

CHM 1321 (prof. S. Gambarotta) Final Exam April 30 – 2008**Your Name:** _____ **Student #:** _____**Your course TA (Steve, Jenn C, Jenn P):** _____

Exercise	key	Exercise	key	Exercise	key
1		25		49	
2		26		50	
3		27		51	
4		28		52	
5		29		53	
6		30		54	
7		31		55	
8		32		56	
9		33		57	
10		34			
11		35			
12		36			
13		37			
14		38			
15		39			
16		40			
17		41			
18		42			
19		43			
20		44			
21		45			
22		46			
23		47			
24		48			

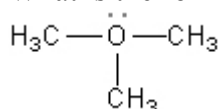
1. You can keep the text. The solution key will be posted today on the web.

**Open book exam. Only a clean textbook is allowed. Molecular models are also allowed.
Blank pages at the end.**

1. According to molecular orbital theory, which molecule could not exist?

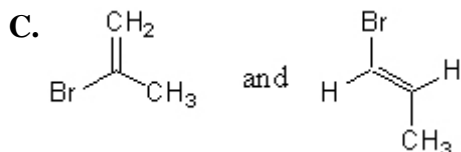
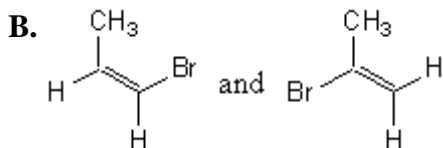
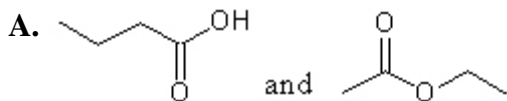
- A. H_2
- B. He_2
- C. Li_2
- D. F_2
- E. N_2

2. What is the formal charge on oxygen in the following structure?



- A. +2
- B. +1
- C. 0
- D. -1
- E. -2

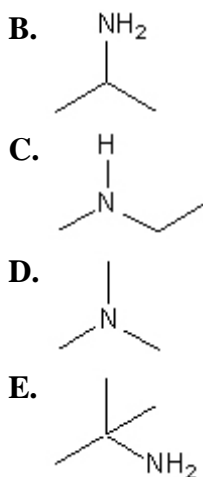
3. Which of the following represent pairs of constitutional isomers?

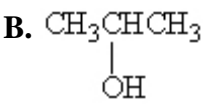


- D. More than one of these pairs
- E. All of these pairs

4. Which compound would you expect to have the lowest boiling point?

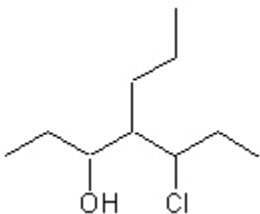




5. Which of these would you expect to have the lowest boiling point?
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- B. 
- C. $\text{CH}_3\text{OCH}_2\text{CH}_3$
- D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- E. $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$
6. Adding sodium amide (NaNH_2) to 1-butyne ($\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$) would produce:
- A. $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CNa} + \text{NH}_3$
- B. $\text{CH}_3\text{CH}_2\text{C}\equiv\text{C}-\text{C}\equiv\text{CH}_2\text{CH}_3 + \text{NaH} + \text{NH}_3$
- C. $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CNH}_2 + \text{NaH}$
- D. $\text{NaCH}_2\text{CH}_2\text{C}\equiv\text{CH} + \text{NH}_3$
- E. $\text{CH}_3\text{CH}(\text{Na})\text{C}\equiv\text{CH} + \text{NH}_3$
7. Which reaction of these potential acids and bases does not occur to any appreciable degree due to an unfavorable equilibrium?
- A. $\text{NaNH}_2 + \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- B. $\text{CH}_3\text{CH}_2\text{CO}_2\text{Na} + \text{HI}$
- C. CH_3Li in hexane + ethyne
- D. $\text{NaH} + \text{methanol}$

E. Two of the above will not occur

8. A correct IUPAC name for the following compound is:

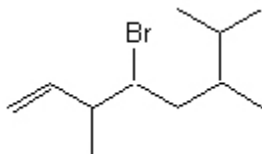


- A. 4-propyl-5-chloro-3-heptanol
- B. 4-propyl-3-chloro-5-heptanol
- C. 4-(1-chloropropyl)-3-heptanol
- D. 5-chloro-4-propyl-3-heptanol
- E. 3-hydroxy-4-propyl-5-chloroheptane

9. Which isomer of C_5H_{10} would you expect to have the smallest heat of combustion?

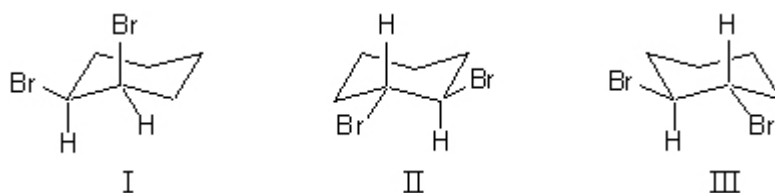
- A. Cyclopentane
- B. Methylcyclobutane
- C. 1,1-Dimethylcyclopropane
- D. cis-1,2-Dimethylcyclopropane
- E. trans-1,2-Dimethylcyclopropane

10. A correct IUPAC name for the following compound is:



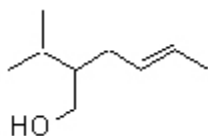
- A. 3,6,7-trimethyl-4-bromo-1-octene
- B. 4-bromo-3-methyl-6-isopropyl-1-heptene
- C. 4-bromo-3,6,7-trimethyl-1-octene
- D. 4-bromo-6-isopropyl-3-methyl-1-heptene
- E. 4-bromo-6-isopropyl-3,6-dimethyl-1-hexene

