

4) Consider the hydrogenation reaction of each compound listed and rank the compounds in order of increasing ΔH° of this reaction. The most negative ΔH° should be listed first.

2,5-dimethyl-1,3-cycloheptadiene,
1,4-dimethyl-1,3-cycloheptadiene, and
3,6-dimethyl-1,4-cycloheptadiene

Answer:

3,6-dimethyl-1,4-cycloheptadiene <

2,5-dimethyl-1,3-cycloheptadiene <

1,4-dimethyl-1,3-cycloheptadiene

Diff: 3

5) What is the hybridization of the central carbon of allene (1,2-propadiene)?

A) sp

B) sp^2

C) sp^3

D) p

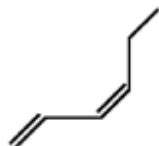
E) none of the above

Answer: A

Diff: 1

14) Draw (Z)-1,3-hexadiene in its *s*-trans conformation.

Answer:



Diff: 2

15) When the relative energies of the *s*-cis and *s*-trans conformers of 1,3-butadiene are compared, one finds:

A) that the *s*-cis conformer is lower in energy than the *s*-trans.

B) that the *s*-trans conformer is lower in energy than the *s*-cis.

C) that the two conformers are of equal energy.

Answer: B

Diff: 1

16) When 3-bromo-1-methylcyclohexene is heated in a good ionizing solvent, reactions occur through a carbocation intermediate. Draw all reasonable resonance contributors of this cation and indicate which is the major contributor.

Answer:



Diff: 3

17) When (*S*)-3-bromopent-1-ene is heated in water, which of the following compounds is not produced?

A) (*S*)-pent-1-en-3-ol

B) (*R*)-pent-1-en-3-ol

C) pent-4-en-1-ol

D) (*E*)-pent-2-en-1-ol

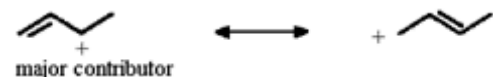
E) (*Z*)-pent-2-en-1-ol

Answer: C

Diff: 2

18) When 3-bromobut-1-ene is heated in a good ionizing solvent, reactions occur through a carbocation intermediate. Draw all reasonable resonance contributors of this cation and indicate which is the major contributor.

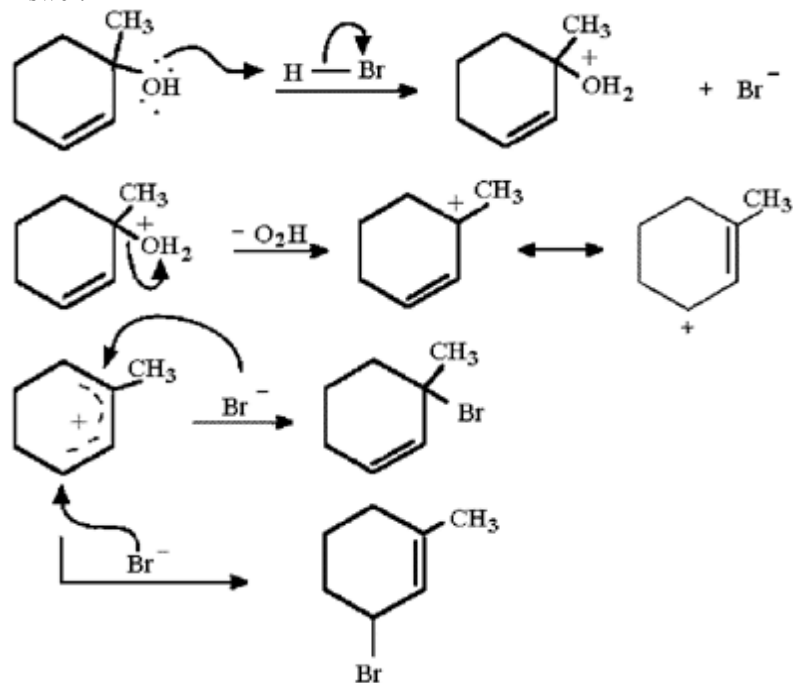
Answer:



Diff: 2

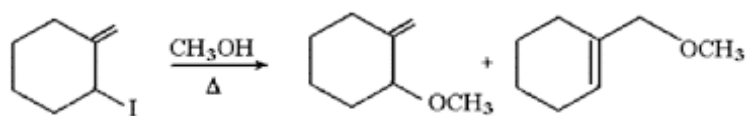
19) When 1-methylcyclohex-2-en-1-ol is treated with HBr, two constitutionally isomeric bromides are produced. Provide a detailed, stepwise mechanism which explains this observation.

