Answers to Unit 3.2 Exercises

Exercise 1

1. a) mixtures of hydrocarbons with similar boiling points

b)

- crude oil is passed into a fractionating column where it boils
- the column is hotter at the bottom than at the top
- the vapour rises up the column until it condenses
- small hydrocarbons have weak van der Waal's forces, hence low boiling points and condense near the top of the column
- large hydrocarbons have strong van der Waal's forces, hence high boiling points and condense near the base of the column

c)

liquefied petroleum gas	camping stoves, gas for cooking
gasoline	fuel for cars
naphtha	petrochemicals
kerosine	fuel for aircraft
diesel	fuel for lorries
lubricating oil	lubrication
fuel oil	fuel for ships
wax	candles
tar	road surfacing

d) the fractions all have different uses
mixed together they have no useful applications

2. a) thermal cracking: high temperature
high pressure
makes alkenes
catalytic cracking: high temperature
slight pressure
zeolite catalyst
makes motor fuels
makes aromatic hydrocarbons

b) it converts hydrocarbons for which supply exceeds demand
into hydrocarbons for which demand exceeds supply

3. a) $C_8H_{18} + 12½O_2 \rightarrow 8CO_2 + 9H_2O$

b) $C_8H_{18} + 8½O_2 \rightarrow 8CO + 9H_2O$
$C_8H_{18} + 4½O_2 \rightarrow 8C + 9H_2O$

c) less energy released, CO is a toxic gas, C particulates are carcinogenic

4. a) CO_2, CO, C, NO_2 or NO, SO_2, unburned hydrocarbons

b)

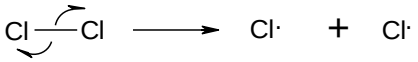
CO_2	greenhouse gas
CO	reduces ability of blood to carry oxygen
C	carcinogen
NO_2 or NO	cause acid rain/destruction of ozone layer
SO_2	acid rain
unburned hydrocarbons	greenhouse gases/photochemical smog

c) $2CO + 2NO \rightarrow N_2 + 2CO_2$

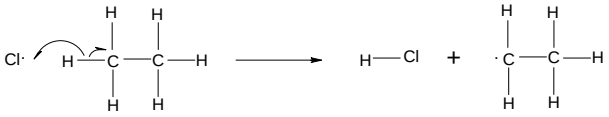
Topic 8 Exercise 2

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

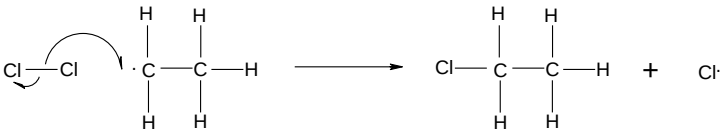
2. a) initiation



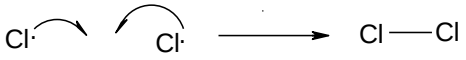
propagation



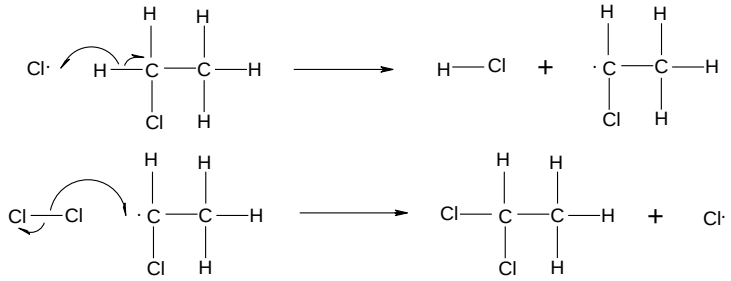
propagation



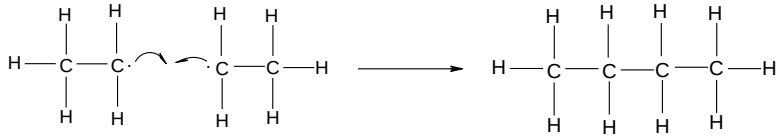
termination



b) i)

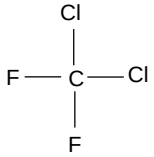


ii)

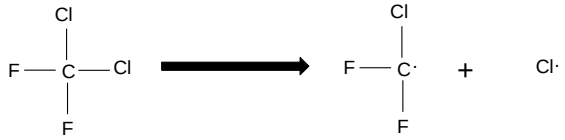


Topic 8 Exercise 3

1. a)

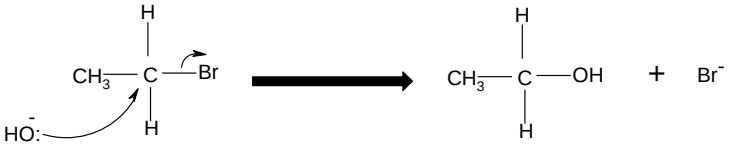


b)

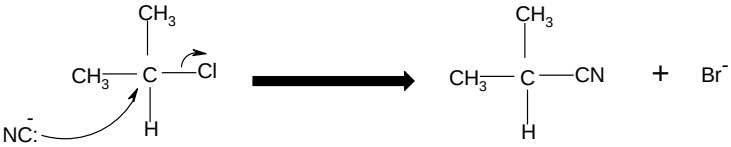


2. a) The halogen is more electronegative than carbon
so the C-X bond is polar
so the carbon atom has a partial positive charge
to which the lone pair of electrons on a nucleophile can be attracted

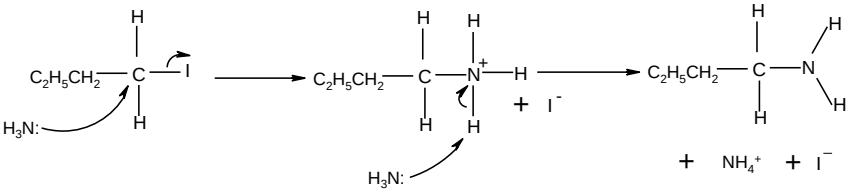
b) i) $C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$



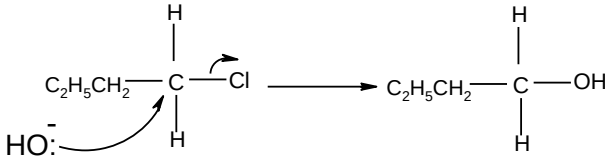
ii) $CH_3CHClCH_3 + KCN \rightarrow CH_3CH(CN)CH_3$



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

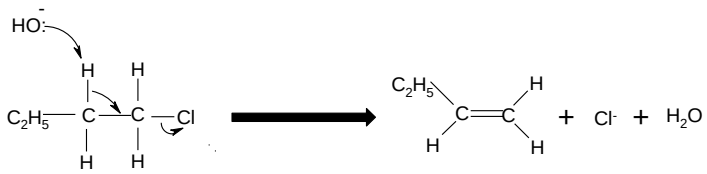


3. nucleophilic substitution



hydroxide ion is a nucleophile
aqueous conditions
warm

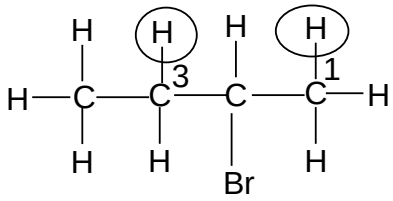
elimination



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