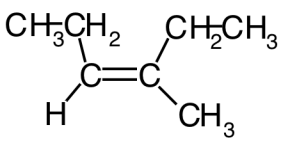
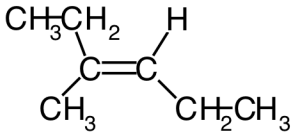
"Grade or Education" = 1

CHEM 2261/01
Summer 10
Final Exam
Chapters 1-11, 14

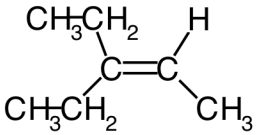
1. Find the structure of the E2 product of the reaction of (3S,4R)-3-bromo-4-methylhexane + CH_3O^- among the structures shown below and choose the answer which references this structure correctly.



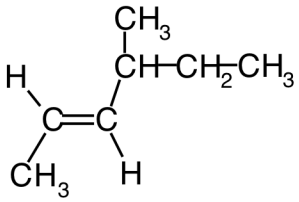
1



2



3



4

__ A. **3** is the E2 product of this reaction.

__ B. The structure of the E2 product of this reaction is not shown.

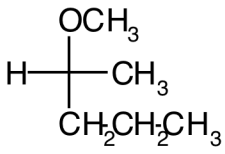
__ C. **4** is the E2 product of this reaction.

__ D. **1** is the E2 product of this reaction.

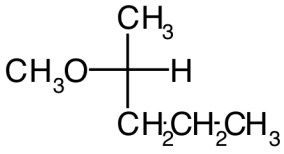
__ E. **2** is the E2 product of this reaction.

Rationale:
Chapter 9 Problem 52c

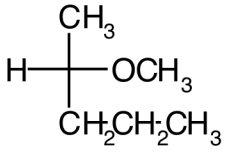
2. Examine the Fischer projections shown below. Choose the one which **CORRECTLY** shows the structure of the product of the reaction of (R)-2-bromopentane + high concentration of CH_3O^-.



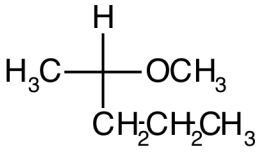
a1



a2



a3



a4

__ A. Structure **a1** is correct.

__ B. Structure **a3** is correct.

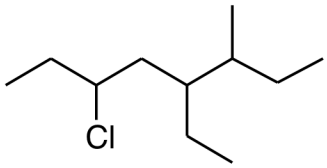
__ C. Structure **a4** is correct.

__ D. None of these structures is correct.

__ E. Structure **a2** is correct.

Rationale:
Chapter 8 Problem 45a

3. Which of the choices gives an acceptable systematic name for the compound having the structure shown below?



__ A. 3-chloro-5-sec-butylheptane

__ B. 3-chloro-5,6-diethylheptane

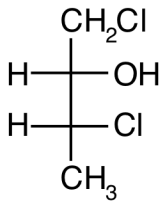
__ C. 3-methyl-4-ethyl-6-chlorooctane

__ D. 6-chloro-4-ethyl-3-methyloctane

__ E. 3-chloro-5-ethyl-6-methyloctane

Rationale:
Chapter 2 Problem 66f

4. Pick the choice which gives the **CORRECT** systematic name of the stereoisomer of 1,3-dichloro-2-butanol shown below.



__ A. (2R,3R)-1,3-dichloro-2-butanol

__ B. (2S,3S)-1,3-dichloro-2-butanol

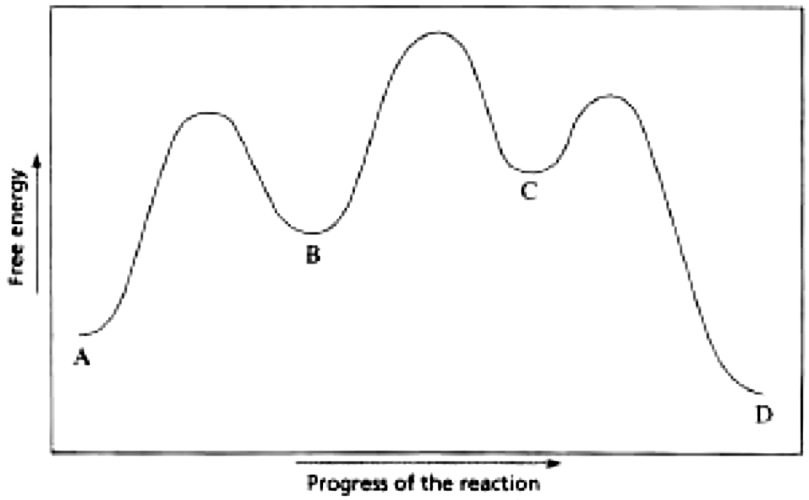
__ C. (3S,2R)-1,3-dichloro-2-butanol

__ D. (2S,3R)-1,3-dichloro-2-butanol

__ E. (2R,3S)-1,3-dichloro-2-butanol

Rationale:
Chapter 5 Problem 35b

5. Givn the following reaction-coordinate diagram for the reaction of A to give D choose the statement which is **WRONG** about the reaction depicted in the diagram.



