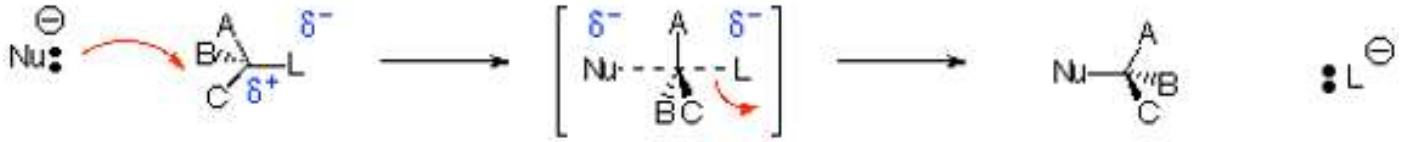
Substitution and Elimination Reactions

Nucleophilic Substitution Reactions - S_N2 Reaction:



Reaction is:
Stereospecific (Walden Inversion of configuration)
Concerted - all bonds form and break at same time
Bimolecular - rate depends on concentration of both nucleophile and substrate

Substrate:
Best if primary (one substituent on C bearing leaving group)

works if secondary, fails if tertiary

Nucleophile:
Best if more reactive (i.e. more anionic or more basic)

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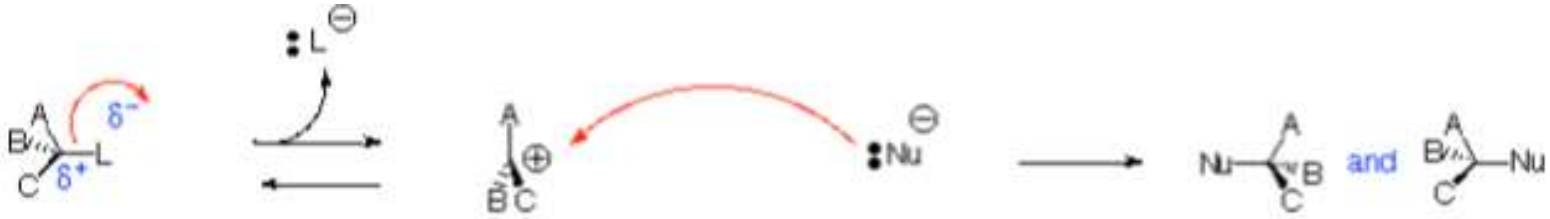
Nucleophilic Substitution Reactions – S_N1 Reaction:



Reaction is:
Non-stereospecific (attack by nucleophile occurs from both sides)

Non-concerted - has carbocation intermediate

Unimolecular - rate depends on concentration of only the substrate

Substrate:

Best if tertiary or conjugated (benzylic or allylic) carbocation can be formed as leaving group departs

never primary

Nucleophile: Best if more reactive (more anionic or more basic)

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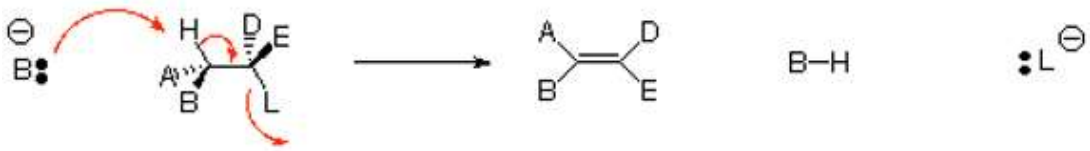
Elimination Reactions - E2 Reaction:



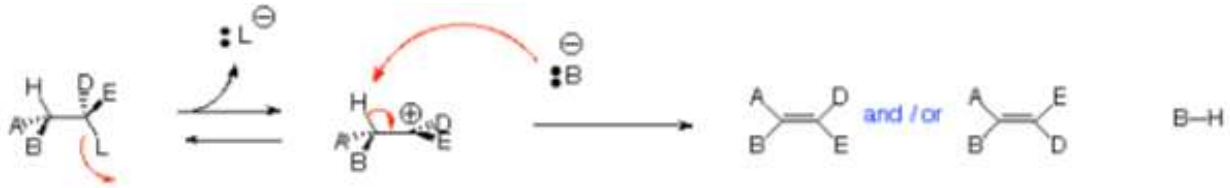
Reaction is:
Stereospecific (Anti-periplanar geometry preferred, Syn-periplanar geometry possible)

Concerted - all bonds form and break at same time

Bimolecular - rate depends on concentration of both base and substrate

Favoured by strong bases

Elimination Reaction – E1 Reaction:



Reaction is:
Non-stereospecific- follows Zaitsev (Saytseff) Rule

Non-concerted - has carbocation intermediate - favoured for tertiary leaving groups

Unimolecular - rate depends on concentration of only the substrate

Does not occur with primary alkyl halides (leaving groups)

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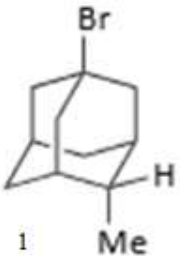
Which of the following molecules are chiral?