11. cis-1,2-Dibromocyclohexane is represented by structure(s):



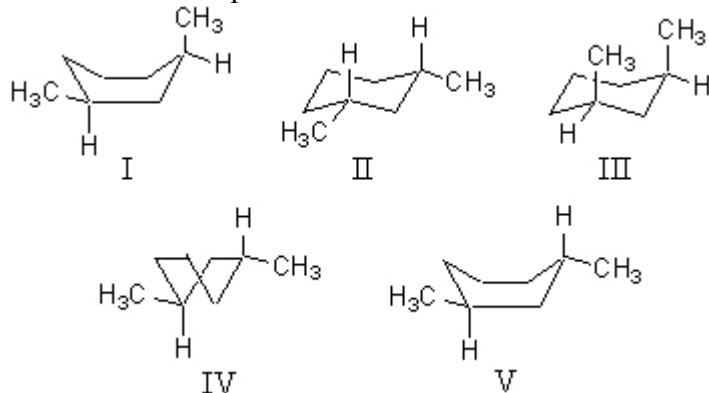
- A. I
- B. II
- C. III
- D. II and III
- E. I and II

12. What is the correct IUPAC name for the following compound?



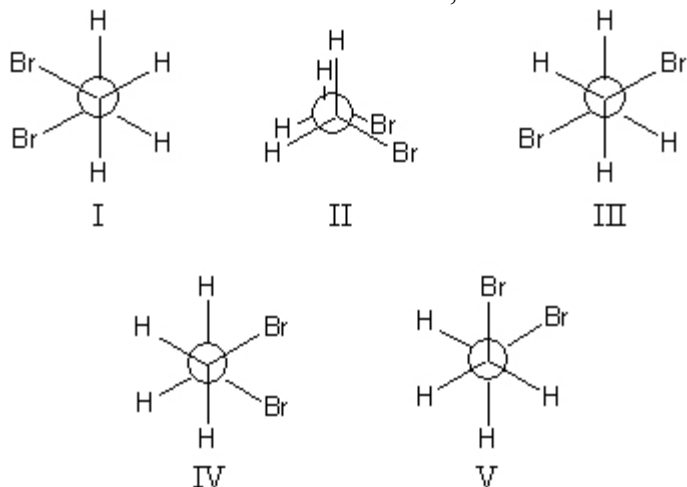
- A. 3-Hydroxymethyl-2-heptene
- B. 2-(1-methylethyl)-4-hexen-1-ol
- C. 5-(1-methylethyl)-2-hexen-6-ol
- D. 5-isopropyl-2,6-hexenol
- E. 2-(1-methylethyl)-4-hepten-1-ol

13. What structure represents the most stable conformation of cis-1,3-dimethylcyclohexane?



- A. I
- B. II
- C. III
- D. IV
- E. V

14. The most stable conformation of 1,2-dibromoethane is:

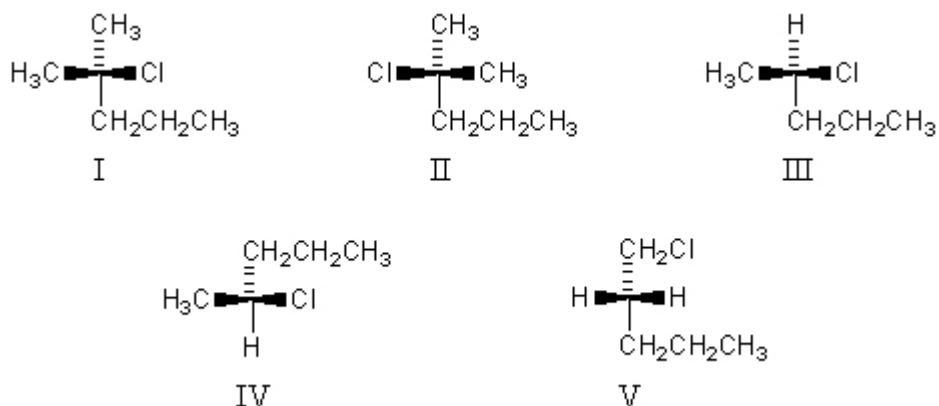


- A. I
- B. II
- C. III
- D. IV
- E. V

15. The twist boat conformation is the preferred conformation for this compound.

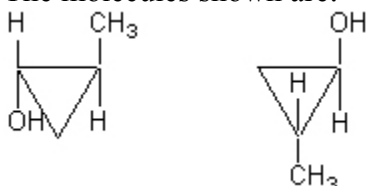
- A. cis-1,4-Di-tert-butylcyclohexane
- B. trans-1,4-Di-tert-butylcyclohexane
- C. cis-1,3-Di-tert-butylcyclohexane
- D. trans-1,2-Di-tert-butylcyclohexane
- E. None of these

16. Pairs of enantiomers are:



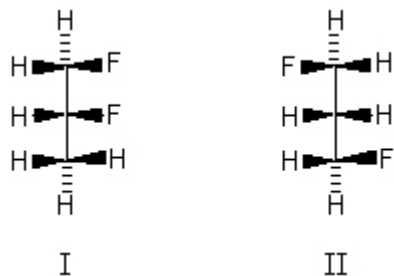
- A. I, II and III, IV
 B. I, II
 C. III, IV
 D. IV, V
 E. None of the structures

17. The molecules shown are:



- A. constitutional isomers.
 B. enantiomers.
 C. diastereomers.
 D. identical.
 E. None of these

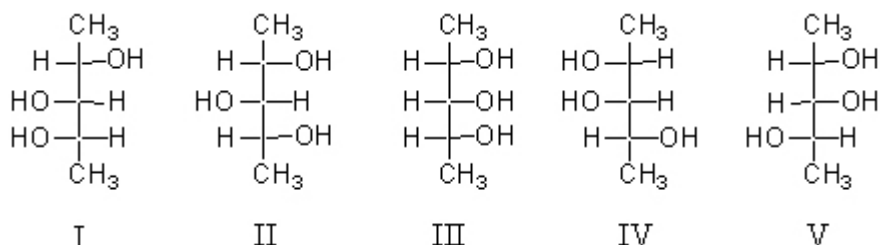
18. The molecules below are:



- A. constitutional isomers.

