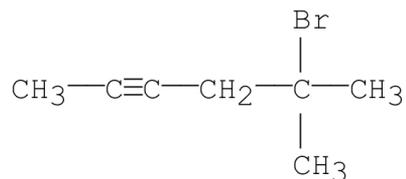


Name _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) What is the IUPAC name for the following alkyne? 1) _____



- A) 5-Bromo-2-heptyne
 B) 5-Bromo-5,5-dimethylhexyne
 C) 5-Bromo-5-methyl-2-hexyne
 D) 3-Bromo-5-heptyne
 E) 2-Bromo-2-methyl-4-hexyne

Answer: C

2) How many distinct terminal alkynes exist with a molecular formula of C_5H_8 ? 2) _____

- A) 1 B) 2 C) 3 D) 4 E) 5

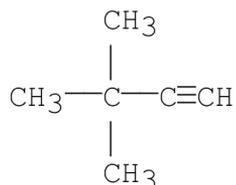
Answer: B

3) How many distinct internal alkynes exist with a molecular formula of C_6H_{10} ? 3) _____

- A) 1 B) 2 C) 3 D) 4 E) 5

Answer: C

4) What is the common name for the following alkyne? 4) _____



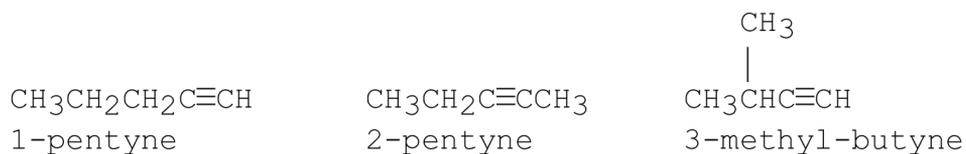
- A) neohexyne
 B) trimethylpropyne
 C) trimethylacetylene
 D) isopropylacetylene
 E) *tert*-butylacetylene

Answer: E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

5) Write structures and give IUPAC names for all alkynes with molecular formula C_5H_8 . 5) _____

Answer:



6) Give the IUPAC name for $(\text{CH}_3)_2\text{C}(\text{CH}_2\text{CH}_3)\text{CCCH}(\text{CH}_3)_2$.

6) _____

Answer: 2, 5, 5-trimethyl-3-heptyne

7) Give the IUPAC name for $\text{HCCCH}_2\text{CH}_2\text{CH}_3$.

7) _____

Answer: 1-pentyne

8) Give the IUPAC name for $\text{BrCH}_2\text{CH}_2\text{CCCH}_2\text{CH}_3$.

8) _____

Answer: 1-bromo-3-hexyne

9) Draw an acceptable structure for acetylene.

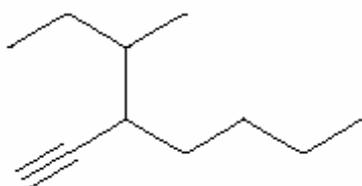
9) _____

Answer: $\text{H}-\text{C}\equiv\text{C}-\text{H}$

10) Draw an acceptable structure for 3-sec-butyl-1-heptyne.

10) _____

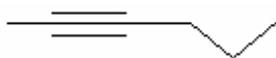
Answer:



11) Draw an acceptable structure for 2-hexyne.

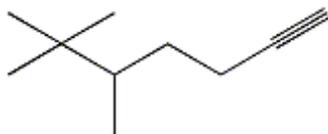
11) _____

Answer:



12) Provide the systematic name of the compound shown.

12) _____



Answer: 5,6,6-trimethyl-1-heptyne

13) Give the systematic name for the alkyne $\text{Cl}_3\text{CCH}_2\text{CH}_2\text{CCCH}_3$.

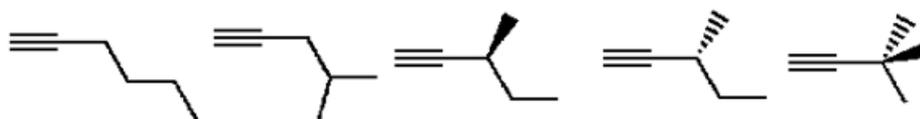
13) _____

Answer: 6,6,6-trichloro-2-hexyne

14) Provide the structure of all distinct terminal alkynes with a molecular formula of C_6H_{10} .

14) _____

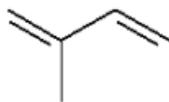
Answer:



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

15) Give the IUPAC name for the following compound.

15) _____

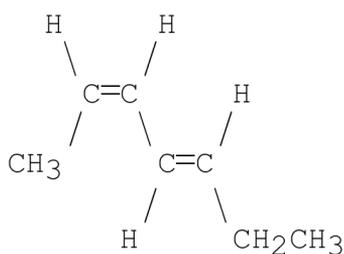


- A) 2-methyl-1,3-butadiene
- B) isobutadiene
- C) 3-methyl-1,3-butadiene
- D) isoprene
- E) 2-methyl-2,3-butadiene

Answer: A

16) What is the IUPAC name for the following compound?

