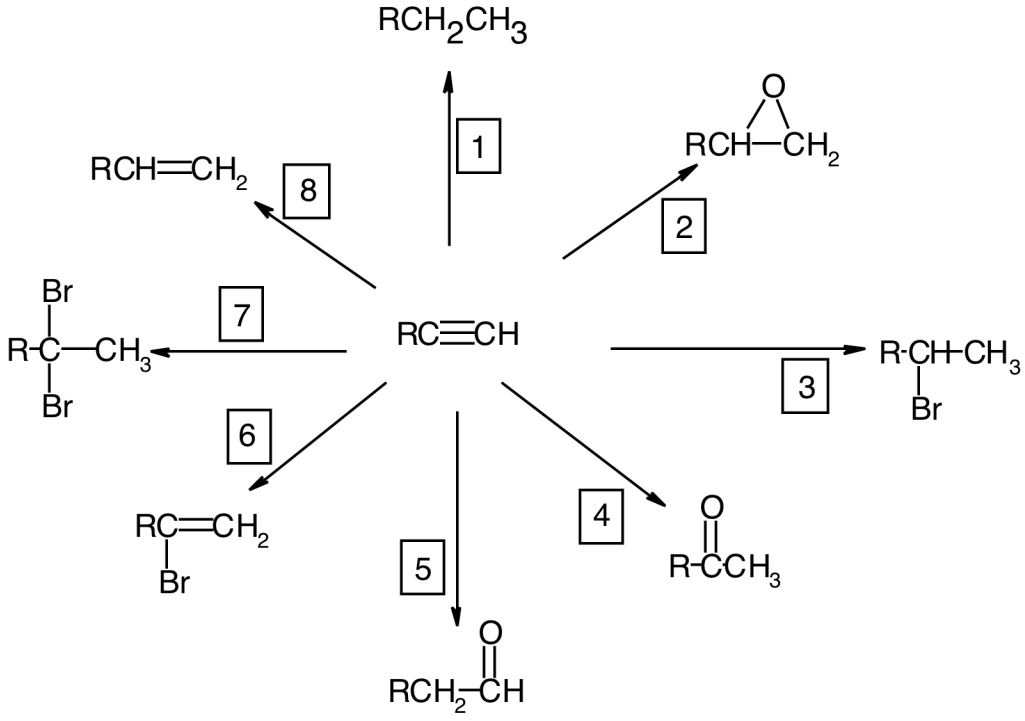
"Grade or Education" = 1

CHEM 2261/01
Summer 11
Final Exam
Chapters 1-12, 15

1. Figure out what reagents could be used to carry out the syntheses shown below. Pick the choice which specifies the CORRECT reagent(s) for one of these syntheses.



__ A. The reagent used to carry out the synthesis associated with box 1 is H_2/Lindlar catalyst.

__ B. The reagents used to carry out the synthesis associated with box 3 are excess H_2 with Pd/C followed by HBr.

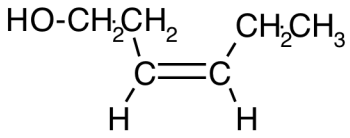
__ C. The reagents used to carry out the synthesis associated with box 5 are BH_3/THF followed by HO^-, H_2O_2, and H_2O.

__ D. The reagent used to carry out the synthesis associated with box 7 is Br_2 in CH_2Cl_2.

__ E. The reagent used to carry out the synthesis associated with box 8 is excess H_2 with Pd/C.

Rationale:
Chapter 6 Problem 29

2. Choose a correct systematic name for the compound whose structure is shown below.



__ A. 4-hexenol

__ B. cis-3-hexen-1-ol

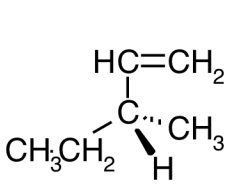
__ C. E-3-hexen-1-ol

__ D. 1-hydroxy-3-hexene

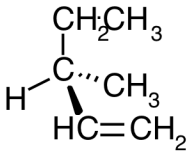
__ E. (3E)-3-hexen-1-ol

Rationale:
Chapter 6 Problem 35b

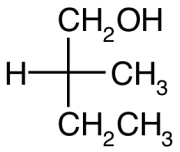
3. Figure out whether each of the following pairs of compounds are identical, or are enantiomers, diastereomers, or constitutional isomers. Pairs of compounds share the same letter, like a1 and a2. Choose the CORRECT statement from the multiple choices.



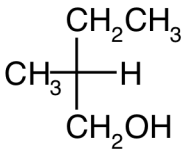
a1



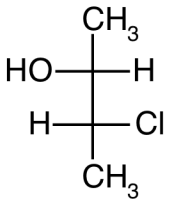
a2



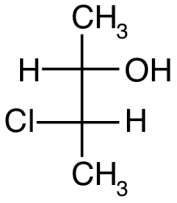
b1



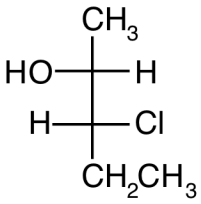
b2



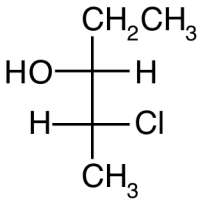
c1



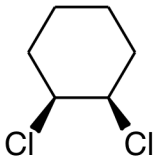
c2



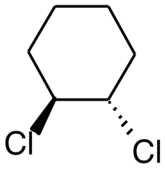
d1



d2



f1



f2

__ A. b1 and b2 are enantiomers.

__ B. d1 and d2 are constitutional isomers.

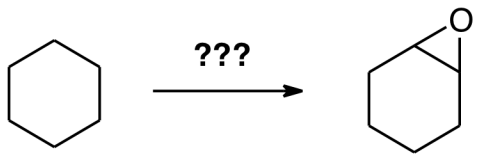
__ C. a1 and a2 are enantiomers.

