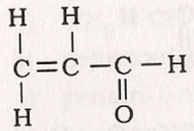
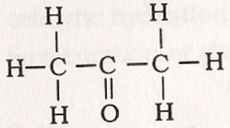
8. a) 

b) Because the molecule gains oxygen.

c) 

Exercise 2.11 Making and breaking esters

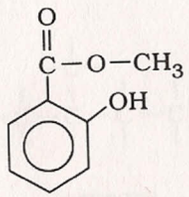
1. a) ethanoic acid butan-2-ol

b) Esterification is a reversible reaction; an equilibrium is extablished between reactants and products.

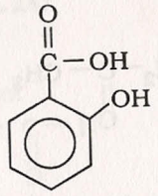
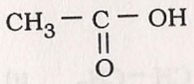
2. a) esterification

b) **X** ethanoic acid and ethanol

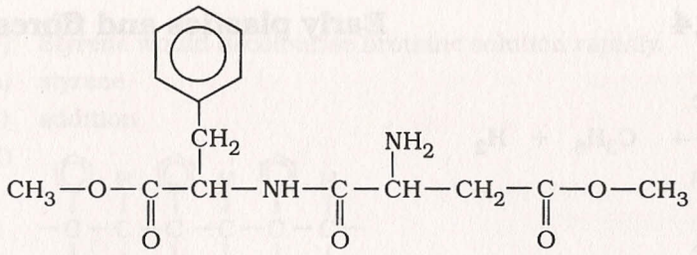
Y ethyl ethanoate

4. a) 

b) i) Breaking down a molecule into two or more smaller molecules by the action of water.

ii)  and 

iii) Hydrolysis of aspirin by heat and moisture forms ethanoic acid which smells of vinegar.

5. 

Exercise 2.12 Percentage yields

1. 80.3% 2. 84.9% 3. 81.6% 4. 88.3% 5. 64.0%

Exercise 2.13 Uses of carbon compounds

1. a) for example, petrol, kerosine, diesel

b) for example, plastics, artificial fibres, detergents

2. a) for example, flavourings, solvents

b) for example, manufacture of esters, solvents

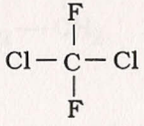
3. a) i) O_3

ii) It absorbs some of the harmful ultra violet radiation from the sun.

b) i) The use of chlorofluorocarbons in aerosols and refrigerators.

ii) For example, increases in the incidence of skin cancers, more rapid melting of polar ice caps.

4. a) for example, aerosol propellants, refrigerants, for foaming plastics

b) i) 

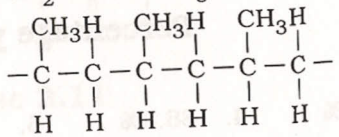
ii) 1,2-dichlorotetrafluoroethane

Exercise 2.14

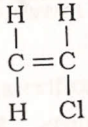
Early plastics and fibres (i)

1. a) propane
   b) $C_3H_8 \rightarrow C_3H_6 + H_2$
   c) naphtha

2. a) propene
   b) $CH_2=CH-CH_3$
   c)

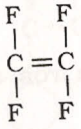


3. a) 4
   b)

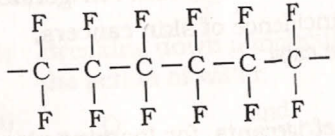


   c) addition

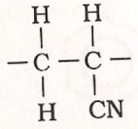
4. a) poly(tetrafluoroethene)
   b)



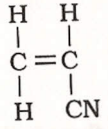
   c)



5. a)

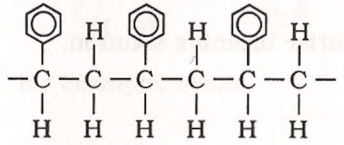


   b)

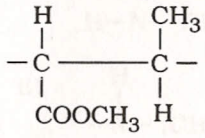


   c) addition polymerisation

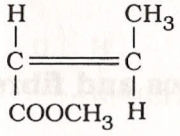
6. a) Styrene would decolourise bromine solution rapidly.
   b) styrene
   c) addition
   d)



7. a)

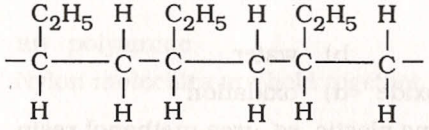


   b)

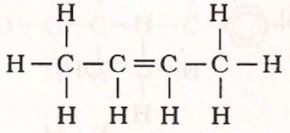


   c) addition

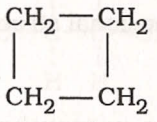
8. a)



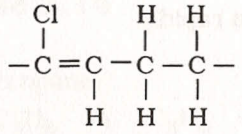
   b) addition
   c) i)



   ii)



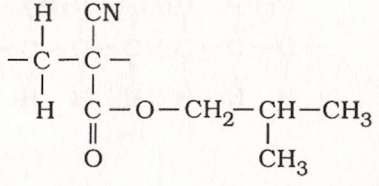
9. a)



b) This polymer would rapidly decolourise bromine solution. Poly(ethene) would not.