16) _____



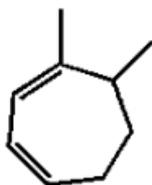
- A) 2Z,4Z-2,4-heptadiene
- B) *trans, trans*-2,4-heptadiene
- C) 2E,4E-2,4-heptadiene
- D) *cis, cis*-2,4-heptadiene
- E) *cis, trans*-2,4-heptadiene

Answer: E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) Give the systematic name of the compound shown below.

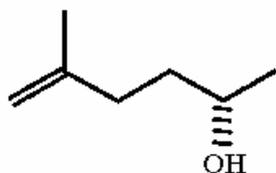
17) _____



Answer: 1,7-dimethyl-1,3-cycloheptadiene

18) Give the systematic name of the compound shown below.

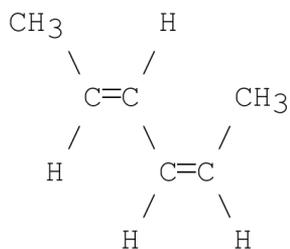
18) _____



Answer: (S)-5-methyl-5-hexen-2-ol

19) Name the following compound:

19) _____

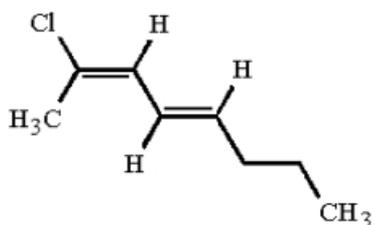


Answer: (2E,4Z)-2,4-hexadiene or *trans, cis*-2,4-hexadiene or (2Z,2E)-2,4-hexadiene or *cis, trans*-2,4-hexadiene

20) Provide the structure of (2E,4E)-2-chloro-2,4-octadiene.

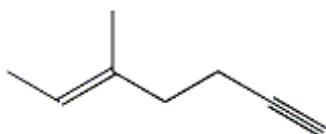
20) _____

Answer:



21) Provide the systematic name of the compound shown.

21) _____



Answer: (E)-5-methyl-5-hepten-1-yne

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

22) Which of the following improperly describes the physical properties of an alkyne?

22) _____

A) relatively nonpolar

B) insoluble in most organic solvents

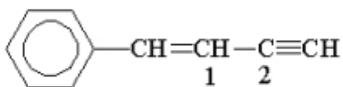
C) less dense than water

D) nearly insoluble in water

Answer: B

23) What is the hybridization of the carbon atoms numbered 1 and 2 respectively in the following structure?

23) _____



A) sp^2, sp

B) sp^3, sp^2

C) sp^2, sp^2

D) sp, sp

E) sp, sp^2

Answer: A

- 24) Which of the following statements is not true about propyne, HC≡C—CH₃? 24) _____
- A) It contains six sigma bonds.
 - B) The C—C—C bond angle is 180°.
 - C) The H—C—H bond angle is about 109.5°.
 - D) It contains three pi bonds.
 - E) The pi bond is weaker than the sigma bond.

Answer: D

- 25) The carbon-carbon triple bond of an alkyne is composed of _____. 25) _____
- A) three σ bonds
 - B) one σ bond and two π bonds
 - C) three π bonds
 - D) two σ bonds and one π bond

Answer: B

- 26) What are the hybridizations of the carbon atoms numbered 1 and 2 in the structure below? 26) _____
- 1 2
- H₃C-CH=CH-C≡C-H

- A) sp², sp²
- B) sp³, sp²
- C) sp, sp
- D) sp², sp

Answer: C

- 27) What two atomic orbitals or hybrid atomic orbitals overlap to form the carbon-carbon σ bond in ethyne? 27) _____
- A) sp³—sp³
 - B) s—s
 - C) sp—sp
 - D) sp²—sp²
 - E) p—p

Answer: C

- 28) Which of the following statements correctly describes the general reactivity of alkynes? 28) _____
- A) Alkynes are generally more reactive than alkenes.
 - B) Alkynes reacts as electrophiles, whereas alkenes reacts as nucleophiles.
 - C) The σ bonds of alkynes are higher in energy than the π bonds and are thus more reactive.
 - D) Unlike alkenes, alkynes fail to undergo electrophilic addition reactions.
 - E) An alkyne is an electron-rich molecule and therefore reacts as a nucleophile.