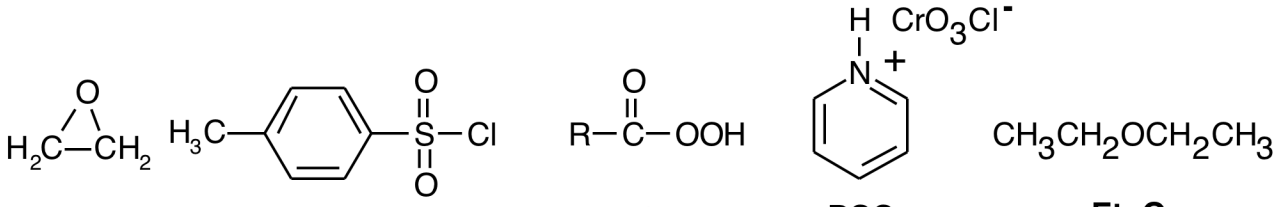
__ D. f1 and f2 are enantiomers.

__ E. c1 and c2 are identical.

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

4. Choose the answer which CORRECTLY outlines how the synthesis suggested below 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 react with Br_2 and light (hν); next react with tert-BuO^-; next react with Br_2/H_2O; finally react with HCl/H_2O.

__ B. First react with Br_2 and light (hν); next react with Mg/Et_2O; next react with $CH_2{=}CH_2$, PdL_2, and OH^-; finally react with RCO_3H.

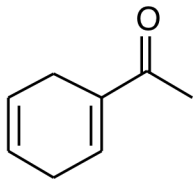
__ C. First react with Br_2 and light (hν); next react with Mg/Et_2O; next react with $CH_2{=}CH_2$, PdL_2, and OH^-; finally react with EO.

__ D. First react with Br_2 and light (hν); next react with tert-BuO^-; finally react with RCO_3H.

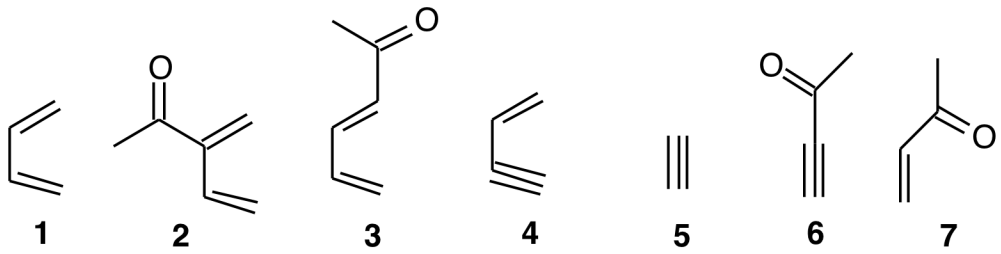
__ E. First react with Br_2 and light (hν); next react with Mg/Et_2O; finally react with EO.

Rationale:
Chapter 12 Problem 19a

5. There are two sets of conjugated diene and dienophile which could be used to prepare the product compound shown below. Pick the choice which lists the two CORRECT combinations of diene and dienophile which can be used to make this product.



PRODUCT



1 **2** **3** **4** **5** **6** **7**

__ A. 1 and 5 will react to form this product. Also 2 and 6 will form this product.

__ B. 3 and 6 will react to form this product. Also 1 and 7 will form this product.

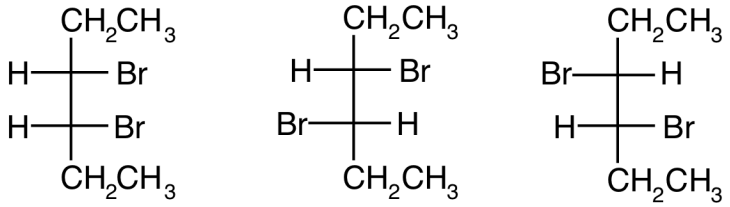
__ C. 1 and 7 will react to form this product. Also 3 and 6 will form this product.

__ D. 4 and 7 will react to form this product. Also 3 and 6 will form this product.

__ E. 1 and 6 will react to form this product. Also 2 and 5 will form this product.

Rationale:
Chapter 7 Problem 72

6. Find the structures of the products of the reactions given in the multiple choices among the Fisher projections numbered 1, 2, and 3 below. Pick the choice which indicates the CORRECT product(s) of the reaction given.



1 **2** **3**

__ A. trans-3-hexene + Br_2/CH_2Cl_2 → products 2 and 3

__ B. trans-3-hexene + Br_2/CH_2Cl_2 → product 3

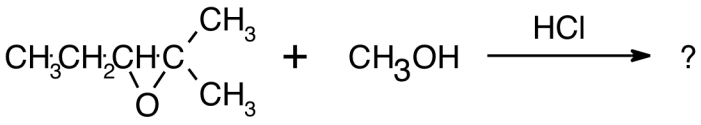
__ C. trans-3-hexene + Br_2/CH_2Cl_2 → product 1

