Answers to Some Questions in Exercises

UNIT 11

11.1
(i) 2,2,4-Trimethylpentan –3-ol (ii) 5-Ethylheptane –2, 4-diol
(iii) Butane –2,3-diol (iv) Propane –1,2,3,-triol
(v) 2- Methylphenol (vi) 4-Methylphenol
(vii) 2,5 – Dimethylphenol (viii) 2,6-Dimethylphenol
(ix) 1-Methoxy-2-methylpropane (x) Ethoxybenzene
(xi) 1-phenoxyheptane (xii) 2 –Ethoxybutane

11.2
(i)
$$CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3$$

(ii) $\phi - CH_2 - \underset{\underset{OH}{|}}{CH} - CH_3$
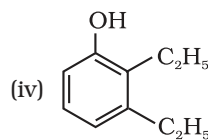
(iii) $HOCH_2 - CH_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{C}} - CH_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{C}} - CH_3$

(iv) benzene ring with OH, C_2H_5, C_2H_5

(v) $C_2H_5 - O - CH_2 - CH_2 - CH_3$

(vi) $CH_3 - \underset{\underset{OC_2H_5}{|}}{CH} - CH - CH_2 - CH_3$ (with CH_3 below CH)

(vii) cyclohexene ring $-CH_2OH$

(viii) $CH_3 - CH_2 - \underset{\underset{cyclohexyl}{|}}{\overset{\overset{OH}{|}}{C}} - CH_2 - CH_3$

(ix) cyclopentene ring with OH

(x) $CH_3 - CH_2 - \underset{\underset{CH_2Cl}{|}}{CH} - CH_2 - CH_2 - OH$
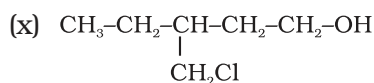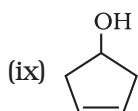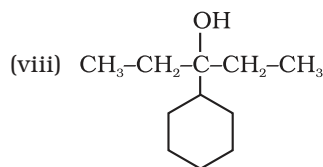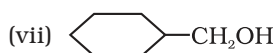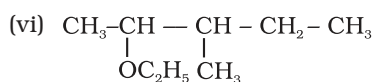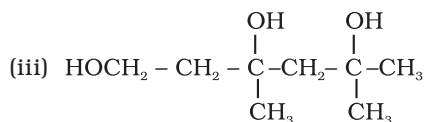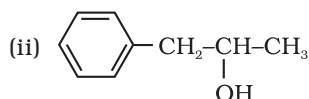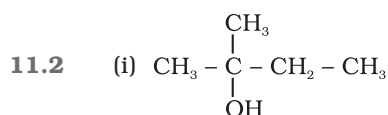
11.3 (i) (a) $CH_3CH_2CH_2CH_2CH_2OH$, Pentan-1-ol;

(b) $CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - OH$, 2-Methylbutan-1-ol;

(c) $CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2OH$, 2,2-Dimethylpropan-1-ol

(d) $CH_3 - CH_2 - \underset{\underset{OH}{|}}{CH} - CH_2 - CH_3$, Pentan-3-ol

(e) $CH_3 - CH_2 - CH_2 - \underset{\underset{OH}{|}}{CH} - CH_3$, Pentan-2-ol

(f) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - \underset{\underset{OH}{|}}{CH} - CH_3$, 3-Methylbutan-2-ol

(g) $CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - OH$, 2-Methylbutan-2-ol

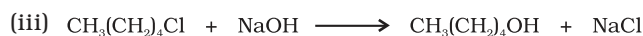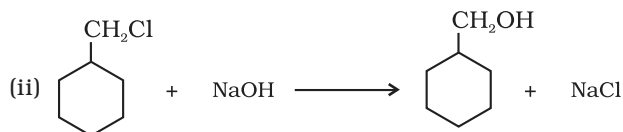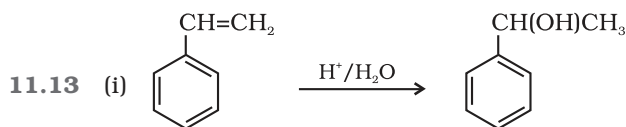(h) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_2OH$, 3-Methylbutan-1-ol

11.4 Hydrogen bonding in propanol.

11.5 Hydrogen bonding between alcohol and water molecules.

11.8 o-Nitrophenol is steam volatile because of intramolecular hydrogen bonding.