Answer: E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 29) Although you might expect 1-propyne to be more reactive than 1-propene in electrophilic addition reactions, the reverse is true. Explain this using your knowledge of the mechanism of electrophilic additions to both alkynes and alkenes. 29) _____

Answer: When HCl is added to an alkene, a secondary carbocation intermediate is



formed, CH₃CHCH₃. When HCl is added to an alkyne, a vinylic cation is formed

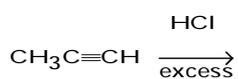


as an intermediate, CH₃C=CH₂. Alkynes are less stable than alkenes but vinylic carbocations are less stable than secondary carbocations. Thus, alkenes are more reactive than alkynes since the difference in stabilities between the carbocations is greater than the difference in stabilities between the alkene and alkyne.

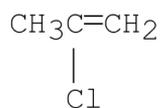
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

30) What is the major product of the following reaction?

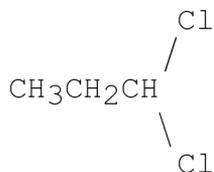
30) _____



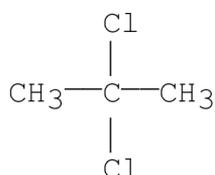
B)



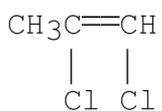
C)



D)



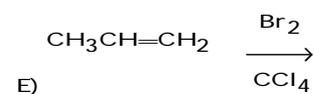
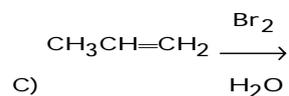
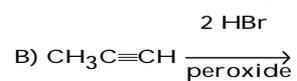
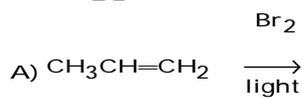
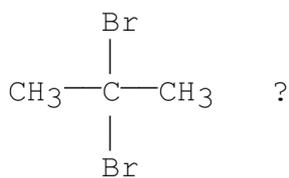
E)



Answer: D

31) Which of the following is the best synthesis of 2, 2-dibromopropane

31) _____



Answer: D

32) In the addition of hydrogen bromide to alkynes in the absence of peroxides, which of the following species is believed to be an intermediate? 32) _____

A) bromonium ion
B) vinyl anion
C) vinyl cation
D) carbene
E) vinyl radical

Answer: C

33) _____ is produced when 1 equivalent of HBr is added to 1-hexyne in the presence of peroxides. 33) _____

A) *E*-1-bromo-1-hexene
B) *E*-2-bromo-2-hexene
C) 2-bromo-1-hexene
D) a mixture of *E* and *Z* isomers of 1-bromo-1-hexene
E) *Z*-1-bromo-1-hexene

Answer: D

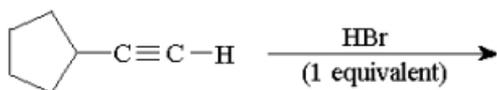
34) Which of the following compounds is the major product when 1-hexyne is treated with excess HBr? 34) _____

A) 1,2-dibromohexene
B) 1,1-dibromohexane
C) 2,2-dibromohexane
D) 1,2-dibromohexane
E) 1,1-dibromohexene

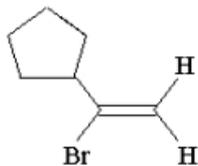
Answer: C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

35) Provide the structure of the major organic product(s) in the reaction below. 35) _____

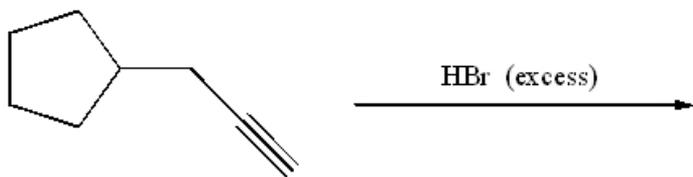


Answer:

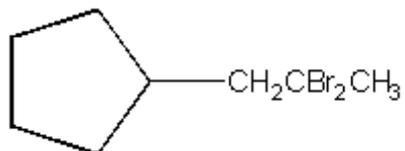


36) Provide the structure of the major organic product of the following reaction.

36) _____

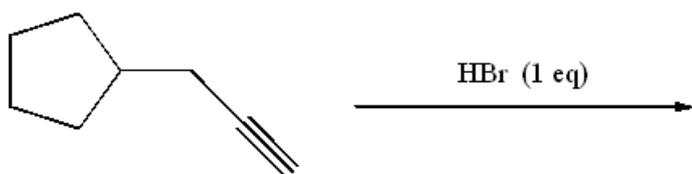


Answer:

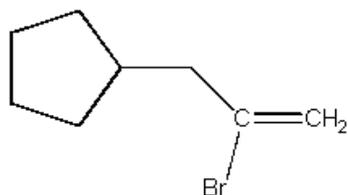


37) Provide the structure of the major organic product of the following reaction.

37) _____



Answer:

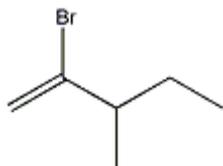


38) Provide the major organic product in the reaction below.