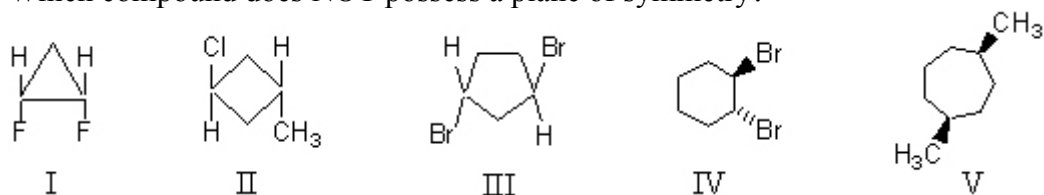
- B. enantiomers.
- C. diastereomers.
- D. identical.
- E. None of these

19. Which structure(s) represent(s) diastereomer(s) of I?



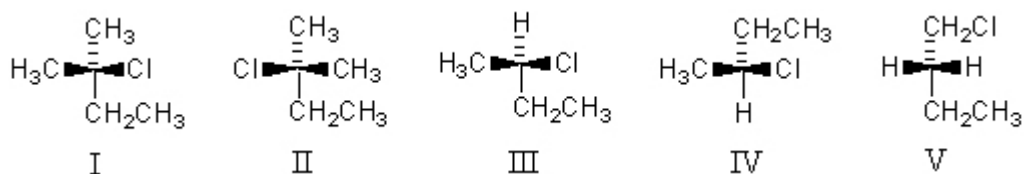
- A. II
- B. II and III
- C. II and IV
- D. III and V
- E. IV and V

20. Which compound does NOT possess a plane of symmetry?



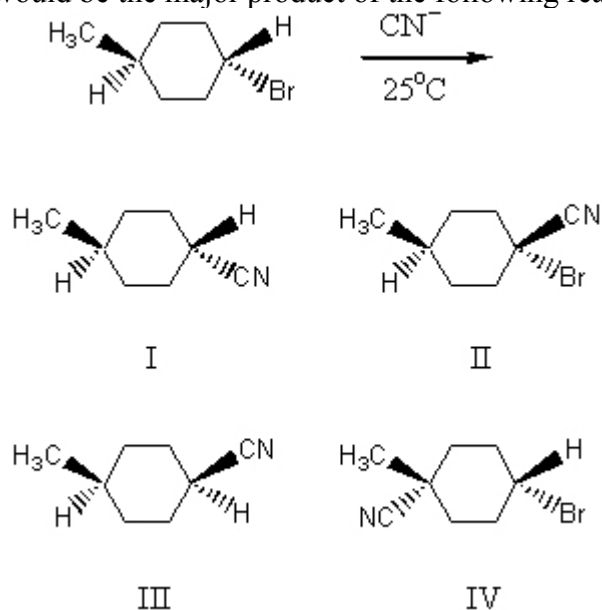
- A. I, II and V
- B. I, III and IV
- C. II, III and IV
- D. III and IV
- E. V

21. (R)-2-Chlorobutane is represented by:



- A. I
B. II
C. III
D. IV
E. V

22. What would be the major product of the following reaction?



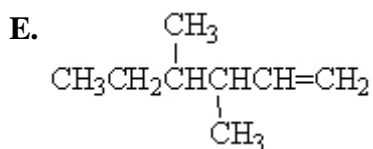
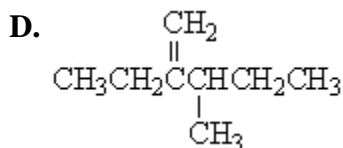
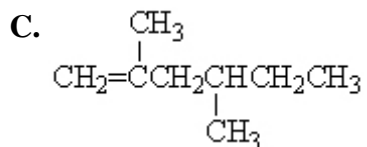
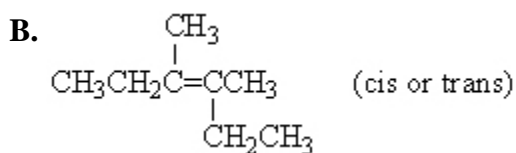
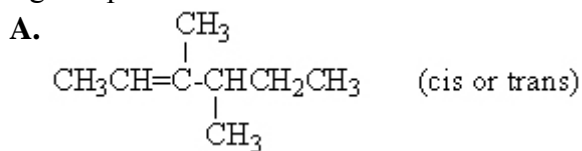
- A. I
B. II
C. III
D. IV
E. Equal amounts of I and III

23. Which ion is the strongest nucleophile in aqueous solution?

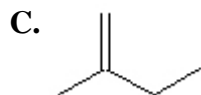
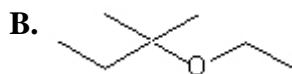
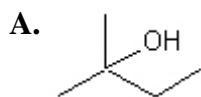
- A. F^-
B. Cl^-

- C. Br^-
 D. I^-
 E. All of these are equally strong.