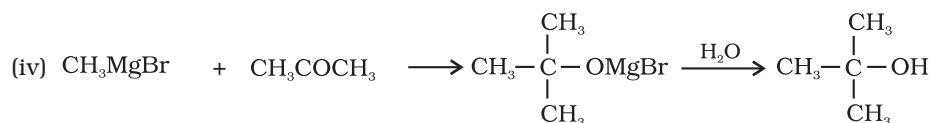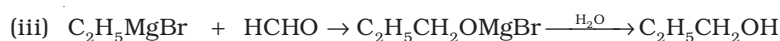**11.12** **Hint:** Carryout sulphonation followed by nucleophilic substitution.

11.13 (i)

$$\underset{\text{CH=CH}_2}{\text{[benzene ring]}} \xrightarrow{\text{H}^+/\text{H}_2\text{O}} \underset{\text{CH(OH)CH}_3}{\text{[benzene ring]}}$$

(ii) $\underset{\text{CH}_2\text{Cl}}{\text{[cyclohexane]}}$ + NaOH $\longrightarrow$ $\underset{\text{CH}_2\text{OH}}{\text{[cyclohexane]}}$ + NaCl

(iii) $CH_3(CH_2)_4Cl$ + NaOH $\longrightarrow$ $CH_3(CH_2)_4OH$ + NaCl

11.14 Reaction with (i) sodium and (ii) sodium hydroxide

11.15 Due to electron withdrawing effect of nitro group and electron releasing effect of methoxy group.

11.20 (i) Hydration of Propene.

(ii) By nucleophilic substitution of –Cl in benzyl chloride using dilute NaOH.

(iii) C_2H_5MgBr + $HCHO \rightarrow C_2H_5CH_2OMgBr \xrightarrow{H_2O} C_2H_5CH_2OH$

(iv) CH_3MgBr + $CH_3COCH_3 \longrightarrow CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OMgBr \xrightarrow{H_2O} CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

11.23 (i) 1-Ethoxy-2-methylpropane.

(ii) 2-Chloro-1-methoxyethane.

(iii) 4-Nitroanisole.

(iv) 1-Methoxypropane.

(v) 1-Ethoxy-4,4-dimethylcyclohexane.

(vi) Ethoxybenzene.
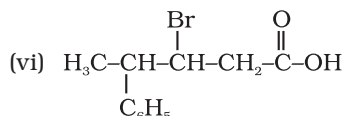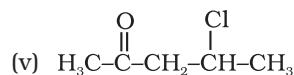
UNIT 12

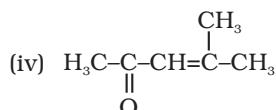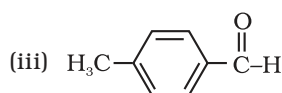**12.2** (i) 4-Methylpentanal

(ii) 6-Chloro-4-ethylhexan-3-one

(iii) But-2-enal

(iv) Pentane-2,4-dione

(v) 3,3,5-Trimethylhexan-2-one

(vi) 3,3-Dimethylbutanoic acid

(vii) Benzene –1,4-dicarbaldehyde

12.3 (i) $H_3C-\underset{\underset{CH_3}{|}}{CH}-CH_2-\overset{\overset{O}{||}}{C}-H$

(ii) $O_2N-\text{[benzene ring]}-\overset{\overset{O}{||}}{C}-CH_2-CH_3$

(iii) $H_3C-\text{[benzene ring]}-\overset{\overset{O}{||}}{C}-H$

(iv) $H_3C-\underset{\underset{O}{||}}{C}-CH=\underset{\overset{CH_3}{|}}{C}-CH_3$

(v) $H_3C-\overset{\overset{O}{||}}{C}-CH_2-\underset{\underset{Cl}{|}}{CH}-CH_3$

(vi) $H_3C-\underset{\underset{C_6H_5}{|}}{CH}-\underset{\overset{Br}{|}}{CH}-CH_2-\overset{\overset{O}{||}}{C}-OH$