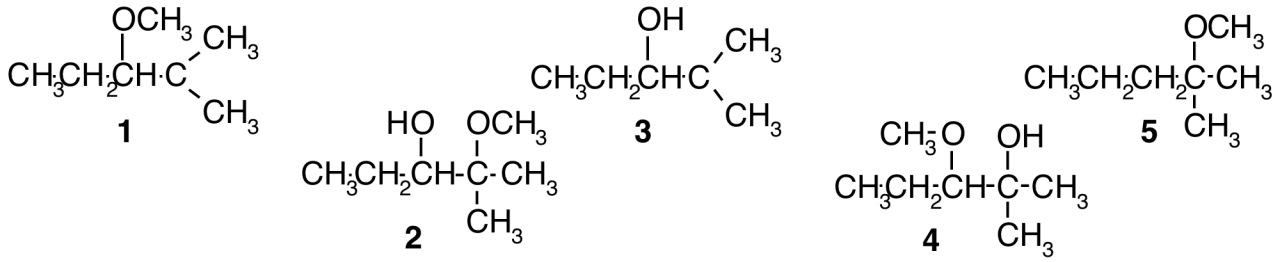
__ D. cis-3-hexene + Br_2/CH_2Cl_2 → product 1 and 3

__ E. cis-3-hexene + Br_2/CH_2Cl_2 → product 1

Rationale:
Chapter 5 Problem 82(e,f)

7. Choose the CORRECT structure of the major product of the reaction shown below.





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

__ A. 1 is the major product of this reaction.

__ B. 3 is the major product of this reaction.

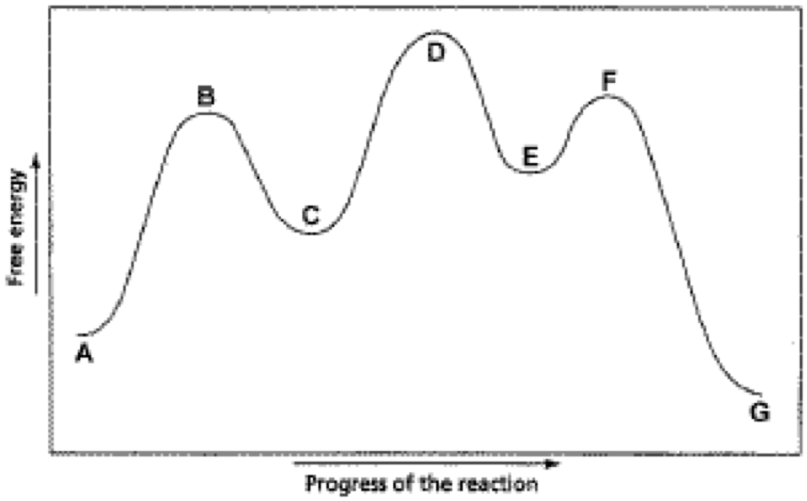
__ C. 2 is the major product of this reaction.

__ D. 4 is the major product of this reaction.

__ E. 5 is the major product of this reaction.

Rationale:
Chapter 10 Problem 33d

8. Given 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. The reactant of the rate-determining step is C.

__ B. E forms faster from C than A does.

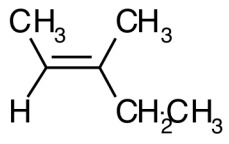
__ C. The first step of the reaction is endergonic.

__ D. G is more stable than A.

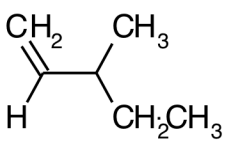
__ E. There are two intermediates formed in the reaction.

Rationale:
Chapter 3 Problem 55(adefg)

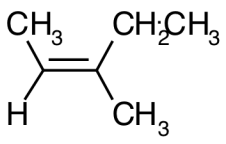
9. Find the elimination product(s) of (2S,3S)-2-chloro-3-methylpentane + high concentration of CH_3O^- among the numbered structures below. Choose the CORRECT product(s) of this reaction.



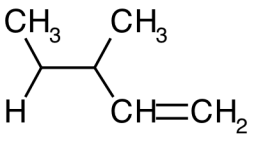
1



2



3



4

__ A. 1 is the product of this reaction.

__ B. 2 is the product of this reaction.

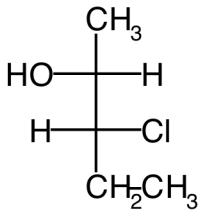
__ C. 1 and 3 are both products of this reaction.

__ D. 3 is the product of this reaction.

__ E. 4 is the product of this reaction.

Rationale:
Chapter 9 Problem 48a

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



__ A. (2R,3R)-3-chloro-2-pentanol

__ B. (3S,4S)-3-chloro-4-pentanol

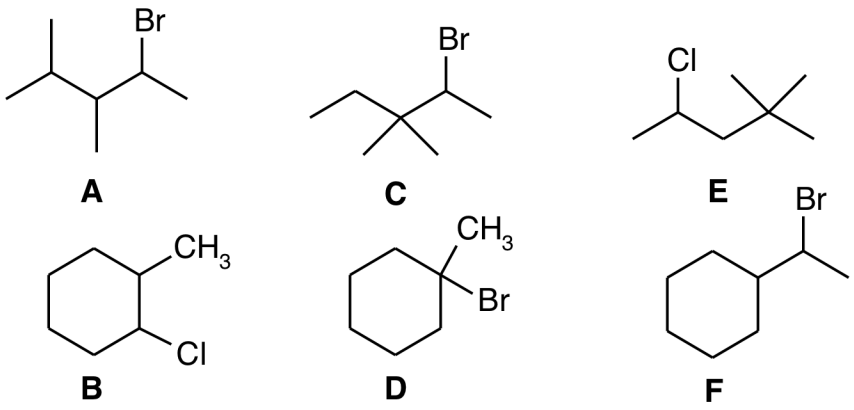
__ C. (2S,3S)-3-chloro-2-pentanol

__ D. (2R,3S)-3-chloro-2-pentanol

__ E. (2S,3R)-3-chloro-2-pentanol

Rationale:
Chapter 5 Problem 65c

11. Which of the alkyl halides whose structures are shown below form a substitution product in an S_N1 reaction that is a different constitutional isomer from the substitution product formed in an S_N2 reaction? Neglect stereochemical considerations.



