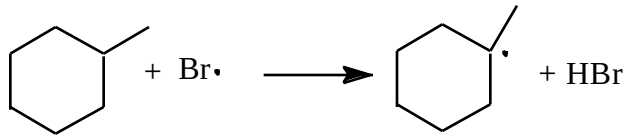
25. Which of the following is the LEAST soluble in water?

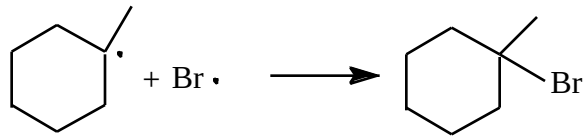
A. CH_3CH_2OH B. CH_3COOH C. CH_3COCH_3 D. $CH_3CH_2OCH_2CH_3$

26. Which of the following is a propagation step?

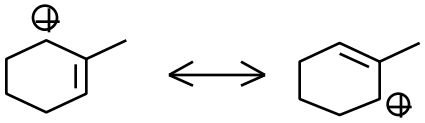
A. $RO\cdot + RO\cdot \longrightarrow ROOR$

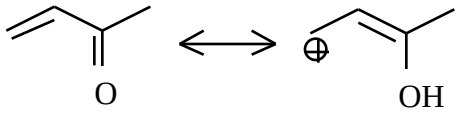
B. $Br_2 \xrightarrow{heat} 2Br\cdot$

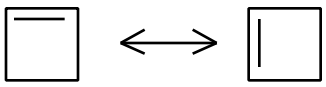
C. 

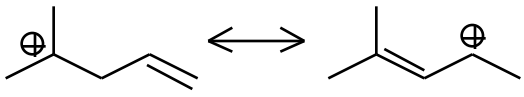
D. 

27. Which of the following is a pair of resonance structures?

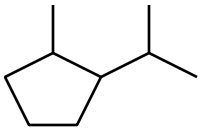
A. 

B. 

C. 

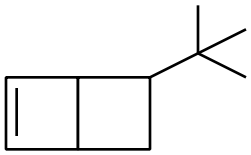
D. 

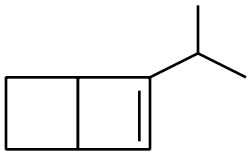
28. For the following structure, there are _____ 1˚, _____ 2˚, and _____ 3˚ hydrogens.

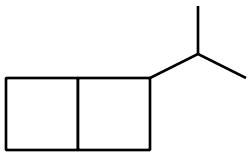


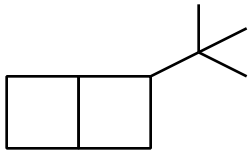
A. 9, 6, 3 B. 9, 8, 2 C. 6, 6, 3 D. 6, 8, 2

29. Which of the following structures is 2-*tert*-butylbicyclo[2.2.0]hexane?

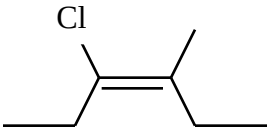
A. 

B. 

C. 

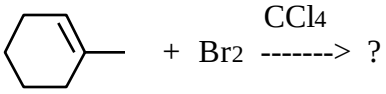
D. 

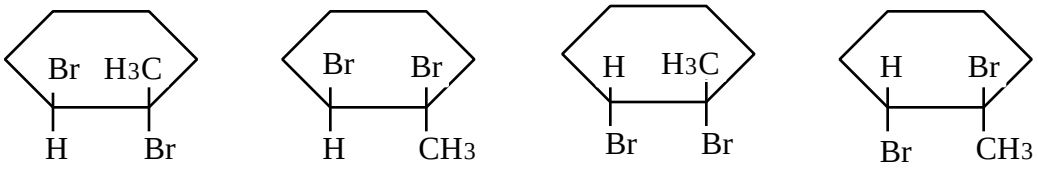
30. What is the IUPAC name for the molecule shown?



A. *cis*-1,2-diethyl-1-chloro-2-methylethene
B. E-3-chloro-4-methyl-3-hexene
C. E-1-chloro-1-ethyl-1-pentene
D. Z-1-chloro-1-ethyl-1-pentene

31. What are the major organic products of the reaction shown?





I II III IV

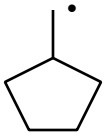
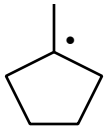
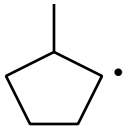
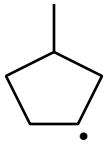
A. I and III B. I and IV C. II and III D. II and IV

32. What is(are) the major organic product(s) of the reaction shown?

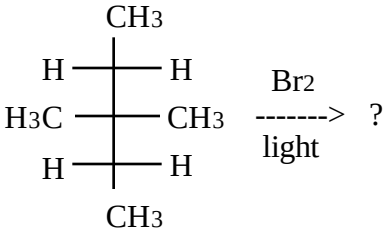
$CH_3CH_2CH_2CH_2CH_2ONa + CH_3CH_2CH_2CH_2Br$ -----> ?