__ A. A is more stable than D.

__ B. The reactant of the rate-determining step is B

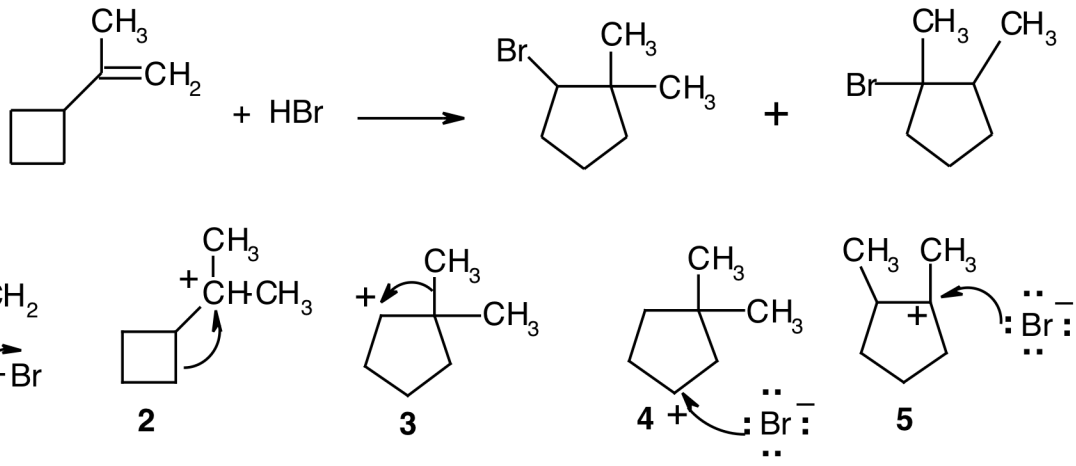
__ C. There are three transition states in the reaction.

__ D. The first step of the reaction is endergonic.

__ E. There are two intermediates in the reaction.

Rationale:
similar to Chapter 3 Problem 55(a,b,d,e,f)

6. Draw out the mechanism for the reaction shown below. Use this mechanism along with the numbered figures below to find the number representing a process which does **NOT** occur in the reaction mechanism.



__ A. Process 4 does not occur in this mechanism.

__ B. Process 5 does not occur in this mechanism.

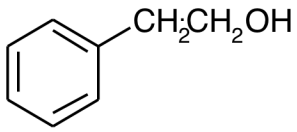
__ C. Process 1 does not occur in this mechanism.

__ D. Process 2 does not occur in this mechanism.

__ E. Process 3 does not occur in this mechanism.

Rationale:
Chapter 4 Problem 62a

7. Choose the synthetic sequence which gives a **CORRECT** method for preparing 2-phenyl-1-ethanol from benzene.



2-phenyl-1-ethanol

__ A. First: CH_3CH_2Cl and $AlCl_3$; next: NBS/Δ and peroxide; next: tert-BuO^-; next: HBr/CH_2Cl_2; finally: HO^-.

__ B. First: CH_3CH_2Cl and $AlCl_3$; next: NBS/Δ and peroxide; next: tert-BuO^-; finally: H_2O and H_2SO_4.

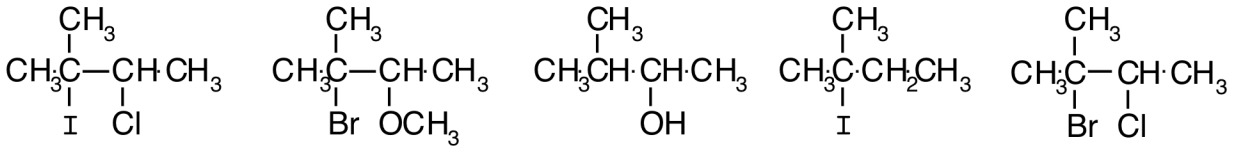
__ C. First: CH_3CH_2COCl and $AlCl_3$; next: Zn(Hg) and HCl/Δ; next: tert-BuO^-; finally: 1. BH_3 followed by 2. HO^-, H_2O_2, H_2O.

__ D. First: CH_3CH_2Cl and $AlCl_3$; next: NBS/Δ and peroxide; next: tert-BuO^-; finally: 1. BH_3 followed by 2. HO^-, H_2O_2, H_2O.

__ E. First: CH_3CH_2COCl and $AlCl_3$; next: NBS/Δ and peroxide; next: tert-BuO^-; finally: 1. BH_3 followed by 2. HO^-, H_2O_2, H_2O.

Rationale:
moved to Chapter 16

8. Pick the choice which gives the **CORRECT** major product of the reaction of 2-methyl-2-butene with the specified reagents. The structures numbered below are those of possible reaction products.