__ A. A, B, C, and F

__ B. B, D, and F

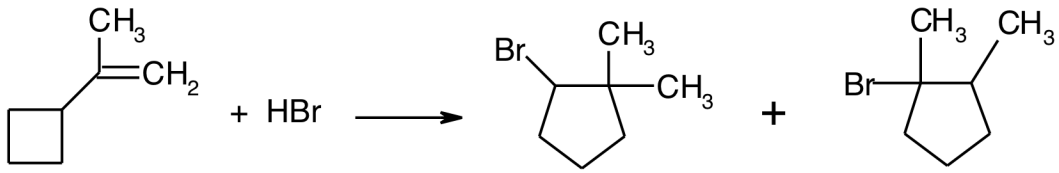
__ C. D and E

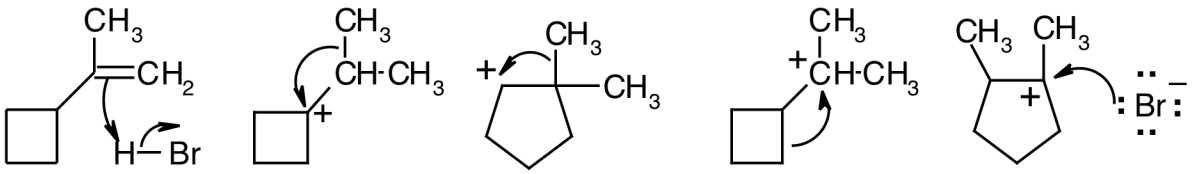
__ D. None of these compounds will form different substitution products in S_N1 reactions than in S_N2 reactions.

__ E. A, C, and E

Rationale:
Chapter 8 Problem 18

12. 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.





1 2 3 4 5

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

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

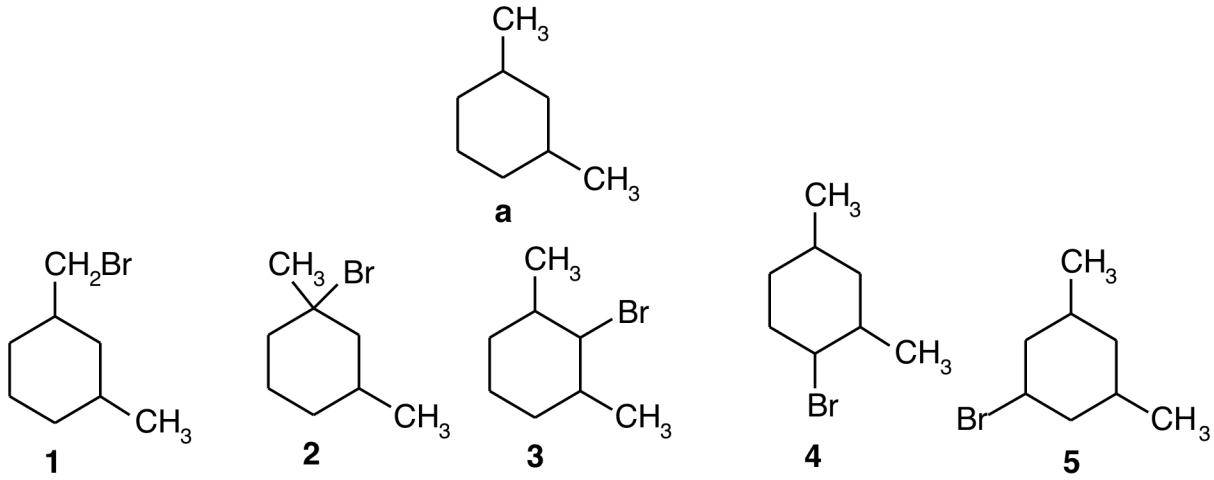
__ C. Process 1 does not occur in this mechanism.

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

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

Rationale:
Chapter 4 Problem 62a

13. Find the MAJOR product which would be obtained by treating an excess of the compound with structure a shown below with Br_2 in the presence of light at room temperature. Disregard stereoisomers.



__ A. Product 5 is the major product of this reaction.

__ B. Product 1 is the major product of this reaction.

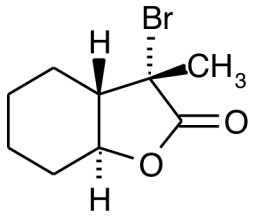
__ C. Product 2 is the major product of this reaction.

__ D. Product 3 is the major product of this reaction.

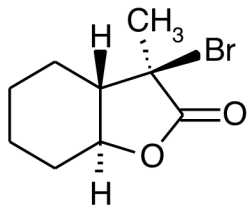
__ E. Product 4 is the major product of this reaction.

Rationale:
Chapter 12 Problem 25a

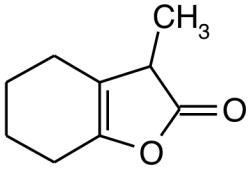
14. Figure out the major elimination products which would be obtained from the reactants with structures a and b shown below under S_N2/E2 conditions. Choose the CORRECT statement from the multiple choices. Use the numbered structures below for reference in choosing the correct answer to this problem.