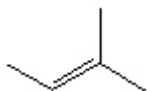
24. An alkene adds hydrogen in the presence of a catalyst to give 3,4-dimethylhexane. Ozonolysis of the alkene followed by treatment with zinc and acetic acid gives a single organic product. The structure of the alkene is:



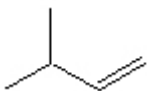
25. Which compound listed below would you expect to be the major product when 2-bromo-2-methylbutane is refluxed with KOH/ethanol?



D.

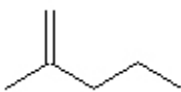


E.

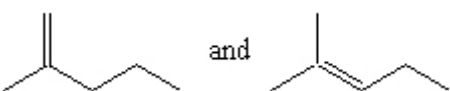


26. Which product(s) would be produced by acid-catalyzed dehydration of 2-methyl-2-pentanol?

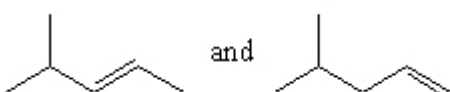
A.



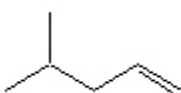
B.



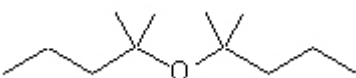
C.



D.



E.



27. The structure of the product obtained from 2-butyne and $\text{Li}/\text{C}_2\text{H}_5\text{NH}_2$ is:

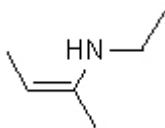
A.



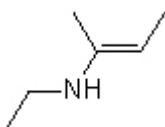
B.



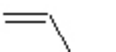
C.



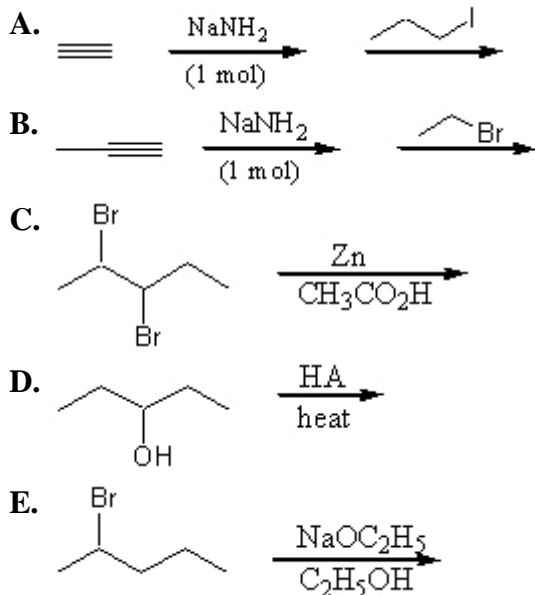
D.



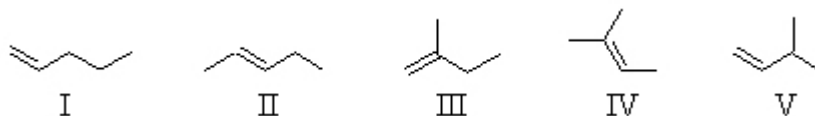
E.



28. Which of the following reactions would yield 2-pentyne?

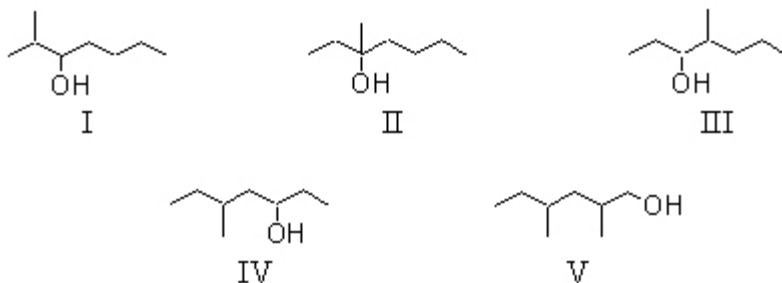


29. One mole of each of the following alkenes is subjected to complete combustion. Which would liberate the least heat?



- A. I
B. II
C. III
D. IV
E. V

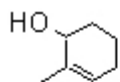
30. Which one of the following alcohols would dehydrate most rapidly when treated with sulfuric acid?



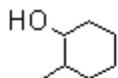
- A. I
- B. II
- C. III
- D. IV
- E. V

31. An alkene with the molecular formula C_8H_{16} undergoes ozonolysis to yield a mixture of $(CH_3)_2C=O$ and $(CH_3)_3CCHO$. The alkene is:
- A. 2,2-Dimethyl-2-hexene
 - B. 2,3-Dimethyl-2-hexene
 - C. 2,4-Dimethyl-2-hexene
 - D. 2,4,4-Trimethyl-2-pentene
 - E. More than one of the above is a possible answer.

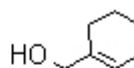
32. Treating 1-methylcyclohexene with H_3O^+ would yield primarily which of these?



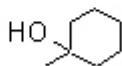
I



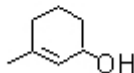
II



III

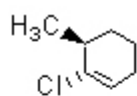


IV

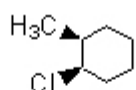


V

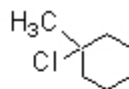
- A. I and V
 - B. II
 - C. III and V
 - D. IV
 - E. I, III and V
33. Treating 1-methylcyclohexene with HCl would yield primarily which of these?



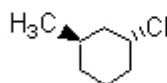
I



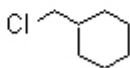
II



III



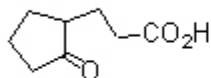
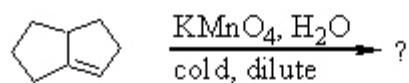
IV



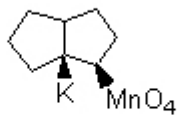
V

- A. I
- B. II
- C. III
- D. IV
- E. V

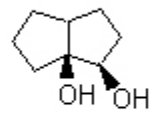
34. What product would result from the following reaction?