38) _____



Answer:

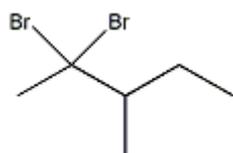


39) Provide the major organic product in the reaction below.

39) _____



Answer:

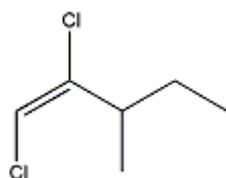


40) Provide the major organic product in the reaction below.

40) _____



Answer:

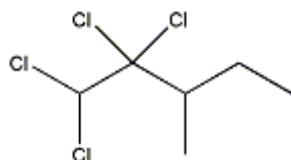


41) Provide the major organic product in the reaction below.

41) _____

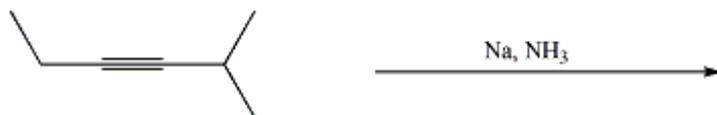


Answer:

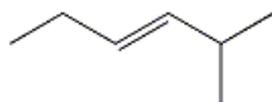


42) Provide the major organic product in the reaction below.

42) _____



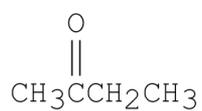
Answer:



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

43) Which of the following are enol forms of 2-butanone,

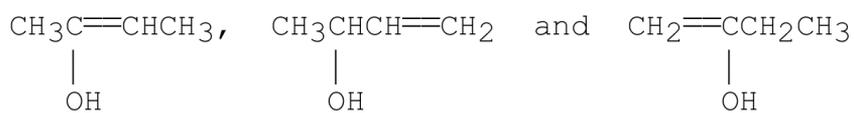
43) _____



A)



B)



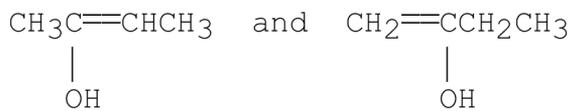
C)



D)



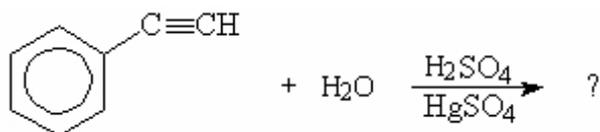
E)



Answer: E

44) Which of the following is the final and major product of this reaction?

44) _____



- I.
- II.
- III.
- IV.
- V.

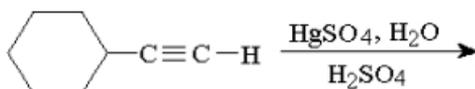
A) I B) II C) III D) IV E) V

Answer: A

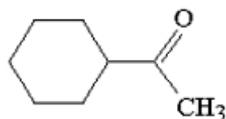
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

45) Provide the structure of the major organic product(s) in the reaction below.

45) _____

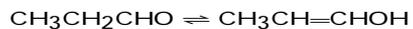


Answer:



46) For the reaction below indicate whether the equilibrium constant will be greater than 1 or less than 1.

46) _____

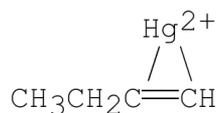


Answer: < 1

47) Provide the structure of the intermediate which forms in the first step of the reaction of 1-butyne with water in the presence of H₂SO₄/HgSO₄.

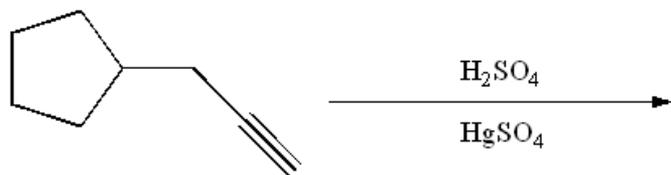
47) _____

Answer:

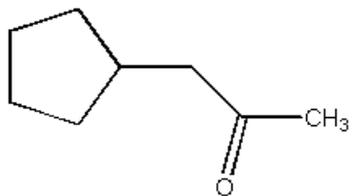


48) Provide the structure of the major organic product of the following reaction.

48) _____

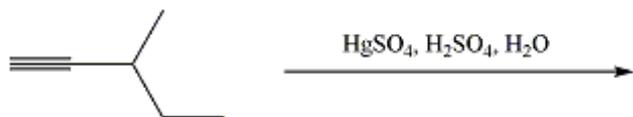


Answer:

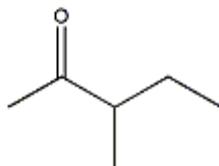


49) Provide the major organic product in the reaction below.