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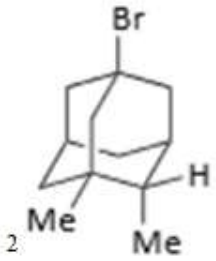

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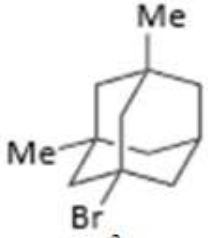

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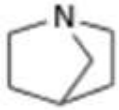

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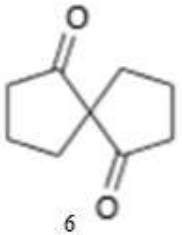

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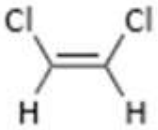

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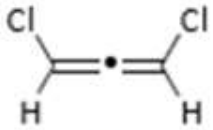

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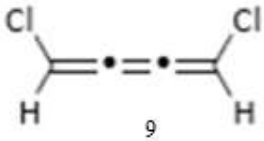

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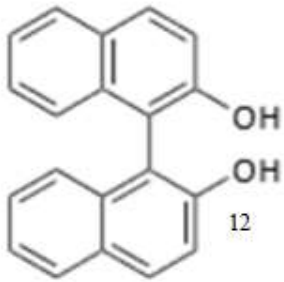

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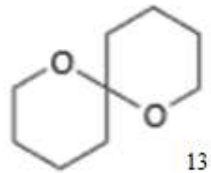

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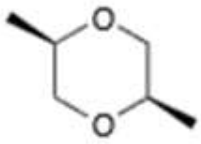

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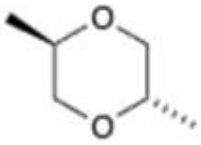

15

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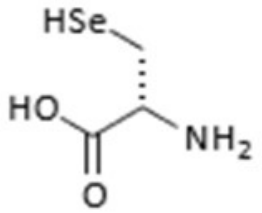
Using the Cahn-Ingold-Prelog sequence rule assign R or S, or E or Z, stereochemical descriptors to the following molecule.



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1. Two isomeric forms of a saturated hydrocarbon
(a) have the same structure.
(b) have different compositions of elements.
(c) have the same molecular formula.
(d) have a different content of the isotopes of hydrogen.
(e) react vigorously with one another.

2. Which of the following hydrocarbons does not have isomers?
(a) C_7H_{16}
(b) C_6H_{14}
(c) C_5H_{10}
(d) C_4H_8
(e) C_3H_8

3. The name of the alkane isomer of cis-3-hexene is:
(a) 2-methylpentane
(b) 3-methylpentane
(c) n-hexane
(d) 2,3-dimethylbutane
(e) cyclohexane

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4. How many aromatic isomers of dibromobenzene exist?
(a) 2
(b) 3
(c) 4
(d) 6
(e) 8

5. Which one of the following compounds is an isomer of $CH_3CH_2CH_2CH_2OH$?
(a) $CH_3CH_2CH_2OH$
(b) $CH_3CH(OH)CH_3$
(c) $CH_3CH_2CH_2CHO$ (Note: This is one way to write an aldehyde.)
(d) $CH_3CH_2CH_2CH_3$
(e) none of the above

6. Which of the following compounds is a functional group isomer of C_2H_5OH, ethanol (ethyl alcohol)?
(a) ethanal, CH_3CHO
(b) acetic acid, CH_3COOH
(c) diethyl ether, $(C_2H_5)_2O$
(d) dimethyl ether, $(CH_3)_2O$
(e) propanol, C_3H_7OH

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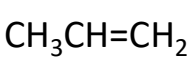
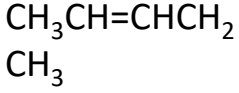
7. For which of the compounds below are cis-trans isomers possible?

(a) only 2
(b) both 1 and 2
(c) both 2 and 3
(d) all three
(e) only 3



(1)



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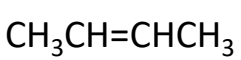

(3)

8. Which of the following does NOT exhibit geometric isomerism?

(a) 4-octene
(b) 2-pentene
(c) 3-hexene
(d) 2-hexene
(e) 1-hexene

9. Which of the following compounds displays optical isomerism?

(a) $CH_2(OH)$-$CH_2(OH)$
(b) CH_3-CHCl-COOH
(c) CH_2=CHCl
(d) CHCl=CHCl
(e) CH_3-O-C_2H_5

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10. How many isomeric alkanes of the molecular formula C_5H_{12} are there?
(a) 1
(b) 2
(c) 3
(d) 4
(e) 5

11. How many alcohols are structural isomers with the formula: $C_5H_{11}OH$?
(a) 5
(b) 6
(c) 7
(d) 8
(e) 9

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