(vii) HO—⬡—C(=O)—⬡—OH   (viii) $H_3C–C≡C–CH=CH–C(=O)–OH$
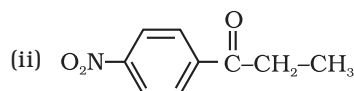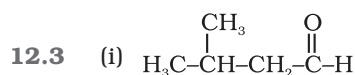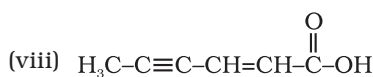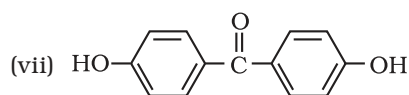
12.4 (i) Heptan-2-one   (ii) 4-Bromo-2-methylhexanal   (iii) Heptanal
(iv) 3-Phenylprop-2-enal   (v) Cyclopentanecarbaldehyde   (vi) Diphenylmethanone

12.5 (i) ⬡—CH=N.NH—(2,4-dinitrophenyl, NO_2)   (ii) cyclopropane N–OH (oxime)

(iii) $CH_3–CH(OCH_3)_2$ (iv) cyclobutylidene =NNH–C(=O)–NH$_2$

(v) $H_3C–CH_2–C(–CH_2–CH_2–CH_3)$ with $H_2C–CH_2$ / O—O ring (cyclic ketal)

(vi) $H–C(OH)(OCH_3)–H$

12.6 (i) cyclohexyl–C(OH)(Ph)(H)   (ii) cyclohexyl–C(=O)–$\bar{O}$

(iii) cyclohexyl–CH=NNH–C(=O)–NH$_2$ (iv) cyclohexyl–C(OC$_2$H$_5$)$_2$(H)   (v) methylcyclohexane (CH_3)
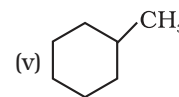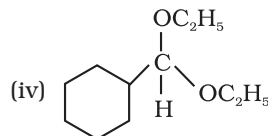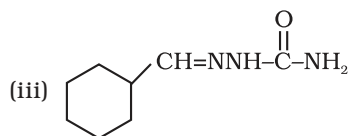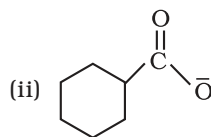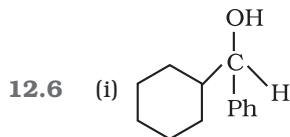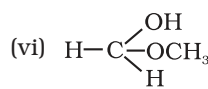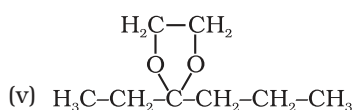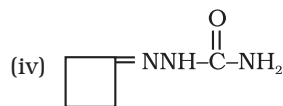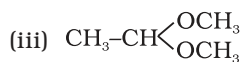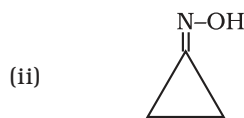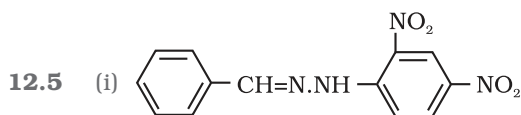
12.7 (ii), (v), (vi), (vii): Aldol condensation. (i), (iii), (ix) Cannizaro reaction. (iv), (viii) Neither.

12.10 2-Ethylbenzaldehyde (draw the structure yourself).

12.11 (A) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$, butyl butanoate.
(B) $CH_3CH_2CH_2COOH$ (C) $CH_3CH_2CH_2CH_2OH$. Write equation yourself.

12.12 (i) Di-tert-butyl ketone < Methyl tert-butyl ketone < Acetone < Acetaldehyde
(ii) $(CH_3)_2CHCOOH$ < $CH_3CH_2CH_2COOH$ < $CH_3CH(Br)CH_2COOH$ < $CH_3CH_2CH(Br)COOH$
(iii) 4-Methoxybenzoic acid < Benzoic acid < 4-Nitrobenzoic acid < 3,4-Dinitrobenzoic acid.