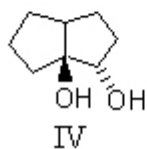
I



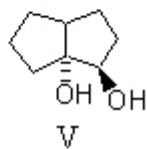
II



III



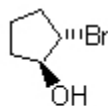
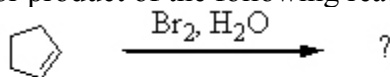
IV



V

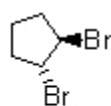
- A. I
- B. II
- C. III
- D. IV
- E. V

35. What would be the major product of the following reaction?



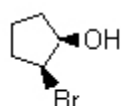
I

A. I



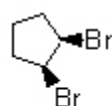
II

B. II



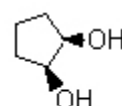
III

C. III



IV

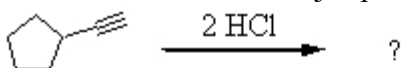
D. IV



V

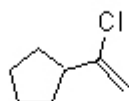
E. V

36. Select the structure of the major product formed in the following reaction.



I

A. I



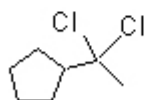
II

B. II



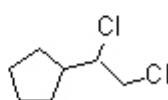
III

C. III



IV

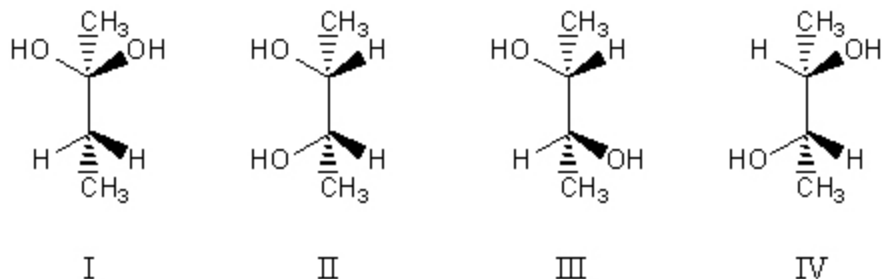
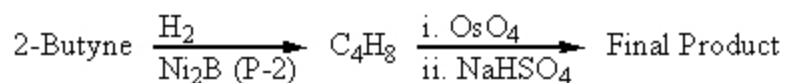
D. IV



V

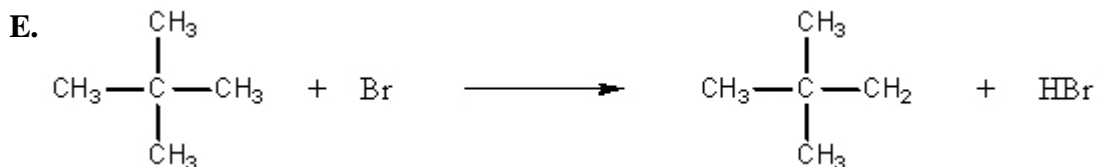
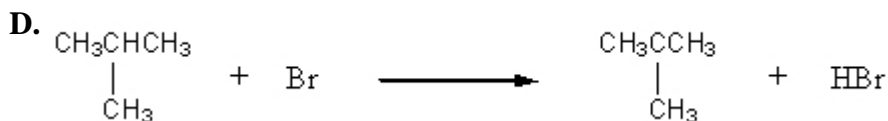
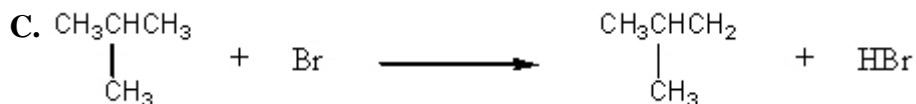
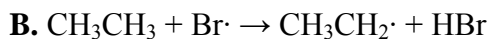
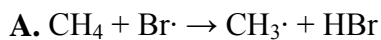
E. V

37. What is the final product of the following synthesis?

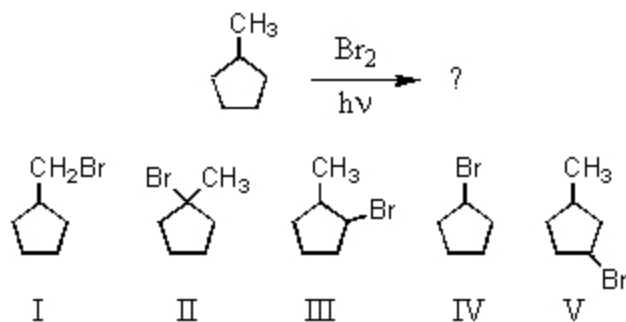


- A. I
 B. II
 C. III
 D. IV
 E. An equimolar mixture of III and IV

38. Which of the following reactions would have the smallest energy of activation?

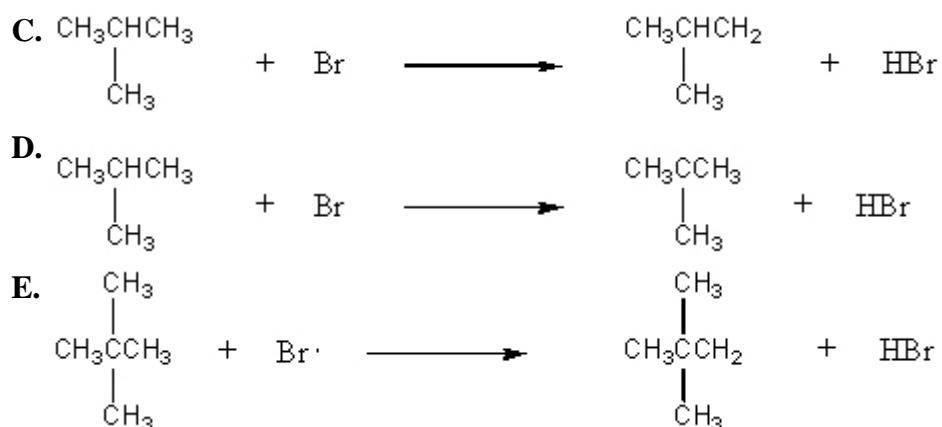


39. Select the structure of the major product formed in the following reaction.

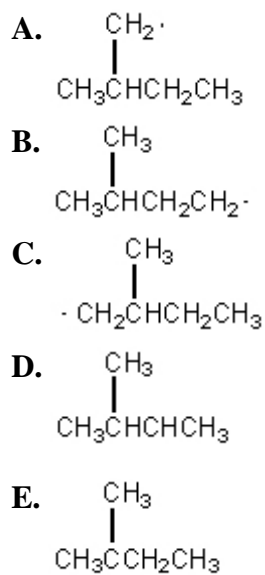


- A. I
 B. II
 C. III
 D. IV
 E. V

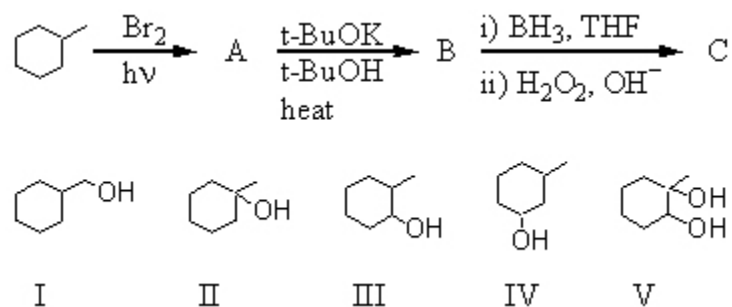
40. What sequence of reactions could be used to prepare *cis*-1,2-cyclopentanediol from cyclopentane?
- A. (1) Cl_2 , $h\nu$; (2) t-BuOK/t-BuOH ; (3) OsO_4 ; (4) $\text{NaHSO}_3/\text{H}_2\text{O}$
 B. (1) t-BuOK/t-BuOH ; (2) Cl_2 , $h\nu$; (3) $\text{NaOH/H}_2\text{O}$
 C. (1) Cl_2 , $h\nu$; (2) t-BuOK/t-BuOH ; (3) H_2O_2
 D. (1) $\text{NaOH/H}_2\text{O}$; (2) Br_2 ; (3) $\text{NaNH}_2(2\text{eq.})/\text{liq. NH}_3$; (4) KMnO_4 , $\text{NaOH/H}_2\text{O}$, 5°C
 E. (1) Cl_2 , $h\nu$; (2) t-BuOK/t-BuOH ; (3) Hg(OAc)_2 , H_2O (4) NaBH_4 , H_3O^+
41. Which statement(s) is(are) true about the reaction of bromine with isobutane?
- A. Bromine selectively abstracts the tertiary hydrogen.
 B. The transition state of the rate determining step is product-like.
 C. The major product formed from this reaction is 1-bromo-2-methylpropane.
 D. A) and B)
 E. A), B) and C)
42. For which reaction would the transition state be most product-like?
- A. $\text{CH}_4 + \text{Br}\cdot \rightarrow \text{CH}_3\cdot + \text{HBr}$
 B. $\text{CH}_3\text{CH}_3 + \text{Br}\cdot \rightarrow \text{CH}_3\text{CH}_2\cdot + \text{HBr}$



43. Which of the following free radicals is the most stable?

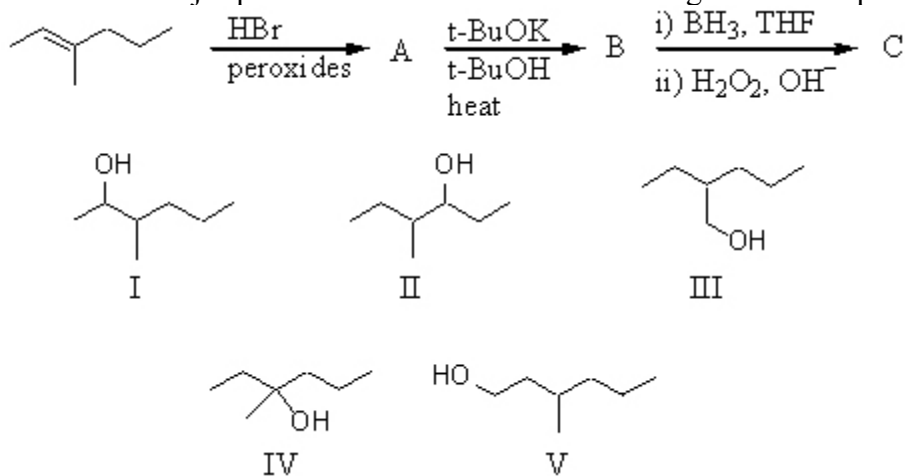


44. What is the final product, C, obtained via the following reaction sequence?



- A. I
- B. II
- C. III
- D. IV
- E. V

45. What is the major product obtained from the following reaction sequence?

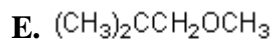
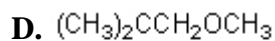


- A. I
- B. II
- C. III
- D. IV
- E. V

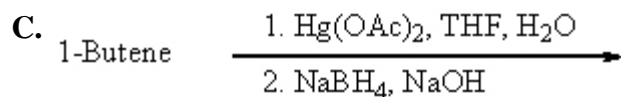
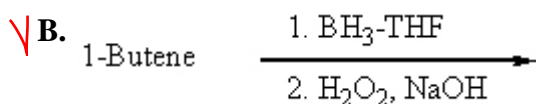
46. What would be the final product?



- A. $(\text{CH}_3)_2\text{CHCH}_2\text{OCH}_3$
- B. $(\text{CH}_3)_2\text{CCH}_3$
- C. $(\text{CH}_3)_2\text{C}(\text{OCH}_3)\text{CH}_2\text{OH}$



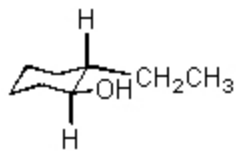
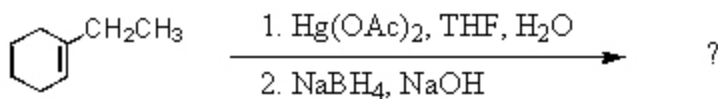
47. Which of the following would be a reasonable synthesis of $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$?



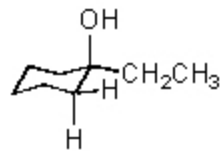
D. More than one of these

E. None of these

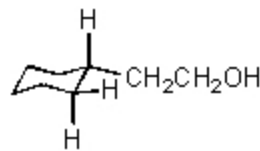
48. Which would be the major product of the reaction shown?



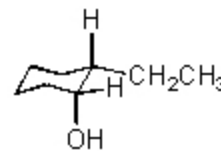
I



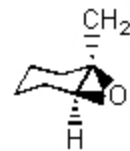
II



III



IV



V

A. I

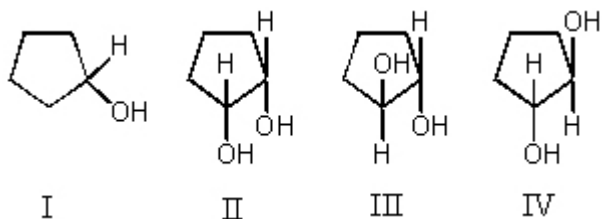
✓ B. II

C. III

D. IV

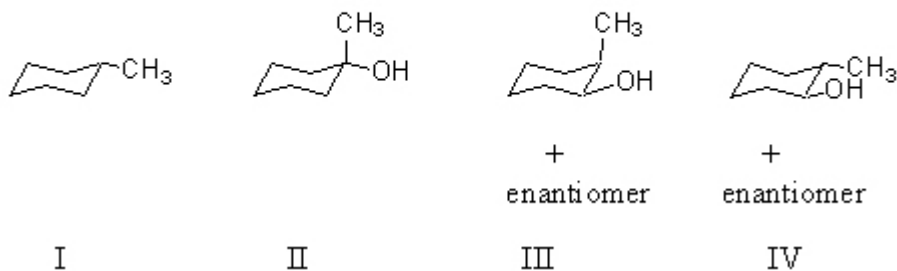
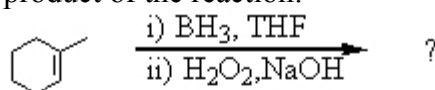
E. V

49. Epoxidation followed by reaction with aqueous base converts cyclopentene into which of these?



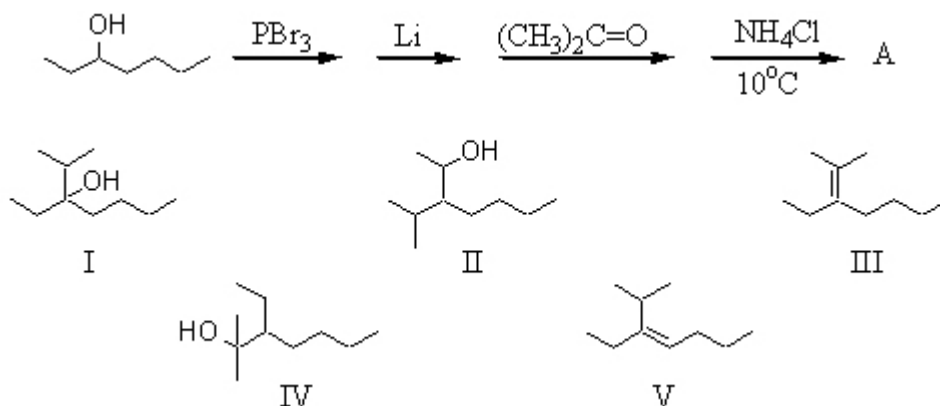
- A. I
 B. II
 C. III
 D. IV
 E. Equal amounts of III and IV

50. What is the major product of the reaction:



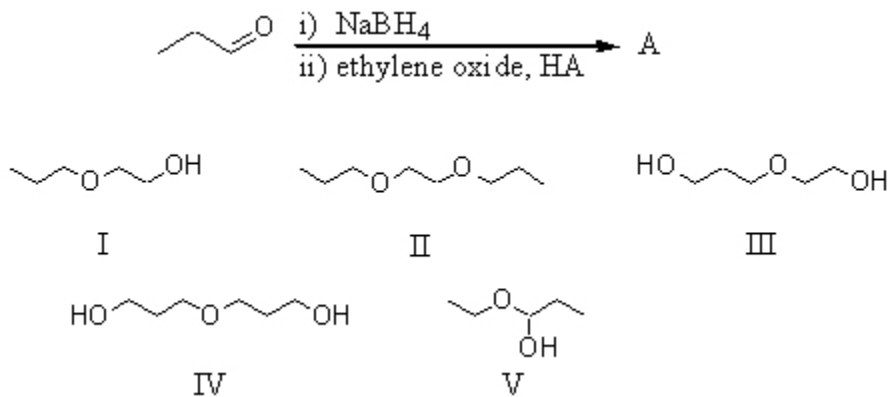
- A. I
 B. II
 C. III
 D. IV
 E. Both III and IV