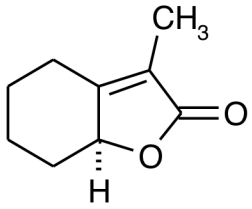
a



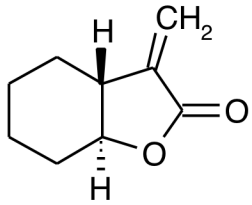
b



1



2



3

__ A. Both a and b give product 2 under S_N2/E2 conditions.

__ B. The compound with structure a gives elimination product 3 under S_N2/E2 conditions.

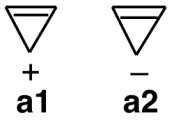
__ C. Both a and b give product 1 under S_N2/E2 conditions.

__ D. The compound with structure b gives elimination product 3 under S_N2/E2 conditions.

__ E. The compound with structure b gives elimination product 2 under S_N2/E2 conditions.

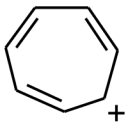
Rationale:
Chapter 9 Problem 49

15. Figure out which structure in each of the pairs shown below is more stable and choose the CORRECT statement from the multiple choices. Pairs of structures share the same letter, like structures a1 and a2.

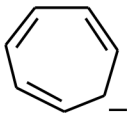


a1

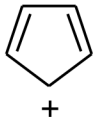
a2



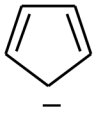
b1



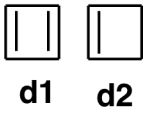
b2



c1



c2



d1 **d2**

__ A. Structure d1 is more stable than structure d2.

__ B. Structure c1 is more stable than structure c2.

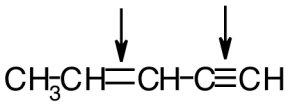
__ C. Structure b1 is more stable than structure b2.

__ D. Structure a2 is more stable than structure a1.

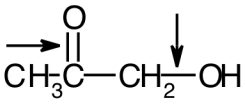
__ E. None of the other statements is correct.

Rationale:
Chapter 15 Problem 38

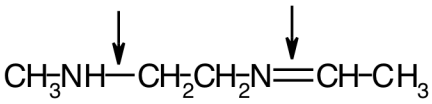
16. Look at the structures below and determine which of the two indicated bonds is shorter for each structure (see arrows). Circle the arrow pointing to the **SHORTER** bond on your test paper and use this information to pick the **CORRECT** statement from the multiple choices.



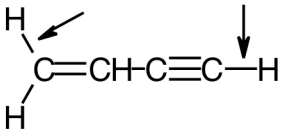
compound 1



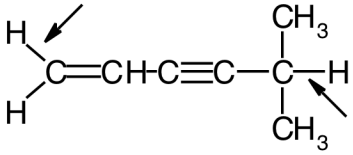
compound 2



compound 3



compound 4



compound 5

__ A. In compound 5 the bond indicated on the right is shorter than the bond indicated on the left.

__ B. In compound 4 the bond indicated on the right is shorter than the bond indicated on the left.

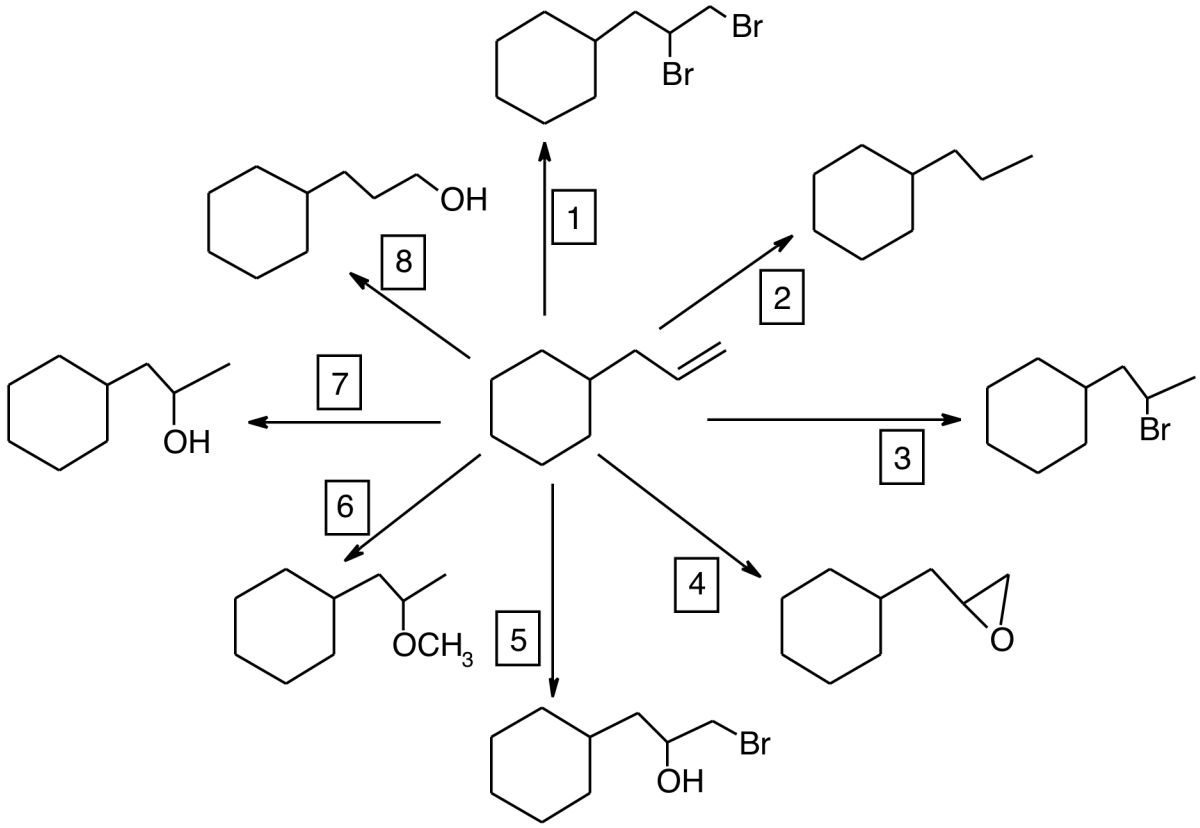
__ C. In compound 2 the bond indicated on the right is shorter than the bond indicated on the left.