12.17 (i) ⬡—COOK   (ii) benzene with COCl, COCl (ortho)   (iii) $C_6H_5CH=NNHC(=O)–NH_2$

(iv) $C_6H_5COCl–AlCl_3$ (v) quinone–COŌ   (vi) cyclohexane with C(OH)(CN)(H)—COOH substituents

(vii) $C_6H_5CH=C(CH_3)–CHO$ + other products   (viii) $CH_3CH(OH)CH_2COOC_2H_5$ (ix) cyclohexanone (⬡=O)

(x) 1. BH$_3$; 2. H$_2$O$_2$/$\bar{O}$H; 3. PCC   (xi) bicyclohexylidene
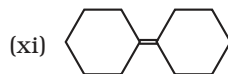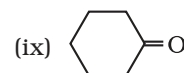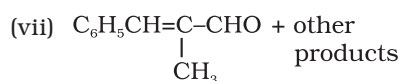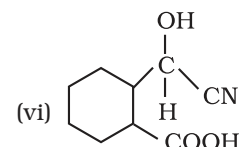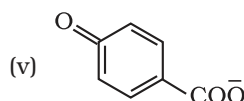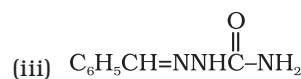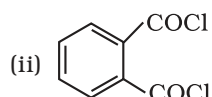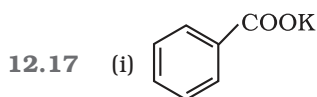
12.19 The compound is methyl ketone and its structure would be: $CH_3COCH_2CH_2CH_3$

UNIT 13

13.1 (i) 1-methylethylamine or propan-2-amine   (ii) Propan-1-amine

    (iii) N-methyl-2-methylethylamine or N-methylpropan-2-amine (iv) 2-methylpropan-2-amine

    (v) N-methylbenzenamine or N-methylaniline   (vi) N-Ethyl-N-methylethanamine

    (vii) 3-Bromoaniline or 3-Bromobenzenamine

13.4 (i) $C_6H_5NH_2 < C_6H_5NHCH_3 < C_2H_5NH_2 < (C_2H_5)_2NH$

    (ii) $C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH$

    (iii) (a) p-nitroaniline < aniline < p-toluidine

         (b) $C_6H_5NH_2 < C_6H_5NHCH_3 < C_6H_5CH_2NH_2$

    (iv) $(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > NH_3$ (v) $(CH_3)_2NH < C_2H_5NH_2 < C_2H_5OH$

    (vi) $C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$

UNIT 15

15.1 Polymer is a high molecular mass macromolecule consisting of repeating structural units derived from monomers.

Monomer is a simple molecule capable of undergoing polymerisation and leading to the formation of the corresponding polymer.
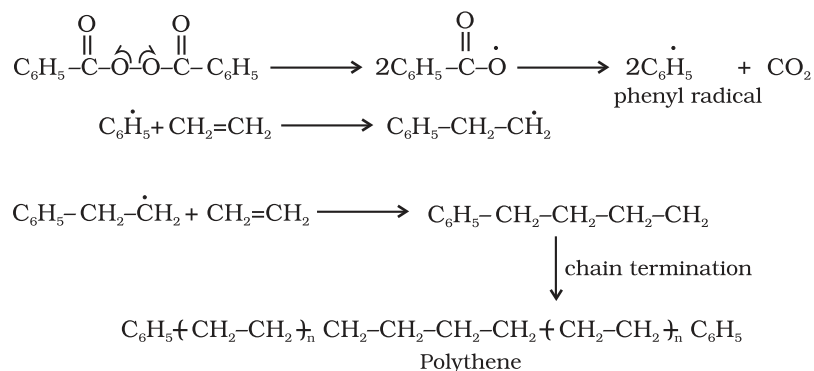
15.2 Natural polymers are high molecular mass macromolecules and are found in plants and animals. The examples are proteins and nucleic acids.

Synthetic polymers are man-made high molecular mass macromolecules. These include synthetic plastics, fibres and rubbers. The two specific examples are polythene and dacron.

15.4 Functionality is the number of bonding sites in a monomer.

15.5 Polymerisation is a process of formation of a high molecular mass polymer from one or more monomers by linking together of repeating structural units with covalent bonds.

15.6 Since the unit $-(NH-CHR-CO)_n$ is obtained from a single monomer unit, it is a homopolymer.

15.7 Polymer chains in elastomeric polymers are held together by weak intermolecular forces which allow the polymer to be stretched. The cross links between the chains bring them back to the original position when the stretching force is removed.

15.8 In addition polymerisation, the molecules of the same or different monomers add together to form a large polymer molecule. Condensation polymerisation is a process in which two or more bi-functional molecules undergo a series of condensation reactions with the elimination of some simple molecules and leading to the formation of polymers.