1 **2** **3** **4** **5**

__ A. When 2-methyl-2-butene reacts with H_2O + trace H_2SO_4 the major product is **3** .

__ B. When 2-methyl-2-butene reacts with ICl the major product is **1** .

__ C. When 2-methyl-2-butene reacts with Br_2/CH_3OH the major product is **2** .

__ D. When 2-methyl-2-butene reacts with Br_2 + excess NaCl the major product is **5** .

__ E. When 2-methyl-2-butene reacts with HI the major product is **4** .

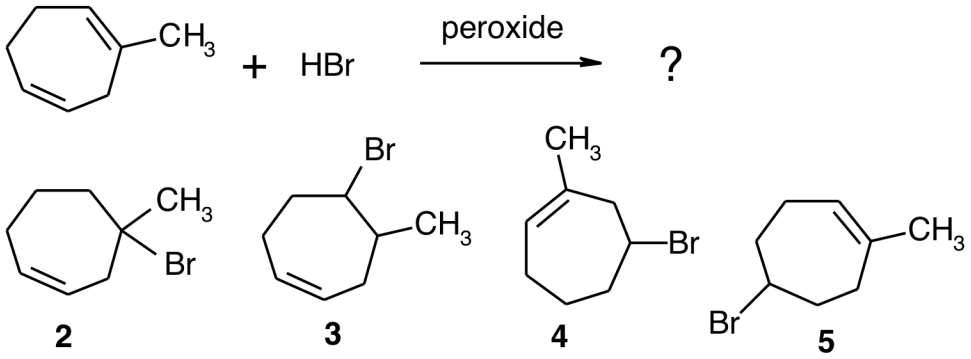
Rationale:
Chapter 4 Problem 40(c,e,g,i,l)

9. Several studies have shown that β-carotene, a precursor of vitamin A, may play a role in preventing cancer. β-Carotene has a molecular formula of $C_{40}H_{56}$ and contains two rings and no triple bonds. How many double bonds does it have?

__ A. 11
__ B. 22
__ C. 12
__ D. 16
__ E. 8

Rationale:
Chapter 3 Problem 46

10. Choose structure of the **MAJOR** product of the reaction shown below.



__ A. **5**
__ B. **1**
__ C. **4**
__ D. **3**
__ E. **2**

Rationale:
Chapter 11 Problem 32e

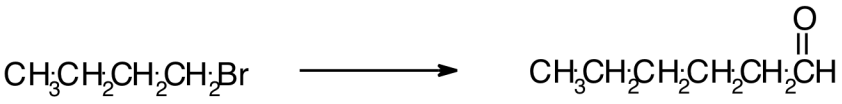
11. By looking at the pKa values of the three weak acids shown below determine what form of these substances will predominate in aqueous solutions having the pH values given in the multiple choices. Pick the choice which is **CORRECT** base on your reasoning.

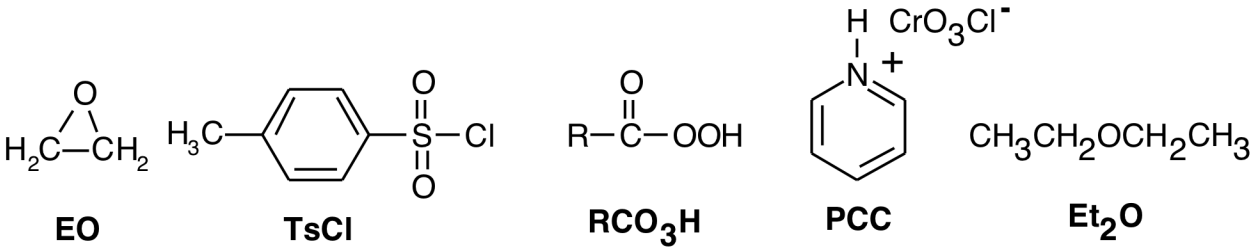
CH_3COOH	$CH_3CH_2NH_3^+$	CF_3CH_2OH
pKa = 4.8	pKa = 11.0	pKa = 12.4

__ A. At pH 3.0 the acid shown on the left will be in the form CH_3COO^-.
__ B. At pH 14.0 the acid shown in the middle will be in the form $CH_3CH_2NH_2$.
__ C. At pH 10.0 the acid shown on the right will be in the form $CF_3CH_2O^-$.
__ D. At pH 10.0 the acid shown on the right will be in the form $CF_3CH_2OH_2^+$.
__ E. At pH 6.0 the acid shown on the left will be in the form $CH_3COOH_2^+$.

Rationale:
Chapter 1 Problem 88

12. Pick the choice which **CORRECTLY** describes how the following synthesis could be carried out. Note the abbreviations used in the multiple choices for several reagents or solvents whose structures are shown below the synthesis.





__ A. First: Mg/**Et_2O** ; Next: 1. **EO** , and 2. H^+; Finally: **PCC**

__ B. First: HO^-/H_2O; Next: **TsCl** /pyridine; Next: CH_2=CHMgBr; Next: **RCO_3H** ; Next: H^+/H_2O; Finally: **PCC**

__ C. First: HO^-/H_2O; Next: **TsCl** /pyridine; Next: $HOCH_2CH_2MgBr$; Finally: **PCC**

__ D. First: $^-NH_2$; Next: Br_2/CH_2Cl_2; Next: $^-NH_2$(excess); Next: 1. $^-NH_2$, and 2. $HOCH_2CH_2Br$; Finally: H_2/Pd