51. What is the product, A, that would be obtained from the following reaction sequence?



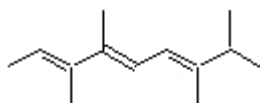
- A. I**
B. II
C. III
D. IV
E. V

52. What would be the major product of the following reaction?



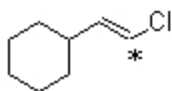
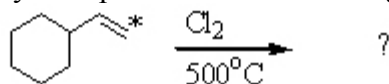
- ~~**A. I**~~
B. II
C. III
D. IV
E. V

53. What is an IUPAC name for this triene?



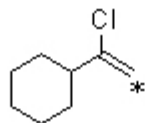
- A. (2E,4Z,6E)–3,4,7,8–tetramethyl-2,4,6–Nonatriene
 B. (2Z,4E,6E)–3,4,7,8–tetramethyl-2,4,6–Nonatriene
 C. (2E,4Z,6E)–2,3,6,7–tetramethyl-3,5,7–Nonatriene
 D. (2E,4Z,6E)– 2,3,6,7–tetramethyl-3,5,7–Nonatriene
 E. (2E,4E,6E)–3,4,7,8–tetramethyl-2,4,6–Nonatriene

54. What product(s) would you expect from the following substitution reaction?



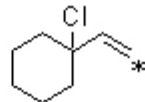
I

A. I



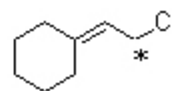
II

B. II



III

C. III

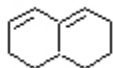


IV

D. IV

E. More than one of the above

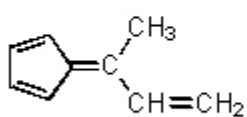
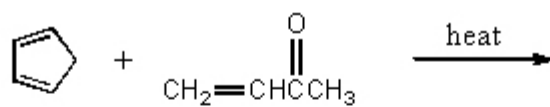
55.



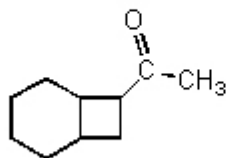
does not undergo the Diels-Alder reaction because:

- A. ring systems cannot function as the diene component.
 B. it cannot adopt the *s*-cis conformation.
 C. it lacks electron-withdrawing groups.
 D. it lacks strong electron-releasing groups.
 E. the two double bonds are further apart than in a non-cyclic conjugated system.

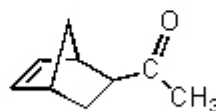
56. What would be the product of the following reaction?



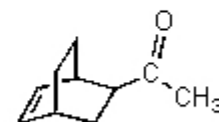
I



II



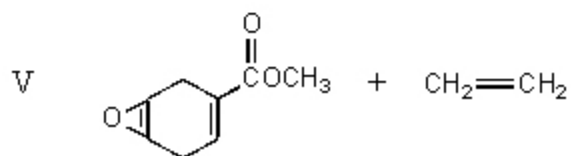
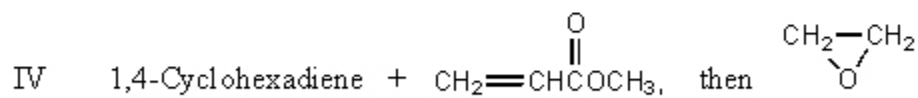
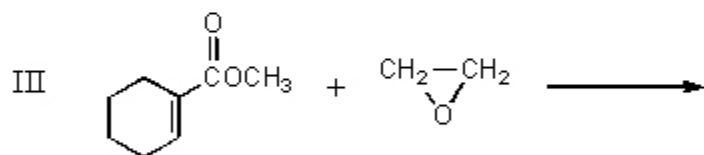
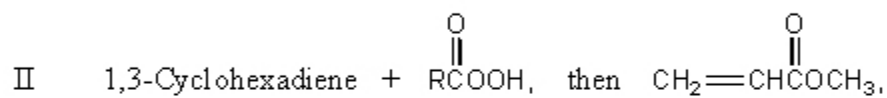
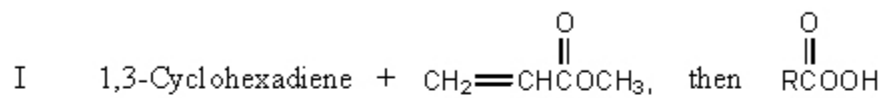
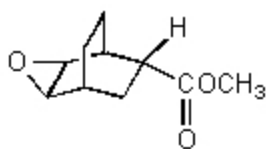
III



IV

- A. I
- B. II
- C. III
- D. IV
- E. All of these

57. How would you synthesize:



- A. I
B. II
C. III
D. IV
E. V

Answer Key

1. B
2. B
3. E
4. D
5. C

6. A
7. A
8. D
9. A
10. C
11. A
12. B
13. B
14. C
15. A
16. C
17. B
18. A
19. B
20. D
21. C
22. C
23. D
24. B
25. D
26. B
27. A
28. B
29. D
30. B
31. D
32. D
33. C
34. C
35. A
36. D
37. B
38. D
39. B
40. A
41. D
42. A

- 43. E
- 44. A
- 45. E
- 46. C
- 47. B
- 48. B
- 49. E
- 50. D
- 51. D
- 52. A
- 53. E
- 54. E
- 55. B
- 56. C
- 57. A