__ D. In compound 1 the bond indicated on the left is shorter than the bond indicated on the right.

__ E. In compound 3 the bond indicated on the left is shorter than the bond indicated on the right.

Rationale:
Chapter 1 Problem 86a

17. The compound whose structure is shown in the center of the figure following can be converted into all of the other outer compounds whose structures are shown. Conversion number 1 transforms the center compound into the topmost compound in the figure (see boxed number 1). Conversion number 2 transforms the center compound into the outer compound one position clockwise from the topmost compound, etc. (ie. the conversion numbers are arranged in a clockwise pattern). Use this information to find the multiple choice answer which is ****WRONG****.



__ A. Conversion number 6 can be carried out using acid (H^+) and CH_3OH.

__ B. Conversion number 8 can be carried out using H_2SO_4/H_2O.

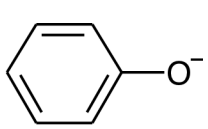
__ C. Conversion number 5 can be carried out using Br_2 and H_2O.

__ D. Conversion number 3 can be carried out using HBr.

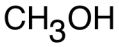
__ E. Conversion number 2 can be carried out using H_2/Pt.

Rationale:
Chapter 4 Problem 47

18. Choose the response which lists the following species in order of DECREASING nucleophilicity in an aqueous solution (ie. most nucleophilic > ... > least nucleophilic).

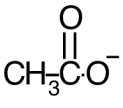


1

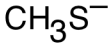


2

3



4



5

__ A. 2 > 4 > 1 > 3 > 5

__ B. 5 > 1 > 4 > 3 > 2

__ C. 3 > 5 > 1 > 4 > 2

__ D. 5 > 3 > 1 > 4 > 2

__ E. 2 > 4 > 1 > 5 > 3

Rationale:
Chapter 8 Problem 8

19. Determine the molecular formula by doing a unit of unsaturation analysis for each of the hydrocarbons described in the multiple choices and choose the correct statement.

__ A. A 10 carbon hydrocarbon with one π bond and two rings has the molecular formula $C_{10}H_{16}$.

__ B. A 5 carbon hydrocarbon with one π bond and one ring has the molecular formula C_5H_6.

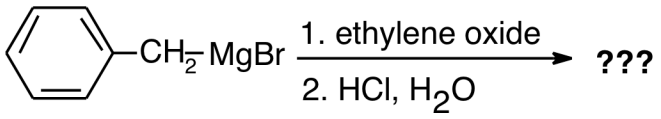
__ C. A 5 carbon hydrocarbon with one π bond and one ring has the molecular formula C_5H_{16}.

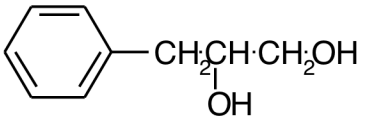
__ D. A 4 carbon hydrocarbon with two π bonds and no rings has the molecular formula C_4H_8.

__ E. A 4 carbon hydrocarbon with two π bonds and no rings has the molecular formula C_4H_{14}.

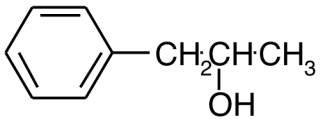
Rationale:
Chapter 3 Problem 1

20. Choose the number under the CORRECT structure of the product of the reaction sequence shown below.

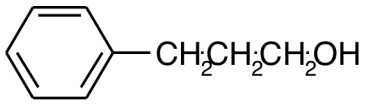




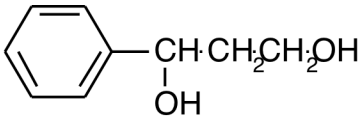
1



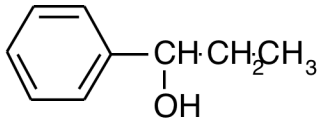
2



3



4



5

__ A. 4

__ B. 5

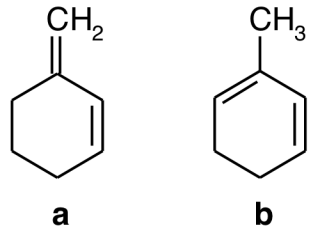
__ C. 2

__ D. 1

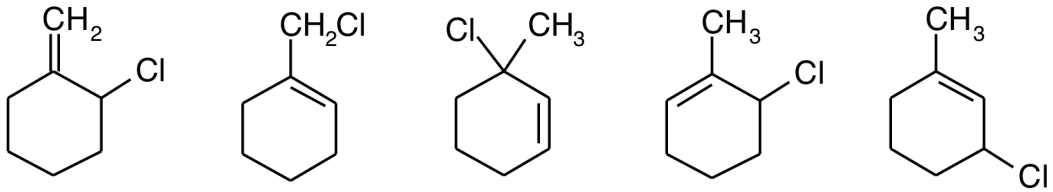
__ E. 3

Rationale:
Chapter 11 Problem 22b

21. Find the structures of the major 1,2 and 1,4 addition products resulting from the reaction of diene b (shown below) with HCl. Figure out which structure is the kinetic product of this reaction and which structure is the thermodynamic product. Choose the CORRECT statement from the multiple choices.



a **b**



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

__ A. The kinetic product has structure 2 and the thermodynamic product has structure 4.

__ B. The kinetic product has structure 4 and the thermodynamic product has structure 2.

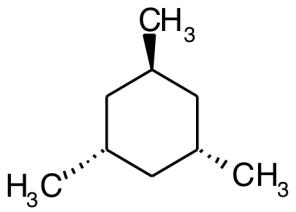
__ C. The kinetic product has structure 1 and the thermodynamic product has structure 3.