__ E. First: HO^-/H_2O; Next: **TsCl** /pyridine; Next: CH_2=CHMgBr; Next: **RCO_3H** ; Next: HO^-/H_2O; Finally: **PCC**

Rationale:
Chapter 11 Problem 29a

13. Which of the following statements is **TRUE**?

__ A. H_2O is a better nucleophile than H_2S in methanol.

__ B. H_2O is a better nucleophile than NH_3 in methanol.

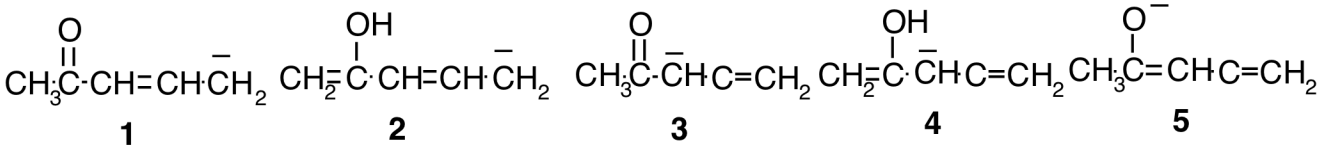
__ C. Cl^- is a better nucleophile than Br^- in methanol.

__ D. HS^- is a better nucleophile than HO^- in methanol.

__ E. H_2O is a better nucleophile than HO^- in methanol.

Rationale:
Chapter 8 Problem 38 (a,b,c,d,f)

14. Choose the structures from below which are **CORRECT** resonance contributors for the ion labelled **1** below.



1 **2** **3** **4** **5**

__ A. All of these structures are correct resonance contributors of one another.

__ B. Only structures **3** and **5** are correct resonance contributors for **1** .

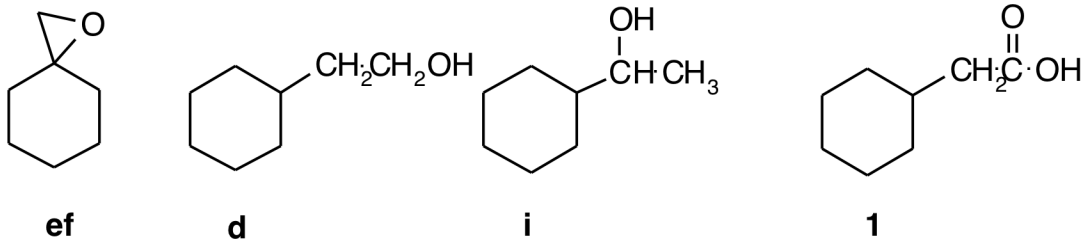
__ C. Only structures **2** and **4** are correct resonance contributors for **1** .

__ D. Only structure **3** is a correct resonance contributors for **1** .

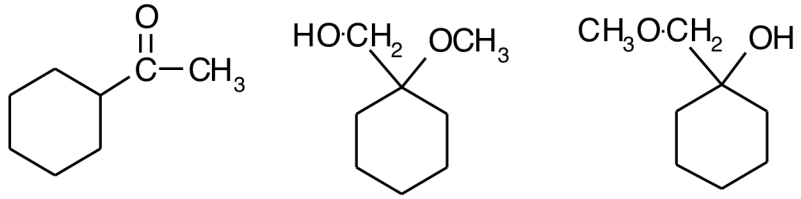
__ E. Structures **2** , **3** , and **4** are correct resonance contributors for **1** .

Rationale:
Chapter 7 Problem 48(a14)

15. By looking at the numbered structures below figure out which of the multiple choices specifies the **CORRECT** product of a reaction.



ef **d** **i** **1**



2 **3** **4**

__ A. **e f** + $CH_3O^-/CH_3OH \rightarrow$ **4**

__ B. **d** + $H_2CrO_4 \rightarrow$ **2**

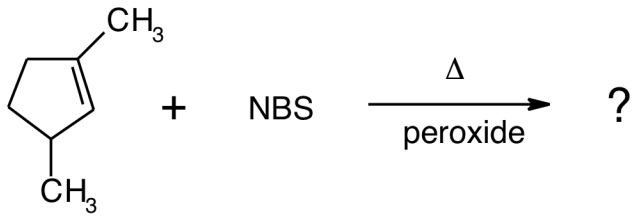
__ C. **e f** + $H^+/CH_3OH \rightarrow$ **d**

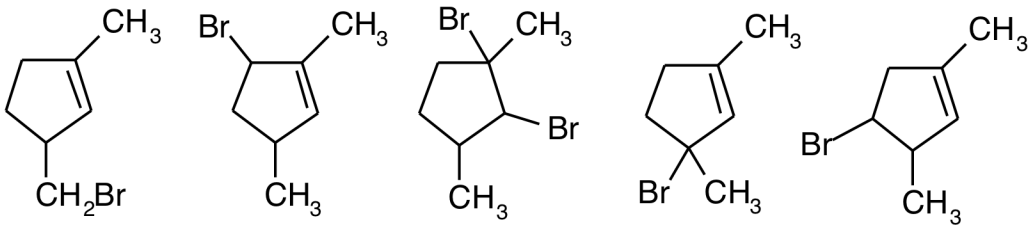
__ D. **i** + $H_2CrO_4 \rightarrow$ **1**