10. a) addition

b)

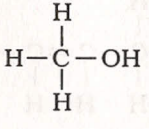


Exercise 2.15 Early plastics and fibres (ii)

1.* a)

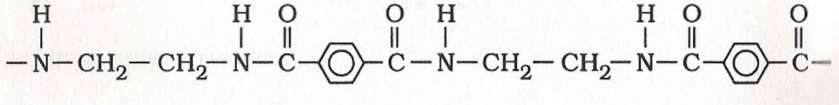
2. a) natural gas b) water
c) hydrogen and carbon monoxide d) oxidation
e) manufacture of thermosetting plastic, eg. urea-methanol resin

3. a) synthesis gas b)

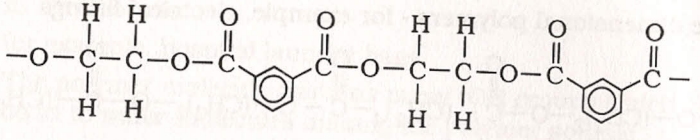


c) methanal
d) It is cross linked and forms a rigid three-dimensional structure.

4. a) **A** - a diamine **B** - a dicarboxylic acid
b) condensation
c)

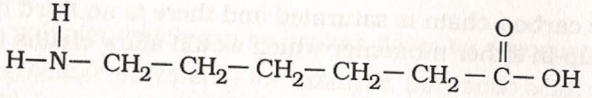


5. a) water
b)

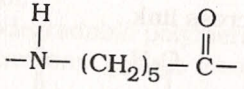


c) for example, nylon

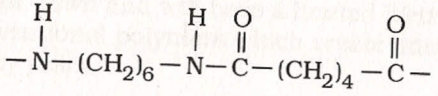
6. a) i)



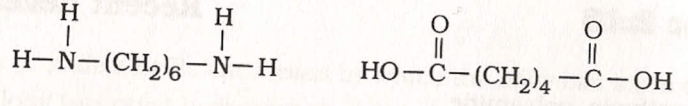
ii)



b) i)

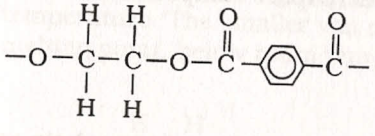


ii)

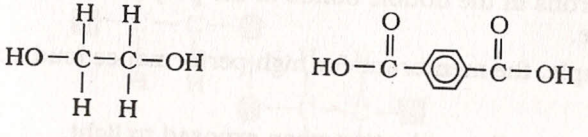


iii) polyamide
c) Nylon molecules are held together by strong hydrogen bonds.

7. a)



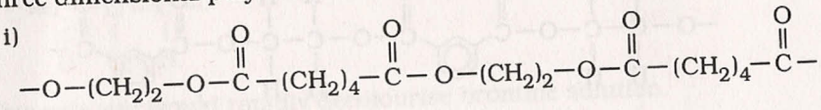
b)



c) condensation polymer

8. a) linear polymers - for example, synthetic fibres
three dimensional polymers - for example, electrical fittings

b) i)

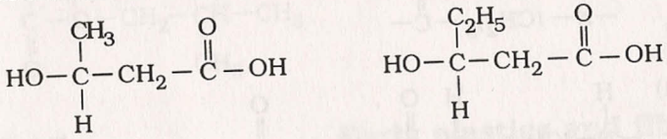


ii) condensation polymerisation

iii) The carbon chain is saturated and there is no third functional group in either monomer which would allow chains to cross link.

9. a) It has a linear structure and cannot cross link.

b)



Exercise 2.16 Recent developments

1. a) synthetic, polyamide

b) The structure is held together by strong covalent bonds and adjacent fibres are held together by extensive hydrogen bonds forming very strong sheets of polymer.

c) for example, bullet proof vests, aerospace components

2. a) poly(ethyne)

b) $H-C\equiv C-H$

c) i) The electrons in the double bonds of the polymer chain can delocalise.

ii) For example, the membrane for high-performance loud speakers.

3. a) It becomes electrically conducting when exposed to light.

b) Manufacture of photo-conducting drums in photocopiers.

4. a) i) addition polymerisation

ii) hydrolysis

b) for example, hospital laundry bags

c) The polymer molecule contains many -OH groups which can hydrogen bond to water molecules making the polymer soluble.

5. a) i) A polymer which can be broken down by the action of bacteria in soil.

ii) A polymer which can be broken down by exposure to light.

b) Biodegradable polymers - for example, polylactic acid, polyvinyl alcohol.
Photodegradable polymers - for example, low density poly(ethene) with carbonyl groups incorporated into the carbon skeleton.

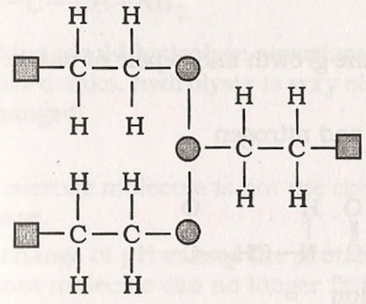
c) Plastic waste which is either biodegradable or photodegradable will break down and will have a limited lifetime in the environment, unlike conventional polymers which create litter and waste problems for many years.

Exercise 2.17 Fats and oils

1. a) They provide an efficient means by which the body can store energy.

b) The long saturated hydrocarbon chains in fats can twist into a relatively small volume, whereas the presence of the double bond in the hydrocarbon chains of an oil restricts this. The fat molecules are much more compact and larger van der Waals' forces can exist between fat molecules giving rise to melting points above room temperature. The smaller van der Waals' forces in oils give a lower melting point, below room temperature.

2. a)



b) The melting point is increased. c) (catalytic) hydrogenation