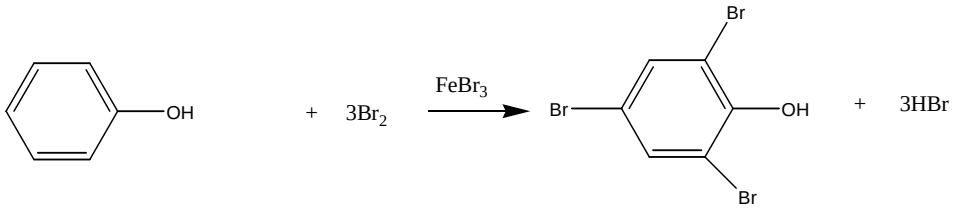
# CH1012 Tutorial 8 Answers

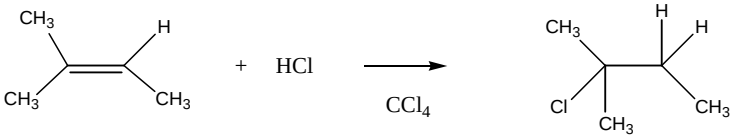
1. Identify each of the following reactions as addition, elimination or substitution reactions.

(i)



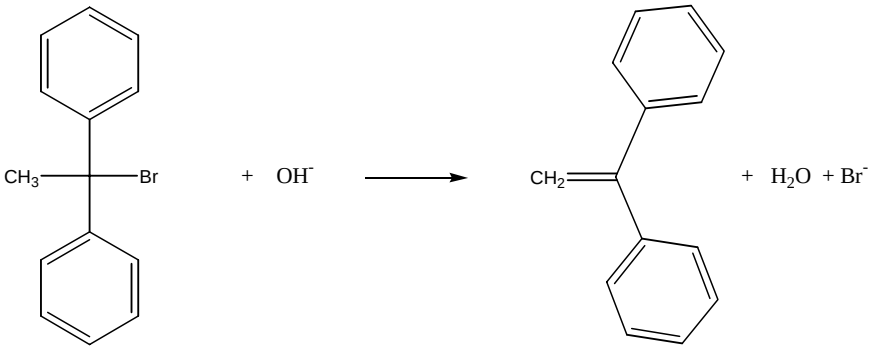

electrophilic aromatic substitution (of H for Br)

(ii)




electrophilic addition of HCl across the double bond

(iii)




elimination of HBr from the alkyl halide to give the alkene

2. Define each of the following, illustrate with an example of each:

(i) carbocation $CH_3^+$

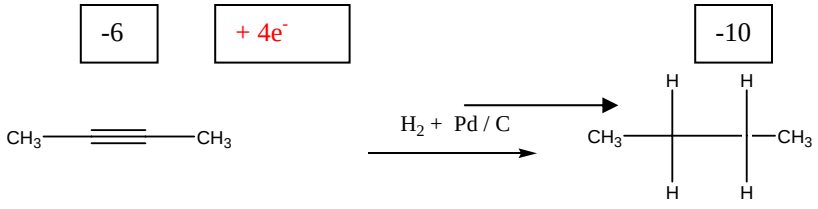
a carbon centre which is positively charged, the formal electron count of the valence electrons assigned to carbon will be 3 instead of 4.

(ii) radical $CH_3^{\cdot}$

A molecule or atom which has an unpaired electron. In organic chemistry this will be a carbon centre where a bond has broken homolytically leaving the carbon with it's full 4 valence electrons but in total around the carbon there will only be 7 electrons, 1 must therefore be unpaired.

3. For the following half reactions work out if the organic transformation is a redox process and if it is state if it is a reduction or a oxidation.

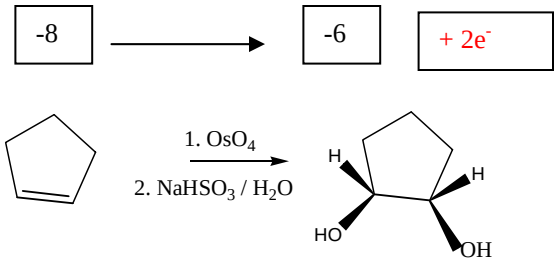
(i)




-3 0 0 -3 -3 -2 -2 -3

reduction but-2-yne butane

(ii)




CHCH2CH2CH2CH

CH(OH)CH2CH2CH2CH(OH)

-1 -2 -2 -2 -1 0 -2 -2 -2 0

Oxidation cyclopentene cyclopentan-1,2-diol

4. Name a chemical test that could be used to distinguish between propane and propyne.
Write down equations for the reaction you propose and describe the differences you would expect to see with your chemical test.