__ E. **e f** + $H^+/CH_3OH \rightarrow$ **4**

Rationale:
similar to 10 Problem 38(d,e,f,i)

16. Choose structure of the **MAJOR** product of the reaction shown below.



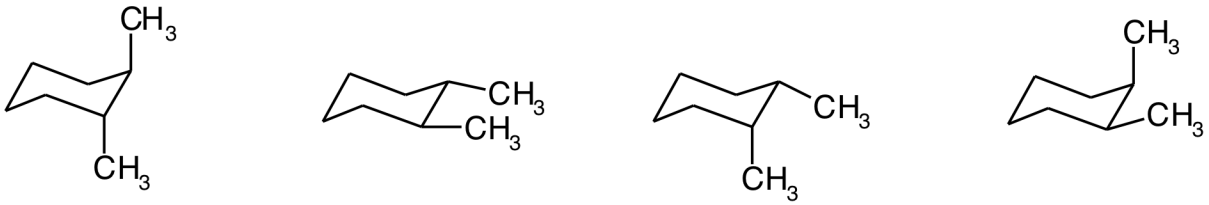


1 **2** **3** **4** **5**

__ A. **3**
__ B. **1**
__ C. **5**
__ D. **2**
__ E. **4**

Rationale:
Chapter 12 Problem 26e

17. Which of the structures shown below represent cis isomers?

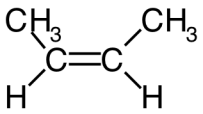


A **B** **C** **D**

__ A. Only structure **A** is a cis isomer.
__ B. Only structures **C** and **D** are cis isomers.
__ C. Only structure **B** is a cis isomer.
__ D. Structures **A** and **B** are cis isomers.
__ E. Structures **B** , **C** , and **D** are all cis isomers.

Rationale:
Chapter 2 Problem 51

18. Starting with acetylene, how could the compound whose structure is shown below be synthesized?



__ A. $HC{\equiv}CH \xrightarrow[2.\ CH_3Br]{1.\ {}^{-}NH_2} \xrightarrow[2.\ CH_3Br]{1.\ {}^{-}NH_2} \xrightarrow[\text{catalyst}]{H_2,\ \text{Lindlar's}}$

__ B. $HC{\equiv}CH \xrightarrow[2.\ CH_3Br]{1.\ {}^{-}NH_2} \xrightarrow[2.\ CH_3Br]{1.\ {}^{-}NH_2} \xrightarrow[NH_3(l)]{Na}$

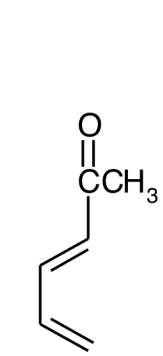
__ C. $HC{\equiv}CH \xrightarrow[2.\ CH_3CH_2Br]{1.\ {}^{-}NH_2} \xrightarrow[2.\ H_3O^{+}]{1.\ \text{disiamylborane}}$

__ D. $HC{\equiv}CH \xrightarrow[2.\ CH_3CH_2Br]{1.\ {}^{-}NH_2} \xrightarrow[\text{catalyst}]{H_2,\ \text{Lindlar's}} \xrightarrow[CH_2Cl_2]{HBr} \xrightarrow{{}^{-}NH_2}$

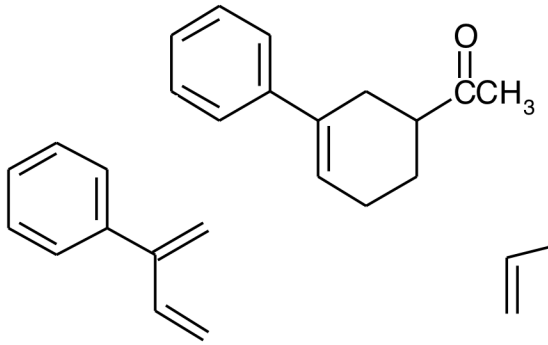
__ E. $HC{\equiv}CH \xrightarrow[2.\ CH_3Br]{1.\ {}^{-}NH_2} \xrightarrow[2.\ CH_3Br]{1.\ {}^{-}NH_2} \xrightarrow[2.\ {}^{-}OH,\ H_2O_2,\ H_2O]{1.\ \text{disiamylborane}}$

Rationale:
Chapter 6 Problem 24c

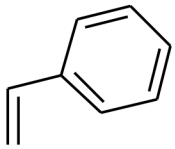
19. Select the choice which **CORRECTLY** indicates two compounds which could be used together to synthesize the compound whose structure is shown below using a Diels-Alder reaction.



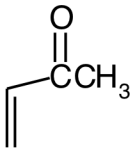
compound 1



compound 2



compound 3



compound 4

__ A. Compounds 2 and 4 could be used together to synthesize the desired compound.

__ B. Compounds 1 and 2 could be used together to synthesize the desired compound.

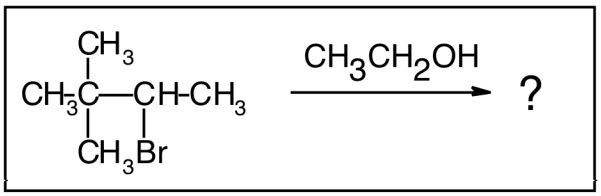
__ C. Compounds 1 and 3 could be used together to synthesize the desired compound.