49) _____



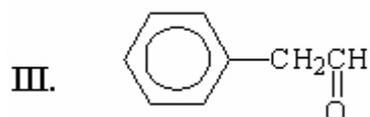
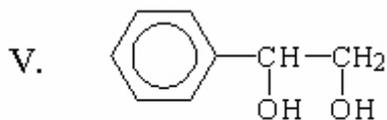
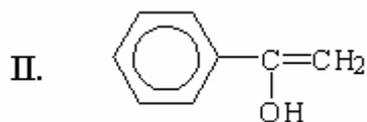
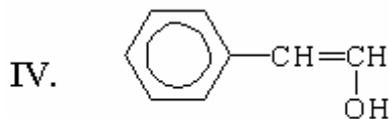
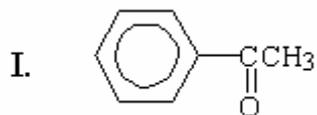
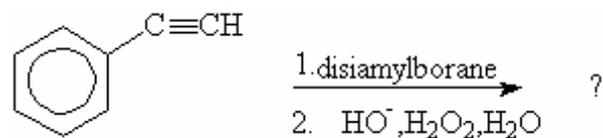
Answer:



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

50) Which of the following is the final and major product of this reaction?

50) _____



A) I

B) II

C) III

D) IV

E) V

Answer: C

51) Which of the alkyne addition reactions below involves an enol intermediate?

51) _____

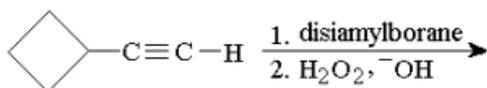
- A) hydroboration/oxidation
- B) treatment with HgSO₄ in dilute H₂SO₄
- C) hydrogenation
- D) both A and B
- E) both A and C

Answer: D

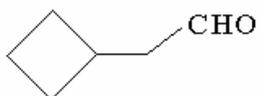
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

52) Provide the structure of the major organic product(s) in the reaction below.

52) _____

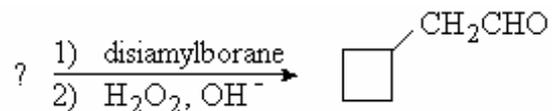


Answer:



53) Complete the following reaction.

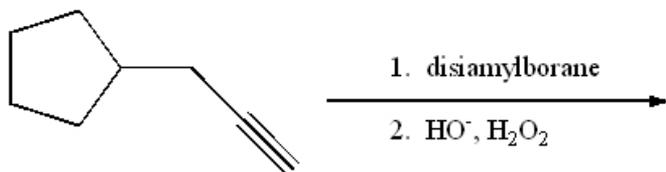
53) _____



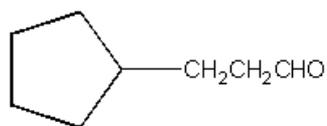
Answer: ethynylcyclobutane

54) Provide the structure of the major organic product of the following reaction.

54) _____

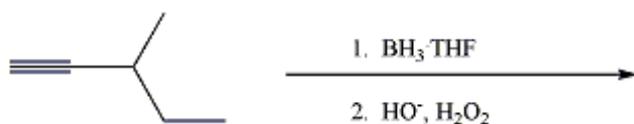


Answer:

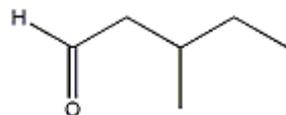


55) Provide the major organic product in the reaction below.

55) _____



Answer:



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

56) The reagent needed to convert 2-butyne to *cis*-2-butene is:

56) _____

- A) Li/NH₃
- B) H⁺/Zinc dust
- C) Na/NH₃
- D) H₂/Lindlar's catalyst
- E) H₂/Pt

Answer: D

57) The reagent needed to convert 2-butyne to *trans*-2-butene is:

57) _____

- A) H₂/Pt
- B) H₂/Lindlar's catalyst
- C) Li/NH₃
- D) Na/NH₃
- E) C or D

Answer: E

58) A mixture of 1-heptyne, 2-heptyne, and 3-heptyne was hydrogenated in the presence of a platinum catalyst until hydrogen uptake ceased. If one assumes that the hydrogenation went to completion, how many distinct seven-carbon hydrocarbons were produced? 58) _____

- A) 1 B) 8 C) 3 D) 6 E) 2

Answer: A

59) In the reduction of alkynes using sodium in liquid ammonia, which of the species below is not believed to be an intermediate in the commonly accepted mechanism? 59) _____

- A) vinyl anion B) vinyl cation C) vinyl radical D) radical anion

Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

60) Provide the major organic product in the reaction below. 60) _____

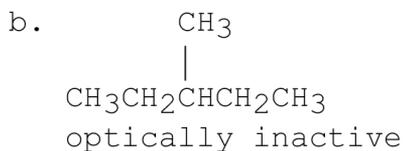
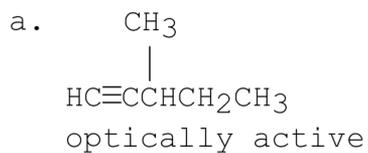