__ D. Both the kinetic and the thermodynamic products have structure 5.

__ E. The kinetic product has structure 3 and the thermodynamic product has structure 5.

Rationale:
Chapter 7 Problem 31(a or b)

22. Draw the MOST STABLE conformer of the molecule whose structure is shown below. Choose the statement which is CORRECT about this conformer.



__ A. All three of the methyl groups are axial in this conformer.

__ B. There are no axial hydrogen atoms in this conformer.

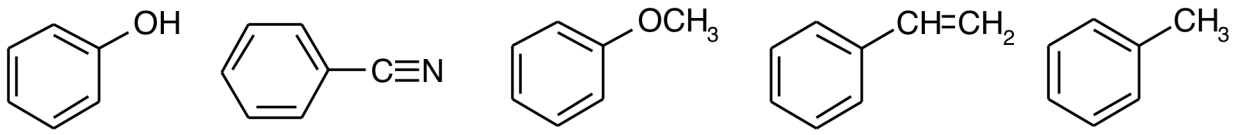
__ C. Two of the methyl groups are equatorial and one of the methyl groups is axial in this conformer.

__ D. All three of the methyl groups are equatorial in this conformer.

__ E. Two of the methyl groups are axial and one of the methyl groups is equatorial in this conformer.

Rationale:
Chapter 2 Problem 71

23. Figure out the names of the five compounds whose structures are shown below. Choose the one which is CORRECTLY named in the multiple choices.



a **c** **e** **f** **g**

__ A. Compound f is styrene.

__ B. Compound c is phenylnitrile.

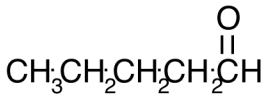
__ C. Compound g is anisole.

__ D. Compound a is phenol.

__ E. Compound e is toluene.

Rationale:
Chapter 14 Problem 35(a,c,e,f,g)

24. Starting with acetylene how could the compound with the structure shown below be synthesized?



__ A. First steps: 1. $NaNH_2$, 2. $CH_3CH_2CH_2Br$; Final step: $H_2SO_4/H_2O/HgSO_4$

__ B. First steps: 1. $NaNH_2$, 2. $CH_3CH_2CH_2Br$; Next step: H_2/Lindlar's catalyst; Final step: H_2SO_4/H_2O

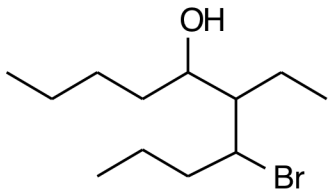
__ C. First steps: 1. $NaNH_2$, 2. $CH_3CH_2CH_2Br$; Next step: Na/NH_3(liq); Final steps: 1. BH_3/THF, 2. HO^-, H_2O_2, H_2O

__ D. First steps: 1. $NaNH_2$, 2. $CH_3CH_2CH_2Br$; Final steps: 1. BH_3/THF, 2. HO^-, H_2O_2, H_2O

__ E. First steps: 1. $NaNH_2$, 2. $CH_3CH_2CH_2Br$; Final step: H_2SO_4/H_2O

Rationale:
Chapter 6 Problem 24d

25. Choose the correct name for the compound which has the structure shown below.



__ A. 7-bromo-6-ethyl-5-decanol

__ B. 3-(1-bromobutyl)-4-octanol

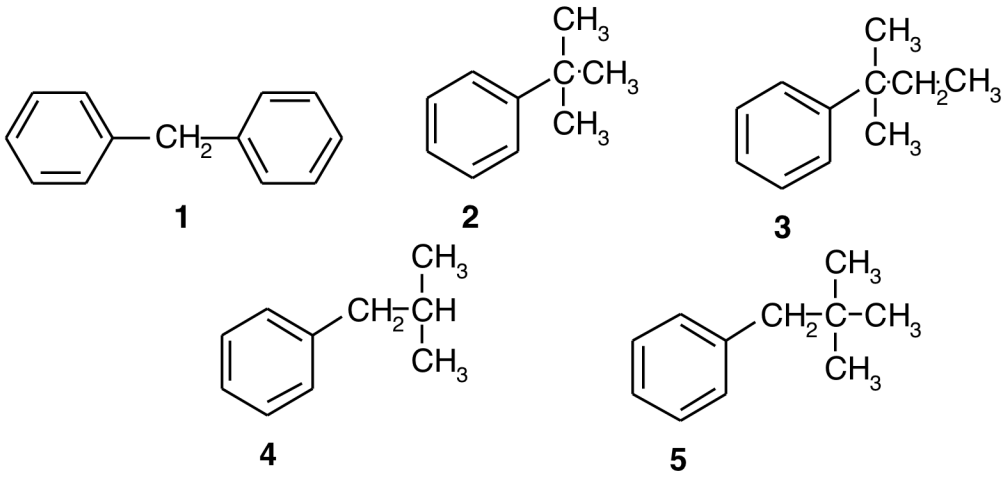
__ C. 6-(1-bromobutyl)-5-octanol

__ D. 4-bromo-5-ethyl-6-decanol

__ E. 1-bromo-6-butyl-5-octanol

Rationale:
Chapter 2 Problem 79a

26. Find the structure of the product of the reaction of excess benzene with isobutyl chloride + $AlCl_3$ from the numbered structures below. Which number represents the CORRECT structure of the product of this reaction?