Answer:

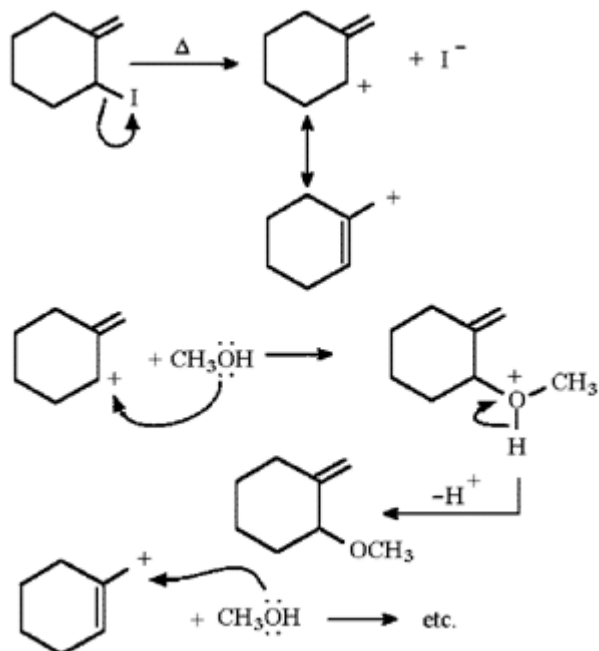


Diff: 3

20) Provide a detailed, stepwise mechanism for the reaction shown below.

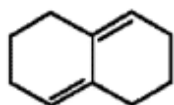


Answer:

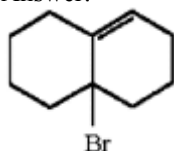


Diff: 2

21) Provide the structure of the major product which results from 1,2-addition of HBr to the diene shown below.

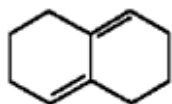


Answer:

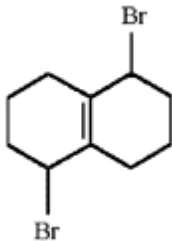


Diff: 2

22) Provide the structure of the major product which results from 1,4-addition of Br₂ to the diene shown below.

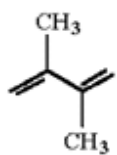


Answer:

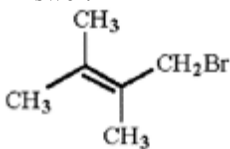


Diff: 1

23) Draw the structure of the major product which results when the diene shown is treated with HBr at 40°C.

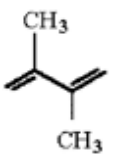


Answer:

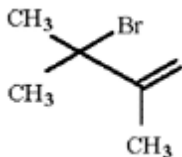


Diff: 2

24) Draw the structure of the major product which results when the diene shown is treated with HBr at -80°C.



Answer:



Diff: 2

25) In the addition of HBr to conjugated dienes, is the product which results from 1,2-addition or that which results from 1,4-addition typically the product of kinetic control?

Answer: The product of kinetic control typically results from 1,2-addition.

Diff: 1

35) Which of the following terms best describes a Diels-Alder reaction?

- A) a [4+2] cycloaddition
- B) a [2+2] cycloaddition
- C) a sigmatropic rearrangement
- D) a 1,3-dipolar cycloaddition
- E) a substitution reaction

Answer: A

Diff: 1

36) When 1,3-butadiene reacts with $\text{CH}_2=\text{CHCN}$, which of the terms below best describes the product mixture?