Answer:

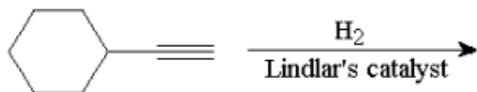


61) An optically active compound (A), C₆H₁₀, reacts with H₂/Ni to produce compound (B), C₆H₁₄. (B) is optically inactive. Deduce the structures of (A) and (B). 61) _____

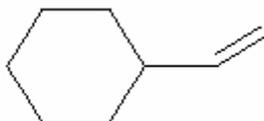
Answer:



62) Provide the structure of the major organic product(s) in the reaction below. 62) _____

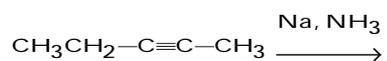


Answer:

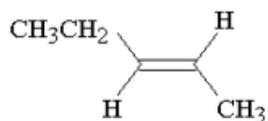


63) Provide the structure of the major organic product(s) in the reaction below.

63) _____

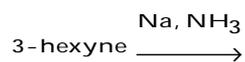


Answer:



64) Complete the following reaction.

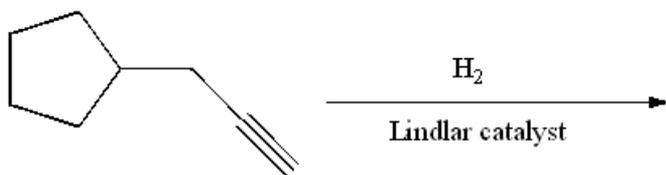
64) _____



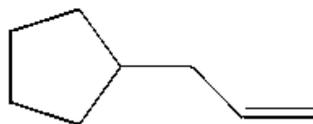
Answer: trans-3-heptene

65) Provide the structure of the major organic product of the following reaction.

65) _____

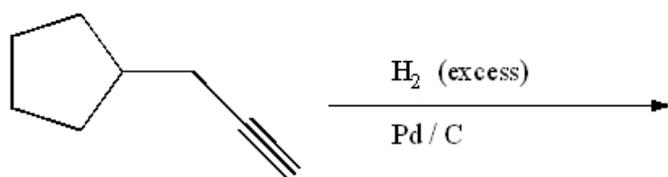


Answer:

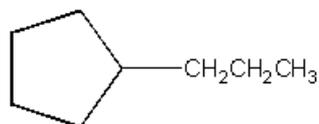


66) Provide the structure of the major organic product of the following reaction.

66) _____

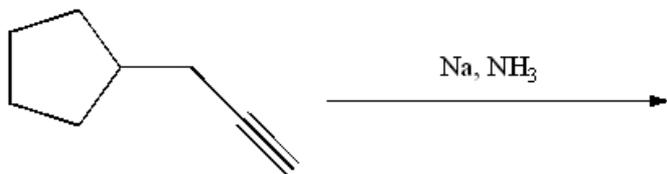


Answer:

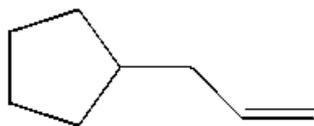


67) Provide the structure of the major organic product of the following reaction.

67) _____



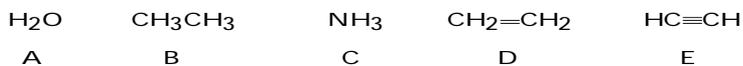
Answer:



MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

68) Which is the correct order of decreasing acidity in the following compounds?

68) _____

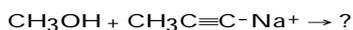


- A) E > A > C > B > D
- B) A > C > E > D > B
- C) E > D > B > A > C
- D) A > E > D > B > C
- E) A > E > C > D > B

Answer: E

69) What are the products of the following reaction,

69) _____



- A) $\text{CH}_3\text{OC}\equiv\text{CH} + \text{NaCH}_3$
- B) $\text{CH}_3\text{C}\equiv\text{CH} + \text{CH}_3\text{O}^-\text{Na}^+$
- C) $\text{CH}_3\text{C}\equiv\text{COCH}_3 + \text{NaOH}$
- D) $\text{CH}_3\text{C}\equiv\text{CCH}_3 + \text{NaOH}$
- E) no reaction

Answer: B

70) Which of the species below is less basic than acetylide?

70) _____

- A) CH₃Li
- B) CH₃ONa
- C) NaOH
- D) both B and C
- E) all of the above

Answer: D

71) Among the compounds water, 1-butyne, 2-butyne, and ethane, which are stronger acids than ammonia?