__ D. Compounds 2 and 3 could be used together to synthesize the desired compound.

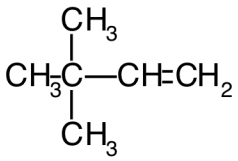
__ E. Compounds 1 and 4 could be used together to synthesize the desired compound.

Rationale:
Chapter 7 Problem 64a

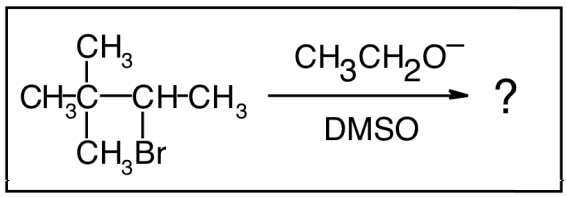
20. From the reaction conditions implied determine whether each of the two reactions below will take place via an E2 or an E1 reaction and find the structure of the major product of each reaction below. Choose the answer which **CORRECTLY** matches your determinations.



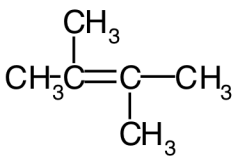
Reaction e



Product 1



Reaction f



Product 2

__ A. **Reaction f** takes place via an E1 mechanism. The major product of this reaction is **Product 1**.

__ B. **Reaction e** takes place via an E2 mechanism. The major elimination product of this reaction is **Product 1**.

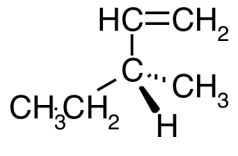
__ C. **Reaction e** takes place via an E1 mechanism. The major product of this reaction is **Product 2**

__ D. **Reaction f** takes place via an E1 mechanism. The major product of this reaction is **Product 2**

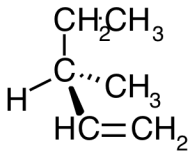
__ E. **Reaction e** takes place via an E1 mechanism and **reaction f** takes place via an E2 mechanism. The major product of both reactions is **Product 1**.

Rationale:
Chapter 9 Problem 10(e,f)

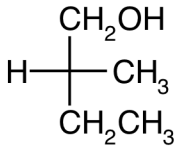
21. Figure out whether each of the following pairs of compounds are identical, or are enantiomers, diastereomers, or constitutional isomers. Pairs of compounds share the same letter, like **a1** and **a2**. Choose the **CORRECT** statement from the multiple choices.



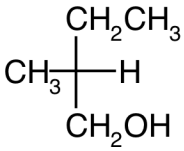
a1



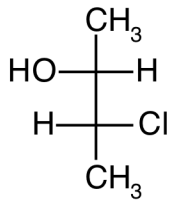
a2



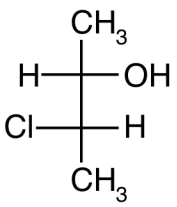
b1



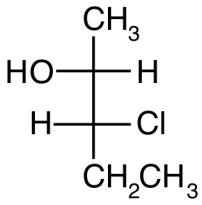
b2



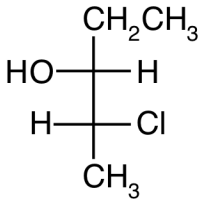
c1



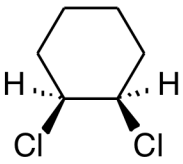
c2



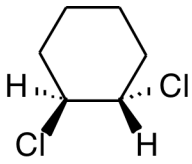
d1



d2



f1



f2

__ A. **b1** and **b2** are enantiomers.

__ B. **f1** and **f2** are enantiomers.

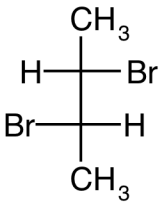
__ C. **a1** and **a2** are identical.

__ D. **d1** and **d2** are diasteriomers.

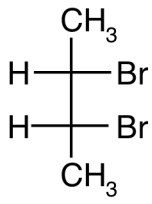
__ E. **c1** and **c2** are diasteriomers.

Rationale:
similar to Chapter 5 Problem 76 (a,b,c,d,f)

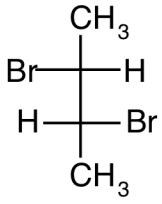
22. Pick the choice which gives the **CORRECT** stereoisomer(s) obtained from the reaction of 2-butyne with: 1. H_2/Lindlar catalyst, followed by 2. Br_2/CH_2Cl_2.



1



2



3

__ A. Only **3** is formed by these reactions.

__ B. Only **2** is formed by these reactions.

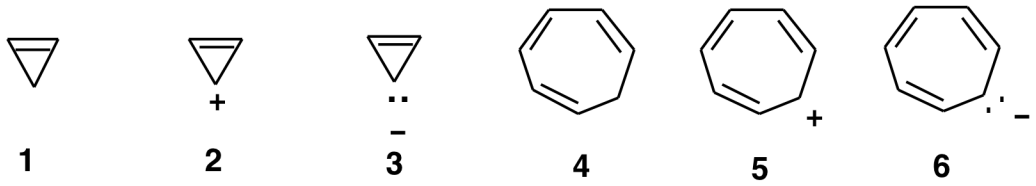
__ C. Only **1** and **2** are formed by these reactions.