- A) a mixture of two diastereomers
- B) a single compound
- C) a racemic mixture
- D) optically active
- E) a mixture of bicyclic compounds

Answer: C

Diff: 1

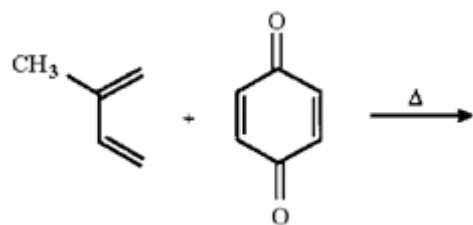
37) The Diels-Alder reaction is a concerted reaction; this means:

- A) a mixture of endo and exo products are formed.
- B) all bond making and bond breaking occurs simultaneously.
- C) the products contain rings.
- D) the reaction follows Markovnikov's rule.
- E) the reaction is highly endothermic.

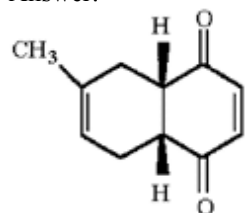
Answer: B

Diff: 2

38) Provide the structure of the major organic product in the following reaction.

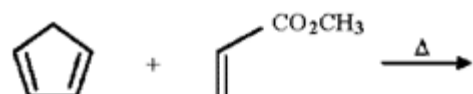


Answer:

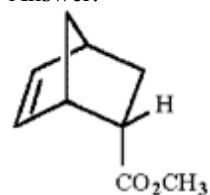


Diff: 2

39) Provide the structure of the major organic product in the following reaction.

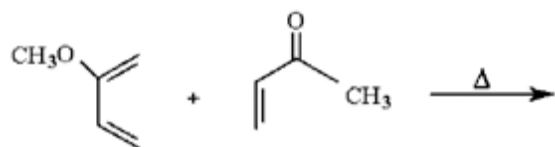


Answer:

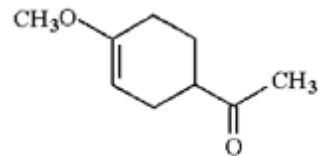


Diff: 2

40) Provide the structure of the major organic product in the following reaction.

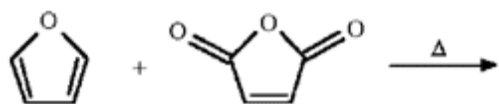


Answer:

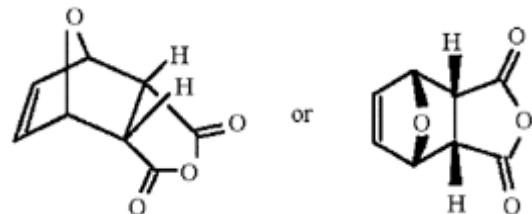


Diff: 3

41) Provide the structure of the major organic product in the following reaction.

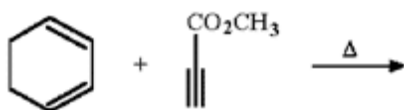


Answer:

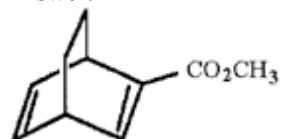


Diff: 3

42) Provide the structure of the major organic product in the following reaction.

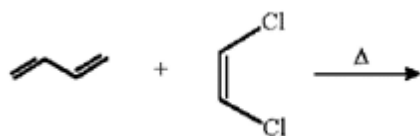


Answer:

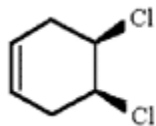


Diff: 2

43) Provide the structure of the major organic product in the following reaction.

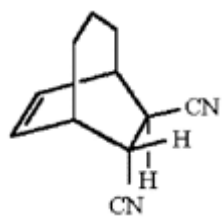


Answer:

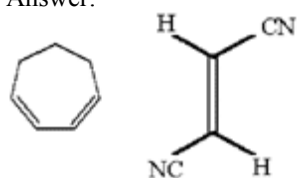


Diff: 1

44) What diene and dienophile would react to give the product below?

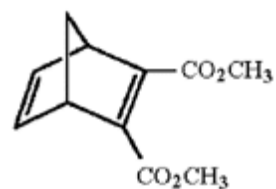


Answer:

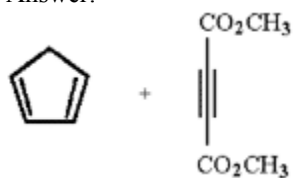


Diff: 2

45) What diene and dienophile would react to give the product below?