71) _____

- | | |
|------------------------|--------------------------|
| A) water and 1-butyne | B) 1-butyne and 2-butyne |
| C) 1-butyne and ethane | D) water and ethane |

Answer: A

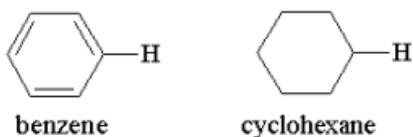
- 72) What type of organic product results when 1-butyne is treated with 6M aqueous NaOH? 72) _____
- A) an alcohol
 - B) a sodium acetylide
 - C) an aldehyde
 - D) an enol
 - E) Not much reaction; most of the alkyne remains unchanged.

Answer: E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 73) Explain why $\text{HC}\equiv\text{N}$ is a stronger acid than $\text{HC}\equiv\text{CH}$. 73) _____
- Answer: Because nitrogen is more electronegative than carbon.

- 74) Which hydrogens are more acidic, those of benzene or those of cyclohexane? Why? 74) _____

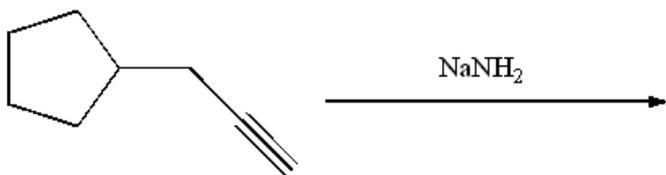


Answer: Benzene. The carbon hybridization of benzene is sp^2 while that of cyclohexane is sp^3 . The more s character in benzene causes its hydrogens to be more acidic than those of cyclohexane.

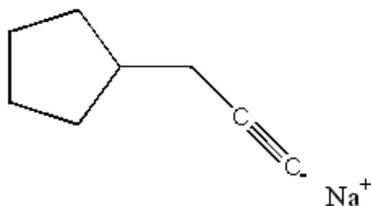
- 75) Why are terminal alkynes more acidic than other hydrocarbons? 75) _____
- Answer: The carbanion which results upon deprotonation of a terminal alkyne has the lone pair of electrons in an sp hybrid orbital. The greater % s character of this orbital gives the orbital a significantly lower energy.

- 76) For the reaction below indicate whether the equilibrium constant will be greater than 1 or less than 1. 76) _____
- $$\text{CH}_3\text{Li} + \text{CH}_3\text{C}\equiv\text{CH} \rightleftharpoons \text{CH}_4 + \text{CH}_3\text{C}\equiv\text{CLi}$$
- Answer: >1

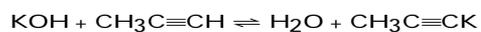
- 77) Provide the structure of the major organic product of the following reaction. 77) _____



Answer:



78) For the reaction below indicate whether the equilibrium constant will be greater than 1 or less than 1. 78) _____



Answer: <1

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

79) What is/are the major organic product(s) of the following reaction, 79) _____

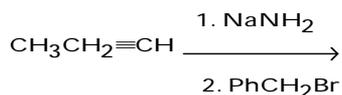


- A) $\text{HC}\equiv\text{CBr}$
- B) $\text{CH}_3\text{C}\equiv\text{CCH}_3$
- C) $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$
- D) $\text{HC}\equiv\text{CCH}_2\text{CH}_2\text{Br}$
- E) $\text{CH}_2=\text{CH}_2 + \text{HC}\equiv\text{CH}$

Answer: C

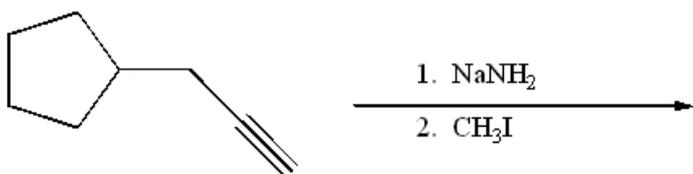
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

80) Provide the structure of the major organic product(s) in the reaction below. 80) _____

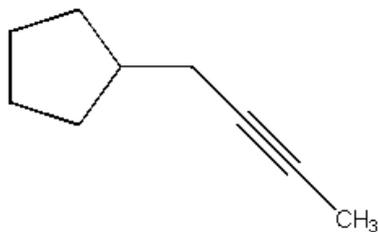


Answer: $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CCH}_2\text{Ph}$

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

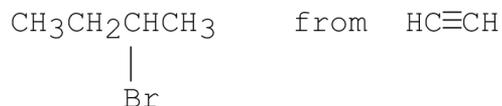


Answer:

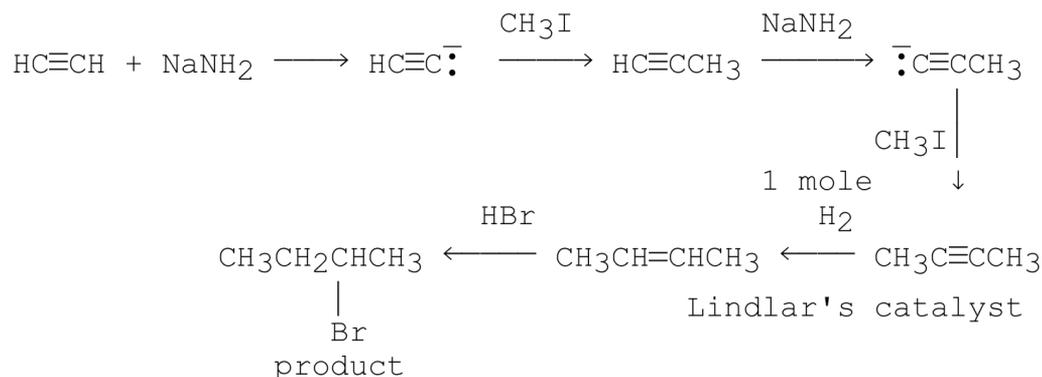


82) Suggest a plausible scheme for the following synthesis

82) _____



Answer:



83) Describe a sequence of reactions by which 3-heptyne can be straightforwardly prepared from acetylene.

83) _____

- Answer: 1) NaNH_2
 2) $\text{CH}_3\text{CH}_2\text{Br}$
 3) NaNH_2
 4) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

84) Describe a sequence of reactions by which *meso*-2, 3-dibromobutane can be straightforwardly prepared from propyne.

84) _____

- Answer: 1) NaNH_2
 2) CH_3Br
 3) Na, NH_3
 4) $\text{Br}_2, \text{CCl}_4$

85) Describe a sequence of reactions by which butylbenzene can be straightforwardly prepared from phenylacetylene.

85) _____

- Answer: 1) NaNH_2
 2) $\text{CH}_3\text{CH}_2\text{Br}$
 3) H_2, Pt

86) Describe a sequence of reactions by which $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCH}_2\text{CH}_3$ can be straightforwardly prepared from 1-butyne.

86) _____

- Answer: 1) NaNH_2
 2) $\text{CH}_3\text{CH}_2\text{Br}$
 3) $\text{HgSO}_4, \text{H}_2\text{O}, \text{H}_2\text{SO}_4$

87) Describe a sequence of reactions by which *trans*-2-pentene can be straightforwardly prepared from propyne. 87) _____

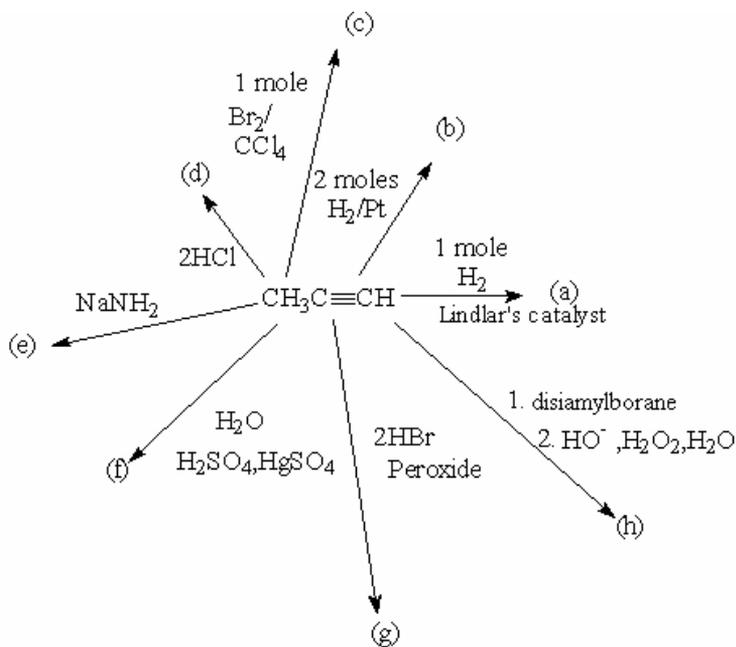
- Answer: 1) NaNH_2
2) $\text{CH}_3\text{CH}_2\text{Br}$
3) Na, NH_3

88) Describe a sequence of reactions by which the aldehyde $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$ could be prepared from acetylene. 88) _____

- Answer: 1) NaNH_2
2) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
3) disiamylborane
4) $\text{H}_2\text{O}_2, ^-\text{OH}$

89) Describe a sequence of reactions by which *cis*-2-pentene could be prepared from acetylene. 89) _____

- Answer: 1) NaNH_2
2) $\text{CH}_3\text{CH}_2\text{Br}$
3) NaNH_2
4) CH_3Br
5) H_2 , Lindlar's catalyst



Answer:

