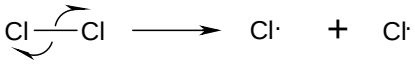
MEGA LECTURE

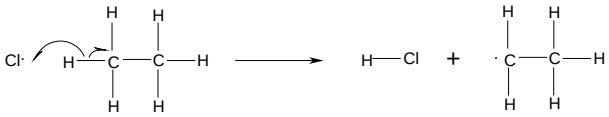
Answers to Topic 8 Exercises

Topic 8 Exercise 1

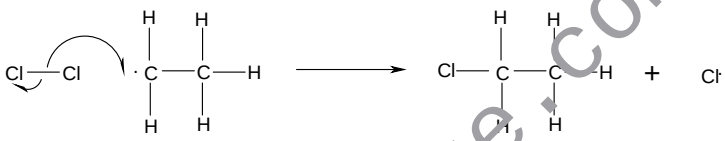
1. i) break a covalent bond in such a way that one electron goes to each atom
   ii) a species with an unpaired electron
   iii) replacement of one atom or group atoms by another
2. a) initiation



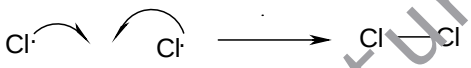
propagation



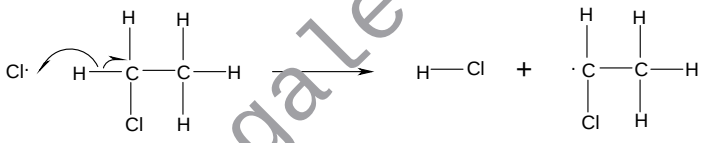
propagation

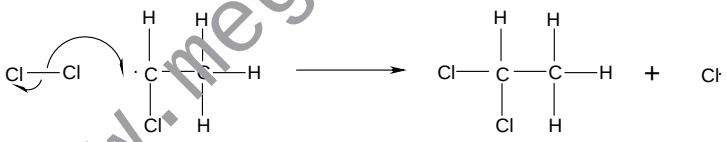


termination

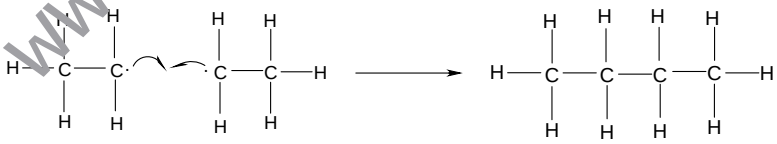


b) i)





ii)



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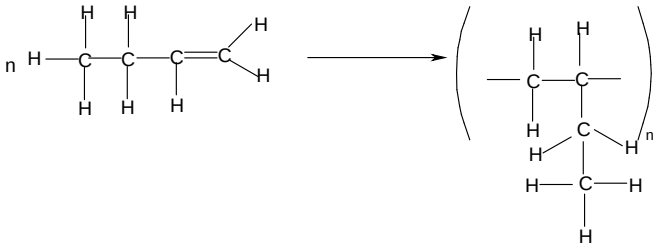
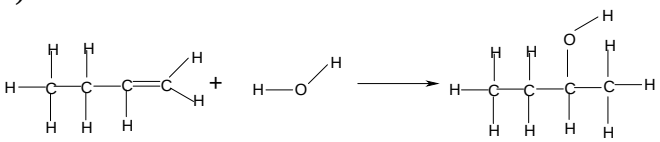
Topic 8 Exercise 2

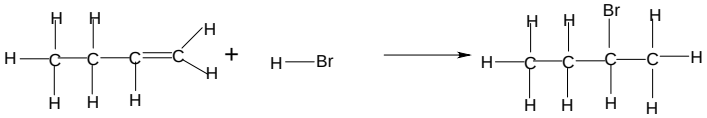
1. a)



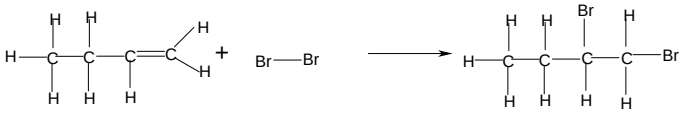
b)



c)

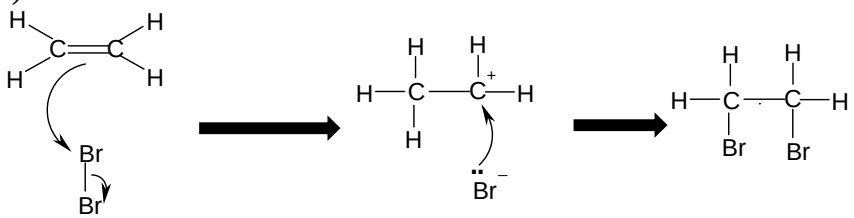


d)

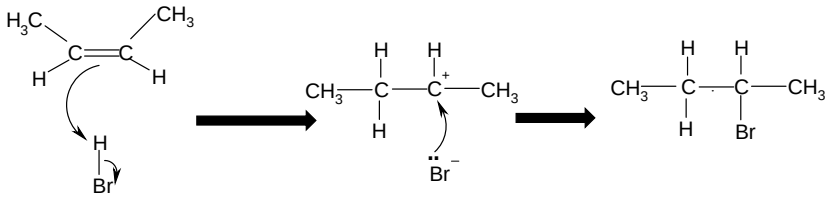


2. a) the C=C bond has a high electron density
to which electron seeking species are attracted

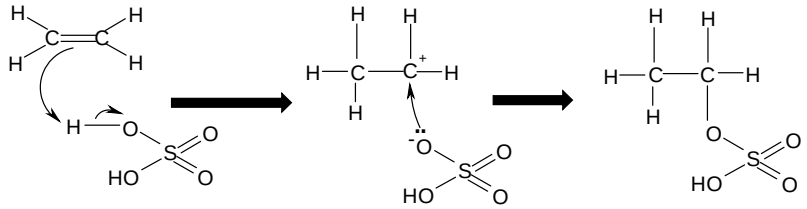
b) i)



ii)

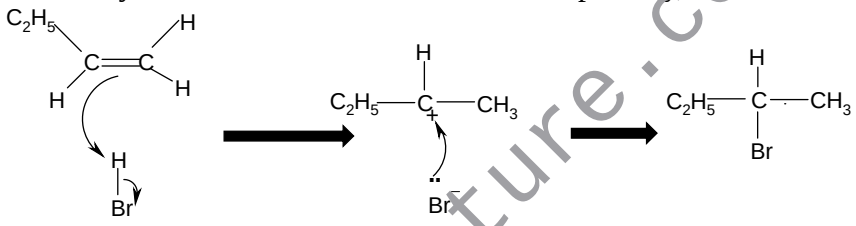


iii)

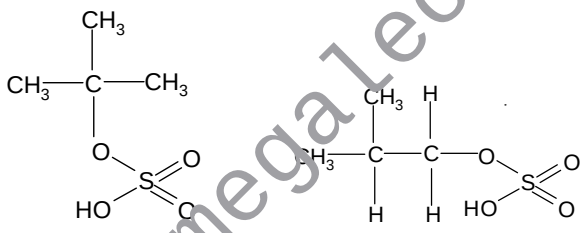


c) the electrons in the Br-Br bond
are distorted by the electron density on the C=C bond
which induce a temporary dipole on the Br-Br bond

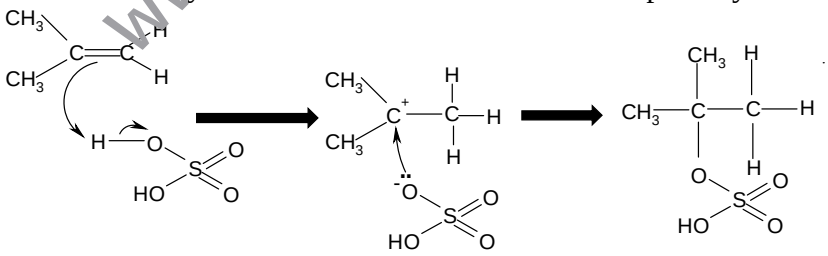
3. a) 2-bromobutane and 1-bromobutane
2-bromobutane is the major product
as it is produced via a secondary carbocation intermediate
and 1-bromobutane is produced via a primary carbocation intermediate
secondary carbocations are more stable than primary carbocations



b)



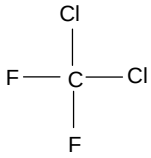
major product minor product
The major product is formed via a tertiary carbocation
The minor product is formed via a primary carbocation
Tertiary carbocations are more stable than primary carbocations



MEGA LECTURE

Topic 8 Exercise 3

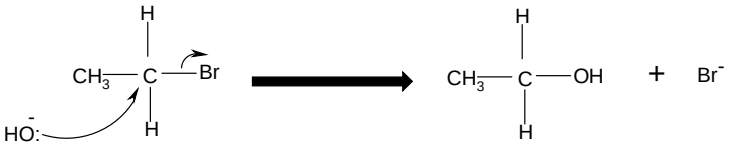
1. a)



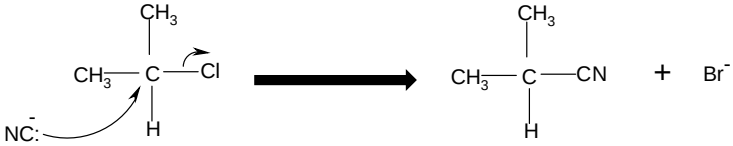
b)

2. a) The halogen is more electronegative than carbon
so the C-X bond is polar
so the carbon atom has a partial positive charge
to which the lone pair of electrons on a nucleophile can be attracted

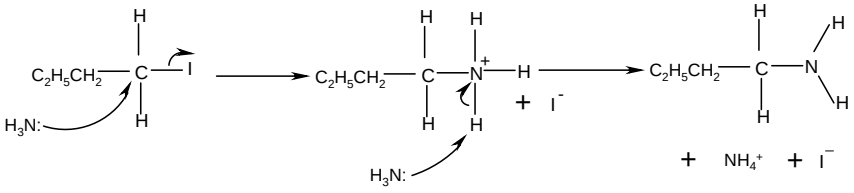
b) i) $C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$



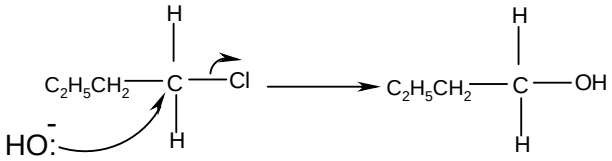
ii) $CH_3CHClCH_3 + KCN \rightarrow CH_3CH(CN)CH_3$



iii) $C_2H_5CH_2CH_2I + 2NH_3 \rightarrow C_2H_5CH_2CH_2NH_2 + NH_4I$

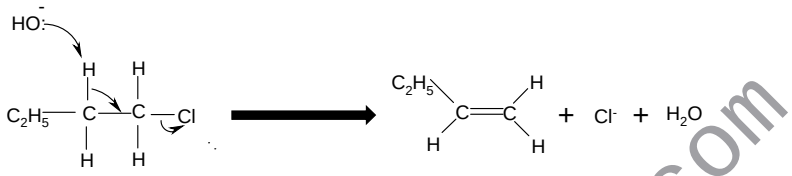


3. nucleophilic substitution



hydroxide ion is a nucleophile
aqueous conditions
warm

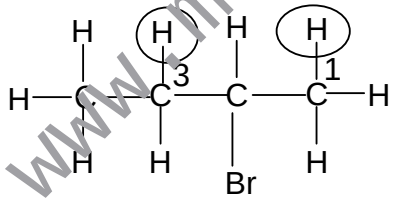
elimination



hydroxide ion is a base
ethanolic conditions
heat

4. iodoethane reacts fastest, followed by bromoethane and then chloroethane
the C-X bond needs to be broken during the reaction
I is a larger atom than Br or Cl, so the C-I bond is longer than C-Br or C-Cl
Hence the C-I bond is weaker than C-Br or C-Cl
So it requires least energy to break and is broken more quickly

5. a) but-1-ene only
b) but-1-ene and but-2-ene



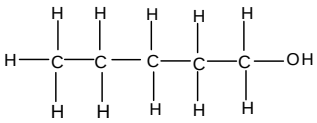
the H atom can be lost from C1 or C3
If H is lost from C1 but-1-ene will be formed
If H is lost from C3 but-2-ene will be formed
c) methylpropene only
d) methylpropene only

Topic 8 Exercise 4

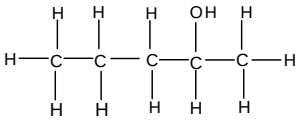
1. i) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$
   35 – 55 ^oC, yeast, no oxygen
   ii) $C_2H_4 + H_2O \rightarrow C_2H_5OH$
   300 ^oC, 60 atm, conc. H_3PO_4
   advantages of fermentation:
   sugar cane is a renewable resource (ethene is non-renewable)
   it is a low technology process (hydration is a high-technology process)
   advantages of hydration:
   it is a continuous process (fermentation is a batch process)
   it makes ethanol quickly (fermentation is slow)
   it makes pure ethanol (fermentation does not make pure ethanol)

2. a) ethene
   b) but-1-ene
   c) but-1-ene and but-2-ene
   d) none (cannot be dehydrated)

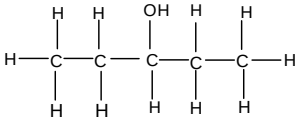
3.



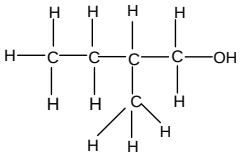
pentan-1-ol
primary



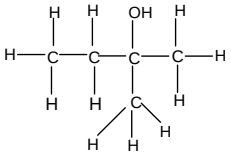
pentan-2-ol
secondary



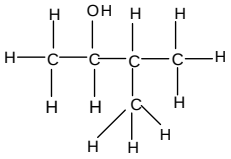
pentan-3-ol
secondary



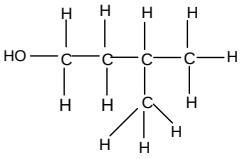
2-methylbutan-1-ol
primary



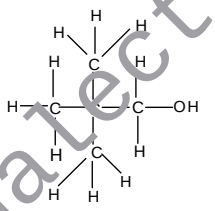
2-methylbutan-2-ol
tertiary



3-methylbutan-2-ol
secondary



3-methylbutan-1-ol
primary



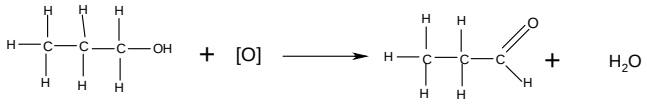
dimethylpropan-1-ol
primary

a) pentan-2-ol can give pent-1-ene and pent-2-ene
2-methylbutan-2-ol can give 2-methylbut-1-ene and 2-methylbut-2-ene
3-methylbutan-2-ol can give 3-methylbut-1-ene and 3-methylbut-2-ene

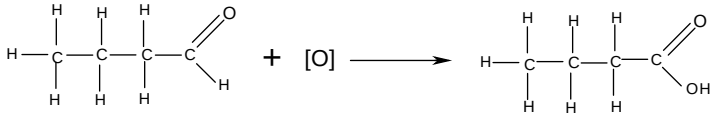
b) pentan-1-ol gives pentanal
pentan-2-ol gives pentan-2-one
pentan-3-ol gives pentan-3-one
2-methylbutan-1-ol gives 2-methylbutanal
3-methylbutan-2-ol gives methylbutanone
3-methylbutan-1-ol gives 3-methylbutanal
dimethylpropan-1-ol gives dimethylpropanal

c) pentanal gives pentanoic acid
2-methylbutanal gives 2-methylbutanoic acid
3-methylbutanal gives 3-methylbutanoic acid
dimethylpropanal gives dimethylpropanoic acid

4. a)



b)



c)