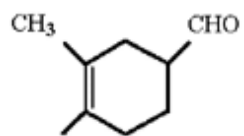


Answer:

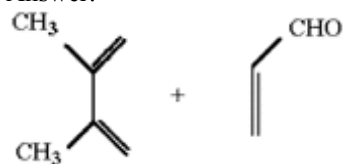


Diff: 2

46) What diene and dienophile would react to give the product below?

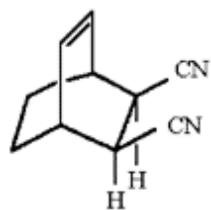


Answer:

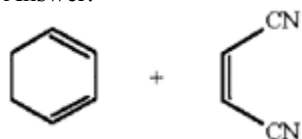


Diff: 1

47) What diene and dienophile would react to give the product below?

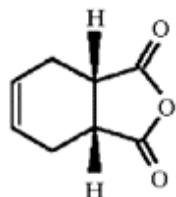


Answer:

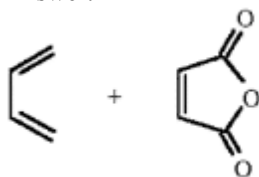


Diff: 2

48) What diene and dienophile would react to give the product below?

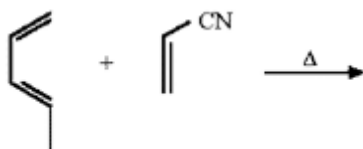


Answer:

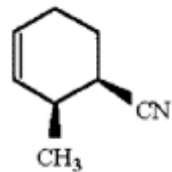


Diff: 1

50) Provide the structure of the major organic product in the following reaction.

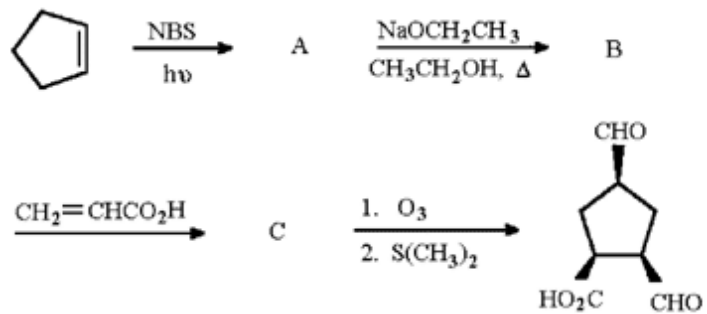


Answer:

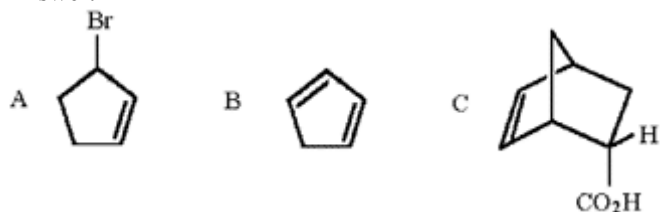


Diff: 3

51) What are the structures of A, B, and C?

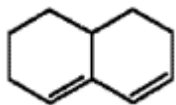


Answer:



Diff: 3

53) Why does the diene shown below fail to undergo a Diels-Alder reaction with even the most reactive dienophiles?



Answer: The diene cannot achieve the necessary *s-cis* conformation.

Diff: 3

58) Absorption of UV-visible energy by a molecule results in:

- A) vibrational transitions
- B) electronic transitions
- C) rotational transitions
- D) nuclear transitions
- E) none of the above

Answer: B

Diff: 1

60) Which of the following compounds absorbs the longest wavelength of UV-visible light?