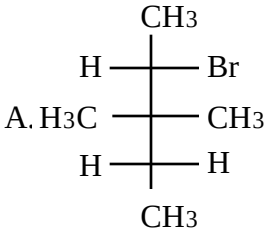
A. $CH_3CH_2CH_2CH_2CH_2OCH_2CH_2CH_2CH_3$
B. $CH_3CH_2CH_2CH_2CH_2OCH(CH_3)CH_2CH_3$
C. $CH_3CH_2CH_2CH_2CH_2OH + CH_3CH_2CH{=}CH_2$
D. $CH_3CH_2CH_2CH{=}CH_2 + CH_3CH_2CH_2CH_2OH$

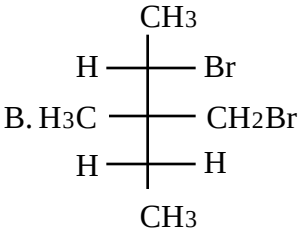
33. Which of the following free radicals is the MOST stable?

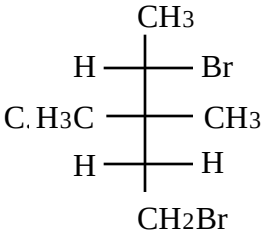
A.  B.  C.  D. 

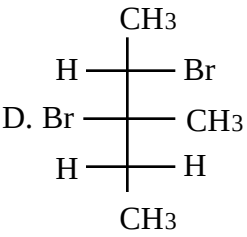
34. Which of the following compounds is NOT a product of the reaction shown?



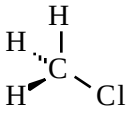
A. 

B. 

C. 

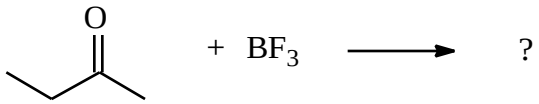
D. 

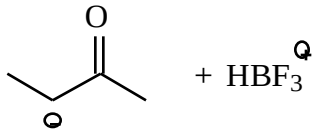
35. What is the direction of the dipole moment in the molecule shown?

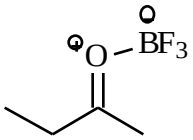


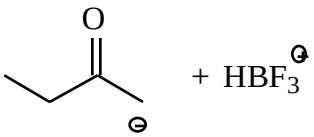
A.  B.  C.  D. 

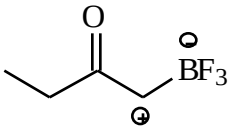
36. What is(are) the product(s) of the acid-base reaction shown?



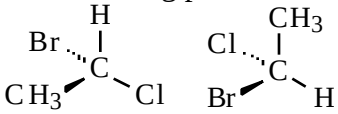
A. 

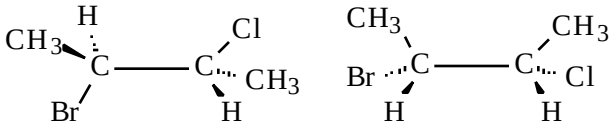
B. 

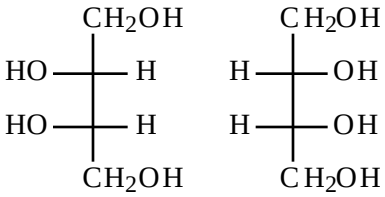
C. 

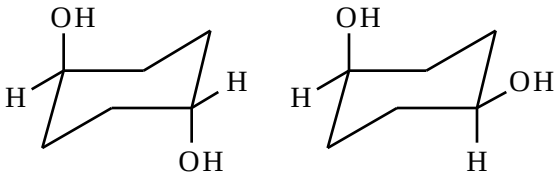
D. 

37. Which of the following pairs of structures are two drawings of the same compound?

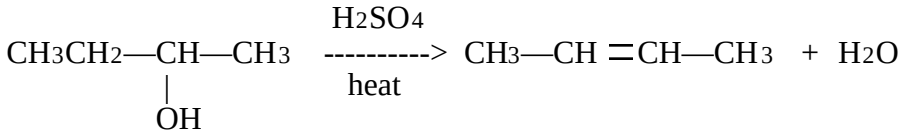
A. 

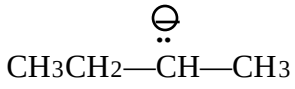
B. 

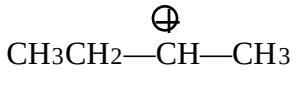
C. 

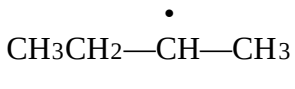
D. 

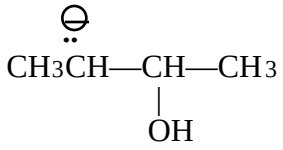
38. Which of the species below is an intermediate in the reaction shown?



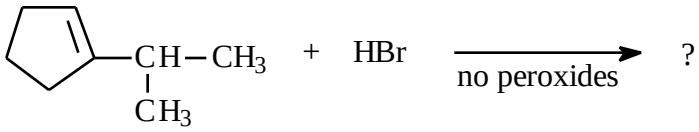
A. 

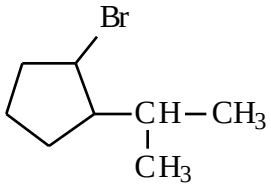
B. 

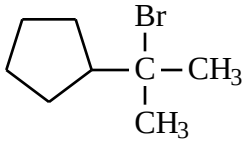
C. 

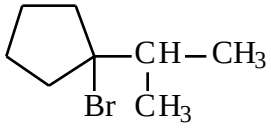
D. 

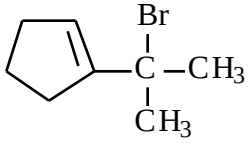
39. What is the major organic product of the following reaction?



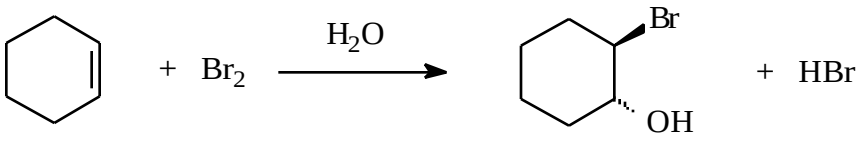
A. 

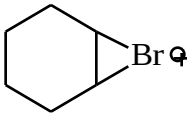
B. 

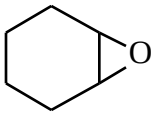
C. 

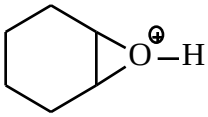
D. 

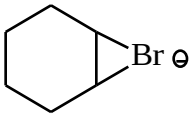
40. Which of the species below is an intermediate in the reaction shown?



A. 

B. 

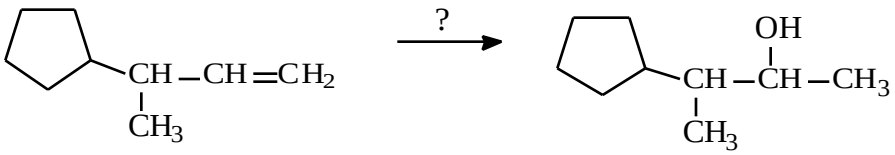
C. 

D. 

41. Which of the following compounds is soluble in concentrated sulfuric acid, decolorizes bromine in carbon tetrachloride, and gives a white precipitate with silver nitrate in ammonia, but does not give a precipitate with silver nitrate in alcohol?

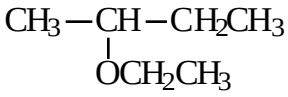
A. $CH_3CH_2CH_2CH{=}CH_2$
B. $CH_3CH(Cl)CH_2CH{=}CH_2$
C. $CH_3CH_2C{\equiv}CCH_3$
D. $CH_3CH_2CH_2C{\equiv}CH$

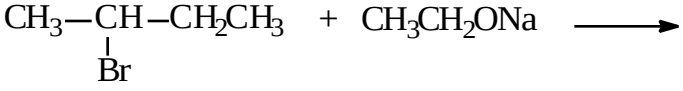
42. Which of the following sets of reagents can be used to bring about the transformation shown?