__ A. 2

__ B. 3

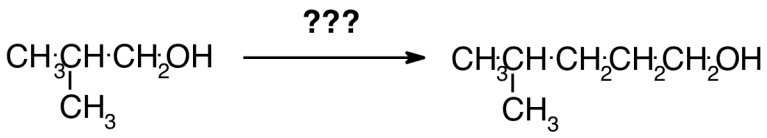
__ C. 1

__ D. 5

__ E. 5

Rationale:
Chapter 15 Problem 37a

27. Choose the answer which CORRECTLY describes how the synthesis suggested below could be carried out.



__ A. First treat with HBr and heat (Δ); next Mg and Et_2O; finally: 1. ethylene oxide (CH_2OCH_2), followed by 2. HCl

__ B. First treat with BH_3/THF with PdL_2 and OH^-; next $CH_2{=}CH_2$; finally: H_2SO_4/H_2O

__ C. First treat with PBr_3; next Mg and Et_2O; finally: 1. $HOCH_2CH_2OH$, followed by 2. HCl

__ D. First react with tert-BuO^-; next CH_3CH_2Br with PdL_2 and OH^-; next Br_2/light; finally OH^-

__ E. First treat with BH_3/THF with PdL_2 and OH^-; next $CH_2{=}CH_2$; finally: 1. BH_3/THF, followed by 2. H_2O_2, OH^-, H_2O

Rationale:
Chapter 11 Problem 25b

28. Water and diethyl ether are immiscible liquids. In a vessel containing both water and ether charged compounds dissolve in water, and uncharged compounds dissolve in ether. Given that $C_6H_{11}COOH$ has a pKa of 4.8 and $C_6H_{11}NH_3^+$ ion has a pKa of 10.7, which of the following statements is **TRUE**?

__ A. If the pH of the water layer is below 2.8 the amine will dissolve in the ether layer and the carboxylic acid will dissolve in the water layer.

__ B. If the pH of the water layer is between 6.8 and 8.7 both compounds will dissolve in the water layer.

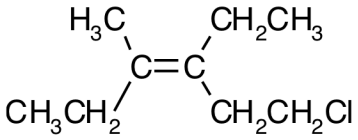
__ C. If the pH of the water layer is above 12.7 both compounds will dissolve in the water layer.

__ D. If the pH of the water layer is below 2.8 both compounds will dissolve in the ether layer.

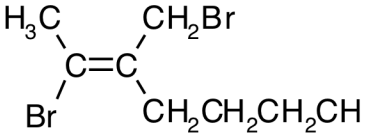
__ E. If the pH of the water layer is above 12.7 the amine will dissolve in the water layer and the carboxylic acid will dissolve in the ether layer.

Rationale:
Chapter 1 Problem 103

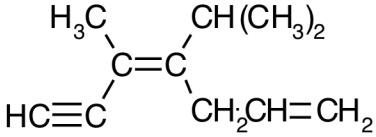
29. Assign the E or Z configuration to the compounds whose structures are shown below. Pick the correct statement from the multiple choices.



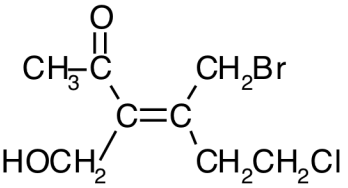
structure A



structure C



structure B



structure D

__ A. The compounds with structures A and D have the E configuration.

__ B. The compounds with structures B and C have the Z configuration.

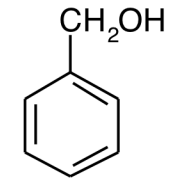
__ C. The compound with structure A has the E configuration.

__ D. The compound with structure B has the Z configuration.

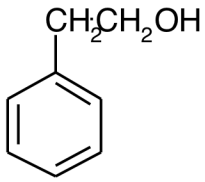
__ E. The compound with structure D has the Z configuration.

Rationale:
Chapter 3 Problem 48

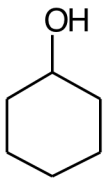
30. Figure out which alcohol in each of the pairs shown below will undergo dehydration more rapidly when heated with H_2SO_4. Pairs of alcohols share the same letter, ie, a1 and a2. Choose the CORRECT statement from the multiple choices.



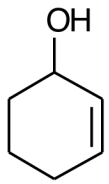
a1



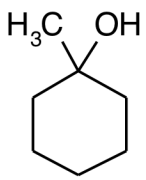
a2



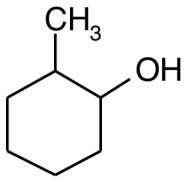
b1



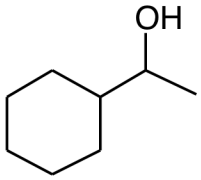
b2



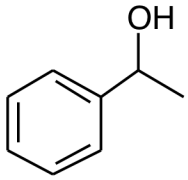
c1



c2



d1



d2

__ A. d1 will undergo dehydration more rapidly than d2 when heated with H_2SO_4.

__ B. b1 will undergo dehydration more rapidly than b2 when heated with H_2SO_4.

__ C. c2 will undergo dehydration more rapidly than c1 when heated with H_2SO_4.

__ D. None of the other choices is correct.

__ E. a1 will undergo dehydration more rapidly than a2 when heated with H_2SO_4.

Rationale:
Chapter 10 Problem 34(a-d)

Answer Key

"Grade or Education" = 1

CHEM 2261/01
Summer 11
Final Exam
Chapters 1-12, 15

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

19. A

20. E

21. E

22. C

23. ERROR

24. D

25. A

26. A

27. A

28. B

29. E

30. D