__ D. Only **1** and **3** are formed by these reactions.

__ E. Only **1** is formed by these reactions.

Rationale:
Chapter 6 Problem 44a

23. Which of the numbered structures below is/are aromatic?



__ A. **2** and **5** only

__ B. **1** , **2** , **4** , and **5** only

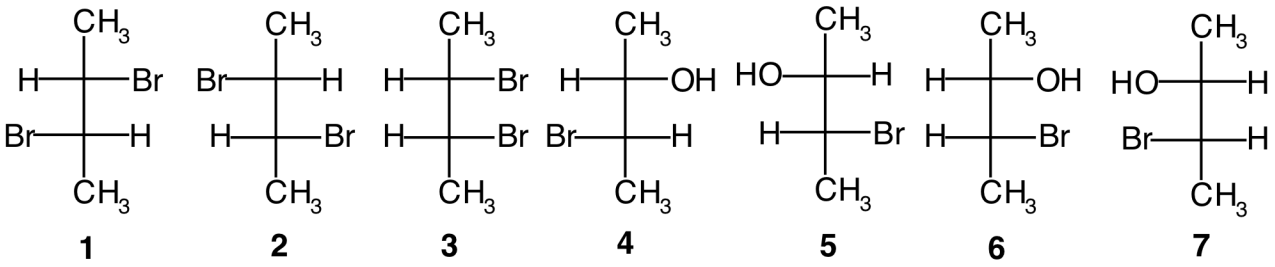
__ C. All of the structures shown are aromatic.

__ D. **3** and **6** only

__ E. **1** and **4** only

Rationale:
Chapter 15 Problem 3

24. Shown below are Fischer projections representing 7 different compounds, labelled 1 through 7. Circle the numbers corresponding to the compound(s) which would be formed by the reaction of trans-2-butene with $Br_2 + H_2O$. Use your work to find the **CORRECT** statement from the multiple choices.



__ A. The reaction of trans-2-butene with Br_2 and H_2O yields 1 and 2 only.

__ B. The reaction of trans-2-butene with Br_2 and H_2O yields 3 only.

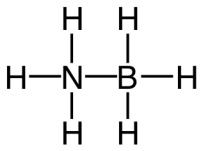
__ C. The reaction of trans-2-butene with Br_2 and H_2O yields 6 and 7 only.

__ D. The reaction of trans-2-butene with Br_2 and H_2O yields 4 and 5 only.

__ E. The reaction of trans-2-butene with Br_2 and H_2O yields 4 , 5 , 6 , and 7 .

Rationale:
Chap 5 Prob 68(a5)

25. Calculate the formal charges on the atoms of the molecule whose structure is shown below. Choose the answer which suggests the **CORRECT** formal charges on these atoms.



__ A. H = 0, N = 0, B = 0

__ B. H = +1, N = 0, B = 0

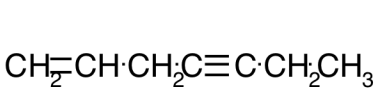
__ C. H = 0, N = +1, B = -1

__ D. H = 0, N = -1, B = +1

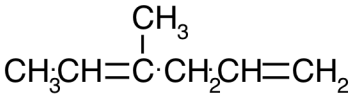
__ E. H = +1, N = -3, B = +3

Rationale:
Chapter 1 Problem 13d

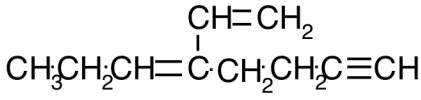
26. Pick the choice which gives a **CORRECT** systematic name for one of the compounds whose structures are shown below.



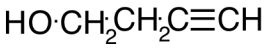
a



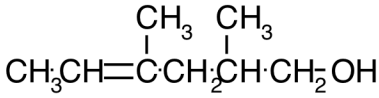
b



c



d



f

__ A. Compound **a** is 3-heptyn-6-ene.

__ B. Compound **d** is 3-butyn-1-ol.

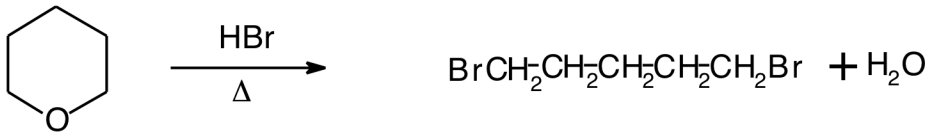
__ C. Compound **b** is 3-methyl-2,5-hexadiene.

__ D. Compound **f** is 3,5-dimethyl-2-hexen-6-ol.

__ E. Compound **c** is 3-(3-butynyl)-1,3-hexadiene.

Rationale:
Chapter 6 Problem 6(a,b,c,d,f)

27. Write out a complete mechanism for the reaction shown below. Pick the choice which contains **WRONG** information about this mechanism.