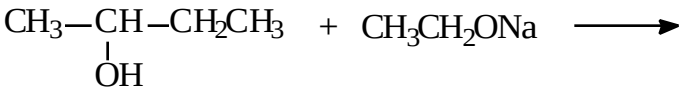


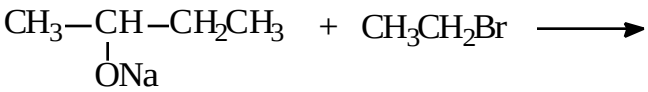
A. H_2O, H_3O^+
B. $Hg(O_2CCH_3)_2$, H_2O; then $NaBH_4$, NaOH
C. CrO_3, H_2SO_4
D. BH_3-THF; then H_2O_2, NaOH

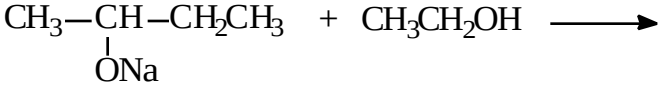
43. Which of the following is the best synthesis of the compound shown?



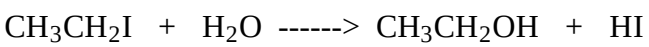
A. 

B. 

C. 

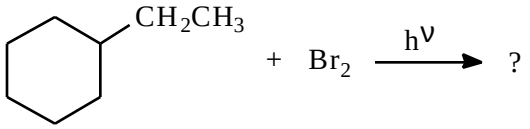
D. 

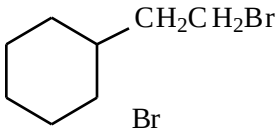
44. Calculate the heat (enthalpy) of reaction for the following reaction from the given bond dissociation energies (DH^o). *All values are in kcal/mole.* (CH_3CH_2-H = 98, CH_3CH_2-I = 53.5, CH_3CH_2-OH = 91.5, CH_3CH_2O-H = 103, H-OH = 119, H-I = 71, I-I = 36)

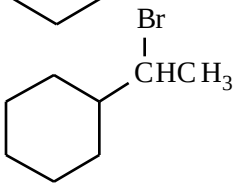


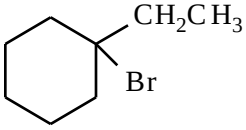
A. – 1.5 kcal/mole B. + 1.5 kcal/mole C. – 10 kcal/mole D. + 10 kcal/mole

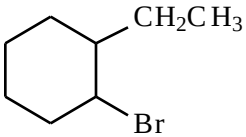
45. What is the major organic product of the reaction shown?



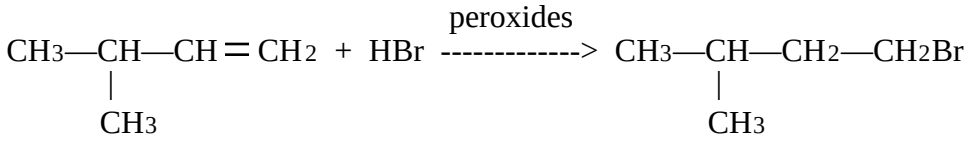
A. 

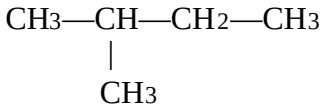
B. 

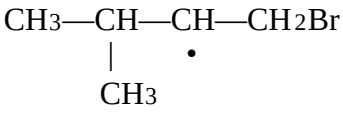
C. 

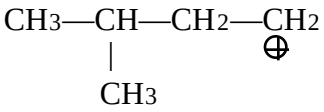
D. 

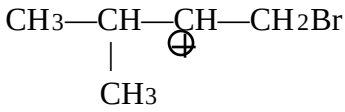
46. Which of the species below is an intermediate in the reaction shown?



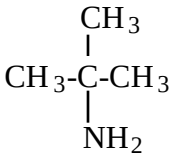
A. 

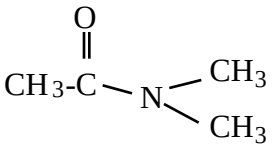
B. 

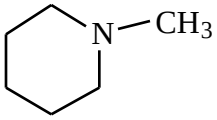
C. 

D. 

47. Which of the following is a 3˚ amine?

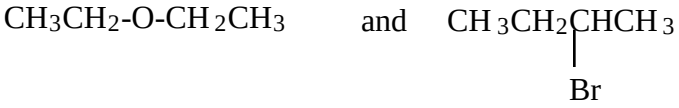
A. 

B. 

C. 

D. $CH_3(CH_2)_{12}NHCH_3$

48. Which of the reagents listed below would serve as the basis for a simple chemical test to distinguish between the compounds shown?



A. $AgNO_3$ in ethanol
B. NaOH in water
C. Br_2 in CCl_4
D. $KMnO_4$, cold

49. Which of the following species have a bent structure?

I. H-C≡C-H II. HOH III. CH_2Cl_2 IV. ClNO

A. I and III B. II and III C. I and IV D. II and IV

50. Which of the following is an s orbital? Nuclei are indicated by solid dots, and the signs of the wave functions are shown.