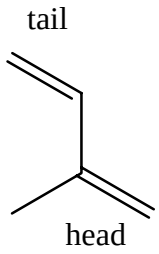
Chemical Test: Halogenation (bromination).

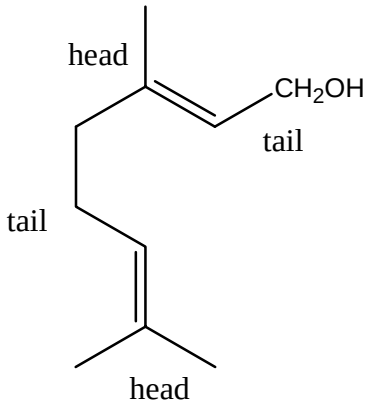
1) Propane: $C_3H_8 + Br_2$ -> no reaction (dark)

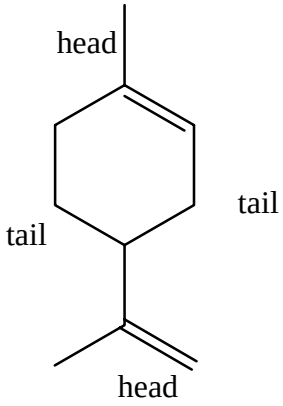
2) Propyne: $CH_3C{\equiv}CH + 2Br_2$ -> $CH_3CBr_2CHBr_2$

When the alkyne was bubbled through an aqueous bromine solution in the dark the yellow colour of the bromine would be lost as it reacted with the propyne to form the tetrabromopropane.

5. Draw the following molecules: isoprene, geraniol, limonene.
Illustrate the composition of geraniol and limonene in terms of linked isoprene units.




Isoprene geraniol limonene

A monoterpene contains 10 carbons in the skeleton (2 isoprenes).
A sesquiterpene contains 15 carbons in the skeleton (3 isoprenes) - farnesol.

6. What is the major difference between the polymerisation reaction that results in the formation of proteins and the polymerisation that results in the formation of high density polyethylene (HDPE)?

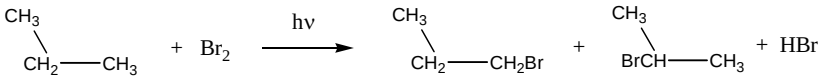
A protein is formed by a condensation polymerisation reaction where a water molecule is eliminated from two monomers. This is an example of step-growth polymerisation.

$RCH(COOH)NH_2 + NH_2\,R'CH(COOH) \rightarrow RCH(CO)NHR'CH(COOH) + H_2O$

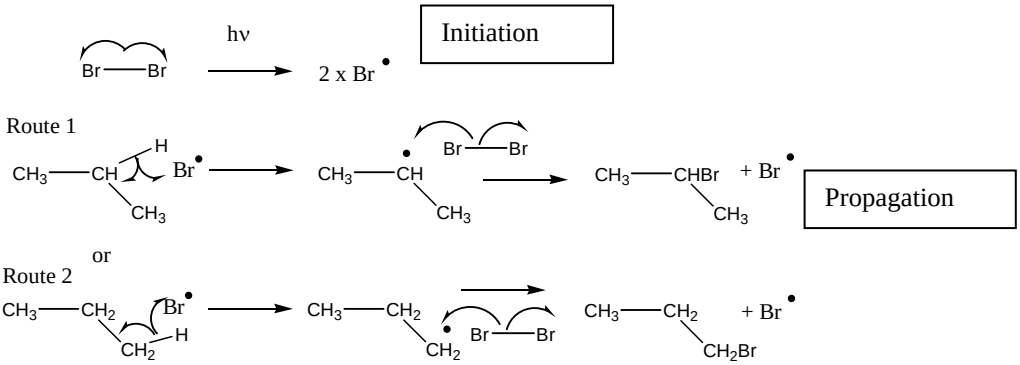
Polyethylene is formed by addition polymerisation that occurs via a radical mechanism

| initiation, | propagation, | termination. |
|---|---|---|
| $R\text{-}C\text{-}C^{\cdot}$ | $R\text{-}C\text{-}C^{\cdot} + RC{=}CR$ | $R\text{-}C\text{-}C^{\cdot} + R\text{-}C\text{-}C^{\cdot}$ |

7. Describe in detail the mechanism for the formation of 2-bromopropane from bromine and propane this reaction. Explain why this is the major product formed.




*Relative product distribution*: 8% 92%




The regioselectivity is obtained in the propagation step where there is a lower activation energy for route 1 where the secondary hydrogens are being abstracted compared with route 2 where the primary hydrogens are being abstracted. This results in a faster rate of formation of the secondary propyl radical and as the reaction with bromine is rapid a preferential formation of the 2-bromopropane product.

Some of the major product will also form in the termination steps.