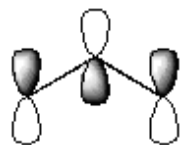
- A) (*E*)-but-2-ene
- B) (*Z*)-but-2-ene
- C) hex-1-ene
- D) (*Z*)-1,3-hexadiene
- E) (*E*)-1,3,5-hexatriene

Answer: E

Diff: 1

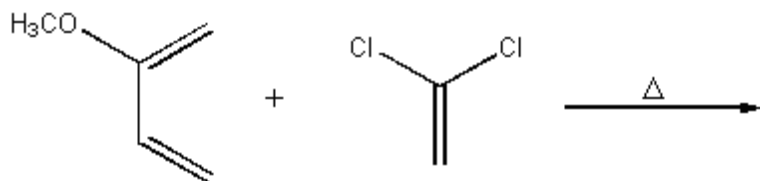
73) Show how the carbon p orbitals overlap to form the LUMO of the allyl anion.

Answer:

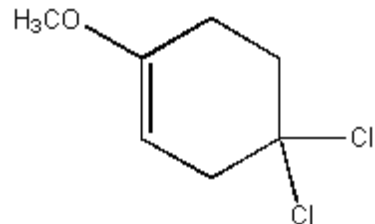


Diff: 2

75) Provide the major organic product of the following reaction.

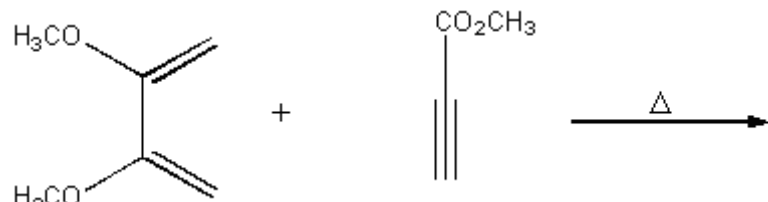


Answer:

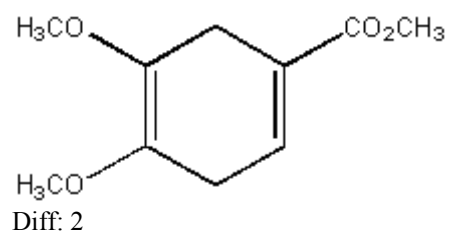


Diff: 2

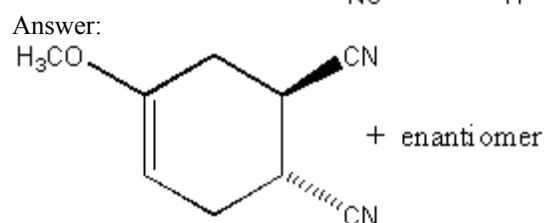
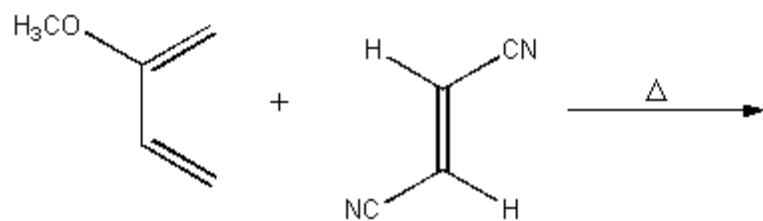
76) Provide the major organic product of the following reaction.



Answer:

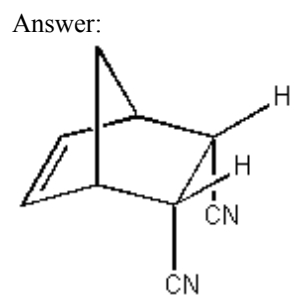
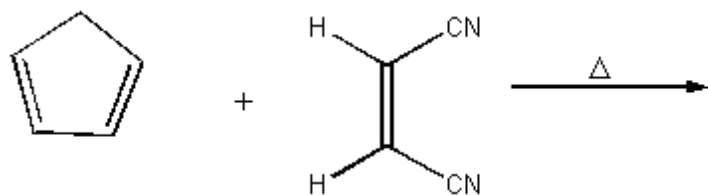


77) Provide the major organic product of the following reaction.



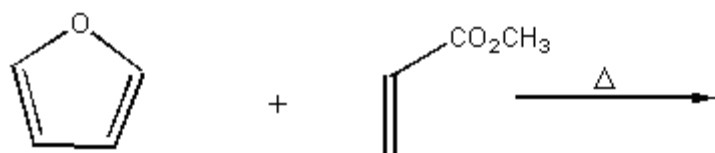
Diff: 2

78) Provide the major organic product of the following reaction.