__ A. In the third step of this mechanism Br^- attacks a carbon atom next to oxygen breaking the C-O bond, and producing a $BrCH_2CH_2CH_2CH_2CH_2O^-$ intermediate.

__ B. In the first step of this mechanism a lone pair of electrons on the oxygen in the six-membered ring attacks the H atom of HBr pushing the electrons in the H-Br bond into the valence shell of Br (producing Br^-).

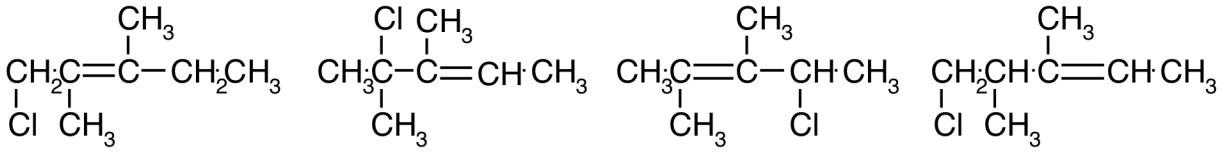
__ C. There are four steps in this mechanism.

__ D. In the second step of this mechanism a lone pair of electrons in Br^- attacks the carbon next to a positively-charged oxygen in a six-membered ring. This makes a C-Br bond and breaks a C-O bond resulting in a $BrCH_2CH_2CH_2CH_2CH_2OH$ intermediate.

__ E. In the last step of this mechanism a lone pair of electrons in Br^- attacks the carbon next to a positively-charged oxygen. This makes a C-Br bond and breaks a C-O bond resulting in the $BrCH_2CH_2CH_2CH_2CH_2Br$ final product.

Rationale:
similar to Chapter 10 Problem 52

28. Find the major products obtained from the reaction of one equivalent of HCl with 2,3-dimethyl-1,3-pentadiene from among the numbered structures below. Label the kinetic and thermodynamic product. Choose the **CORRECT** statement from the multiple choices.



1 **2** **3** **4**

__ A. **3** is the kinetic product and **2** is the thermodynamic product.

__ B. **2** is the kinetic product and **3** is the thermodynamic product.

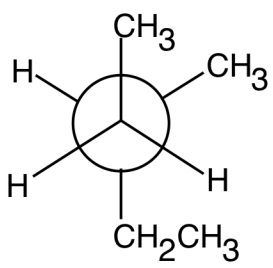
__ C. **1** is the kinetic product and **4** is the thermodynamic product.

__ D. **4** is the kinetic product and **1** is the thermodynamic product.

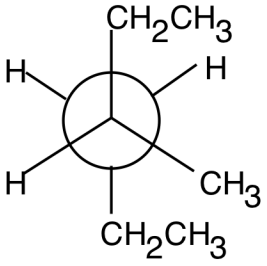
__ E. **3** is the kinetic product and **1** is the thermodynamic product.

Rationale:
Chapter 7 Problem 68a

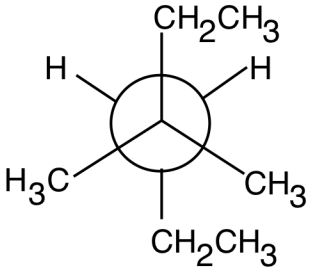
29. Look at the three Newman projections below labelled **a** , **b** , and **c** . Choose the statement which is completely **CORRECT** about one of these projections.



a



b



c

__ A. Structure **c** is the most stable conformation of 3-methylpentane, viewed along the C2-C3 bond.

__ B. Structure **b** is the most stable conformation of 3,3-dimethylhexane, viewed along the C3-C4 bond.

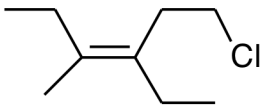
__ C. Structure **a** is the most stable conformation of 3-methylhexane, viewed along the C3-C4 bond.

__ D. Structure **a** is the most stable conformation of 3,3-dimethylhexane, viewed along the C3-C4 bond.

__ E. Structure **b** is the most stable conformation of 3-methylhexane, viewed along the C3-C4 bond.

Rationale:
Chapter 2 Problem 36

30. Choose a **CORRECT** name for the compound whose structure is shown below.



__ A. (Z)-2,3-diethyl-5-chloro-2-pentene

__ B. (E)-2,3-diethyl-5-chloro-2-pentene

__ C. (Z)-1-chloro-3-ethyl-4-methyl-3-hexene

__ D. (E)-1-chloro-3-ethyl-4-methyl-3-hexene

__ E. (E)-3-(2-chloroethyl)-4-methyl-3-hexene

Rationale:
Chapter 3 Problem 14c

Answer Key

"Grade or Education" = 1

CHEM 2261/01
Summer 10
Final Exam
Chapters 1-11, 14

1. D
2. B
3. D
4. D
5. A
6. A
7. D
8. E
9. A
10. D
11. B
12. A
13. D
14. B
15. A
16. E
17. B
18. A

19. A
20. C
21. C
22. D
23. A
24. C
25. C
26. B
27. A
28. B
29. E
30. C