15.9 Copolymerisation is a process in which a mixture of more than one monomeric species is allowed to polymerise. The copolymer contains multiple units of each monomer in the chain. The examples are copolymers of 1,3-butadiene and styrene and 1, 3-butadiene and acrylonitrile.

15.10

$$C_6H_5-\overset{O}{\overset{\|}{C}}-O-O-\overset{O}{\overset{\|}{C}}-C_6H_5 \longrightarrow 2C_6H_5-\overset{O}{\overset{\|}{C}}-\overset{\bullet}{O} \longrightarrow 2\overset{\bullet}{C_6H_5} + CO_2$$
<div align="center">phenyl radical</div>

$$\overset{\bullet}{C_6H_5} + CH_2=CH_2 \longrightarrow C_6H_5-CH_2-\overset{\bullet}{C}H_2$$

$$C_6H_5-CH_2-\overset{\bullet}{C}H_2 + CH_2=CH_2 \longrightarrow C_6H_5-CH_2-CH_2-CH_2-CH_2$$

<div align="center">↓ chain termination</div>

$$C_6H_5-(CH_2-CH_2)_n CH_2-CH_2-CH_2-CH_2-(CH_2-CH_2)_n C_6H_5$$
<div align="center">Polythene</div>

15.11 A thermoplastic polymer can be repeatedly softened on heating and hardened on cooling, hence it can be used again and again. The examples are polythene, polypropylene, etc.

A thermosetting polymer is a permanent setting polymer as it gets hardened and sets during

moulding process and cannot be softened again. The examples are bakelite and melamine-formaldehyde polymers.

15.12 (i) The monomer of polyvinyl chloride is $CH_2=CHCl$ (vinyl chloride).

(ii) The monomer of teflon is $CF_2=CF_2$ (tetrafluoroethylene).

(iii) The monomers involved in the formation of bakelite are HCHO (formaldehyde) and C_6H_5OH (phenol).

15.14 From the structural point of view, the natural rubber is a linear cis-1,4- polyisoprene. In this polymer the double bonds are located between C_2 and C_3 of isoprene units. This cis-configuration about double bonds do not allow the chains to come closer for effective attraction due to weak intermolecular attractions. Hence, the natural rubber has a coiled structure and shows elasticity.

15.16 The monomeric repeat unit of Nylon-6 polymer is:

$[NH–(CH_2)_5–CO]$

The monomeric repeat unit of Nylon-6,6 polymer is derived from the two monomers, hexamethylene diamine and adipic acid.

$[NH–(CH_2)_6–NH-CO–(CH_2)_4–CO]$

15.17 The names and structures of monomers are:

Polymers	Monomer Names	Monomer Structures
(i) Buna-S	1,3-Butadiene	$CH_2=CH–CH=CH_2$
	Styrene	$C_6H_5CH=CH_2$
(ii) Buna-N	1,3- Butadiene	$CH_2=CH–CH=CH_2$
	Acrylonitrile	$CH_2=CH\ CN$
(iii) Neoprene	Chloroprene	$CH_2=\overset{\overset{\displaystyle Cl}{|}}{C}–CH=CH_2$
(iv) Dacron	Ethylene glycol	$OHCH_2–CH_2OH$
	Terephthalic acid	$COOH{-}\langle\underline{\quad}\rangle{-}COOH$

15.18 The monomers forming the polymer are:

(i) Decandioic acid $HOOC–(CH_2)_8–COOH$ and Hexamethylene diamine $H_2N(CH_2)_6\ NH_2$

(ii)

$$\begin{array}{c} H_2N{-}\overset{N}{\underset{\substack{N{\quad}N \\ |}}{\bigcirc}}{-}NH_2 \\ NH_2 \end{array}$$

and HCHO
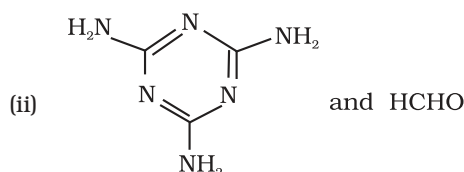
15.19 The following are the equations for the formation of Dacron.

n $HOCH_2CH_2OH$ + nHOOC$-\langle\underline{\quad}\rangle-$COOH $\longrightarrow$ $\{$ $O–CH_2CH_2O–CO-\langle\underline{\quad}\rangle-CO$ $\}_n$

Ethylene glycol   Terephthalic acid   Dacron