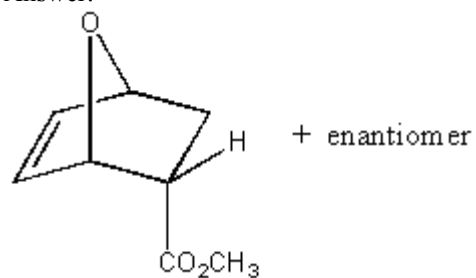


Diff: 3

79) Provide the major organic product of the following reaction.

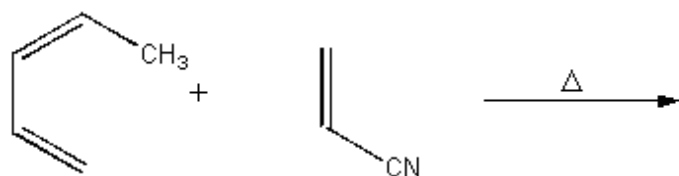


Answer:

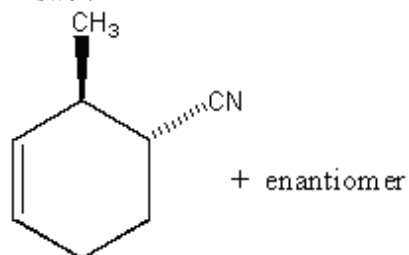


Diff: 3

80) Provide the major organic product of the following reaction.

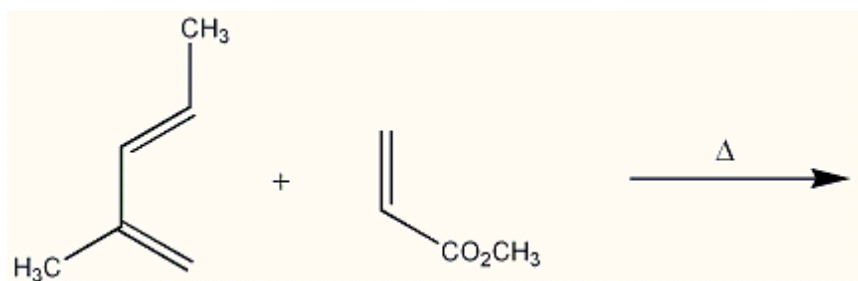


Answer:

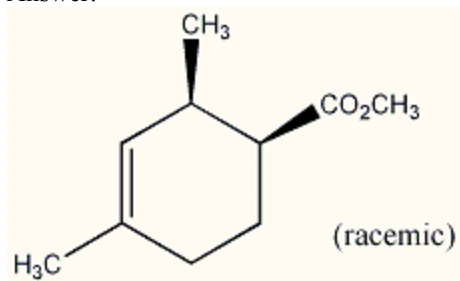


Diff: 3

81) Provide the major organic product of the following reaction.

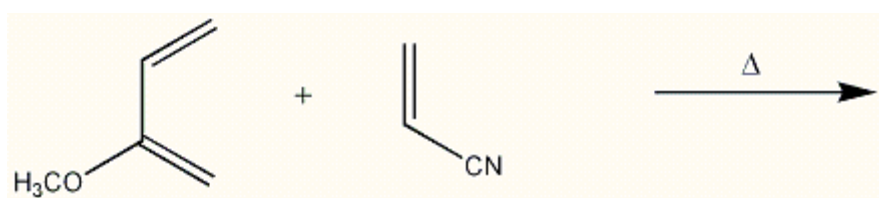


Answer:

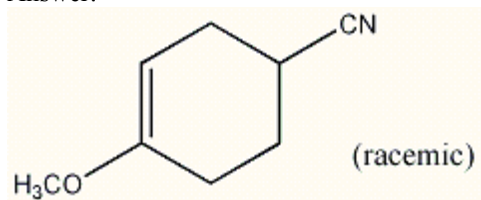


Diff: 3

82) Provide the major organic product of the following reaction.

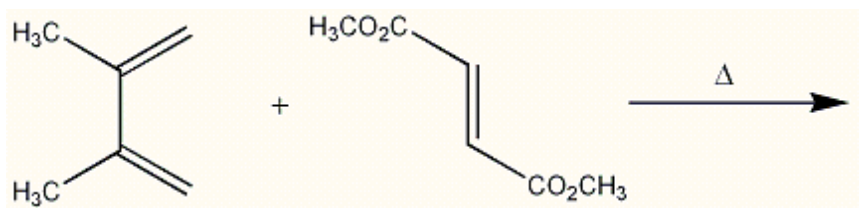


Answer:

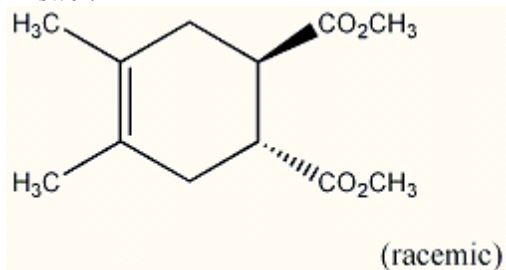


Diff: 3

83) Provide the major organic product of the following reaction.

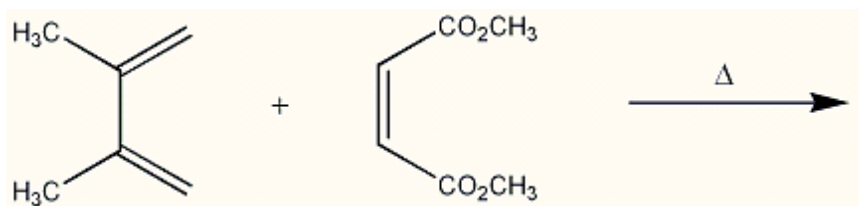


Answer:

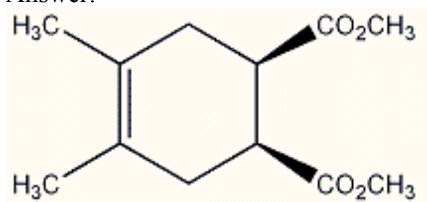


Diff: 3

88) Provide the major organic product of the following reaction.



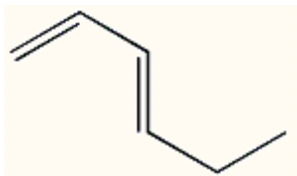
Answer:



Diff: 3

89) Draw (E)-1,3-hexadiene in its s-cis conformation.

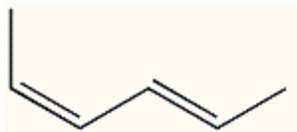
Answer:



Diff: 2

90) Draw the most stable conformation of (2Z,4E)-2,4-hexadiene.

Answer:



Diff: 2

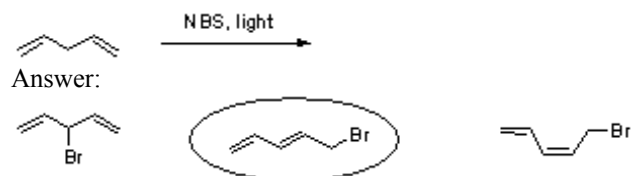
92) Which substrate would react most rapidly in an S_N2 reaction?

- A) $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{Br}$
- B) $\text{BrCH}_2\text{CH}_2\text{CH}=\text{CHCH}_3$
- C) $\text{CH}_3\text{CHBrCH}=\text{CH}_2\text{CH}_3$
- D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CHBr}$

Answer: A

Diff: 2

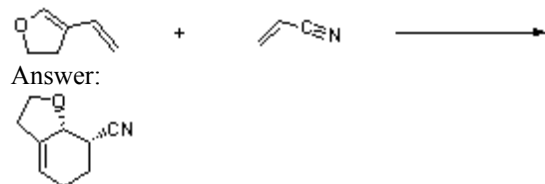
93) Three halogenated organic products result from the reaction below. Draw the structure of each product and then circle the most stable product.



Answer:

Diff: 3

94) Assuming kinetic conditions, provide the correct stereochemistry and regiochemistry of the major product of the following reaction.



Answer:

Diff: 3