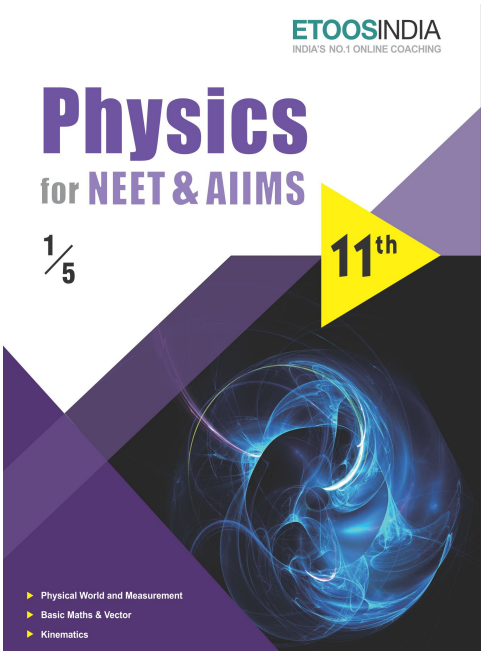
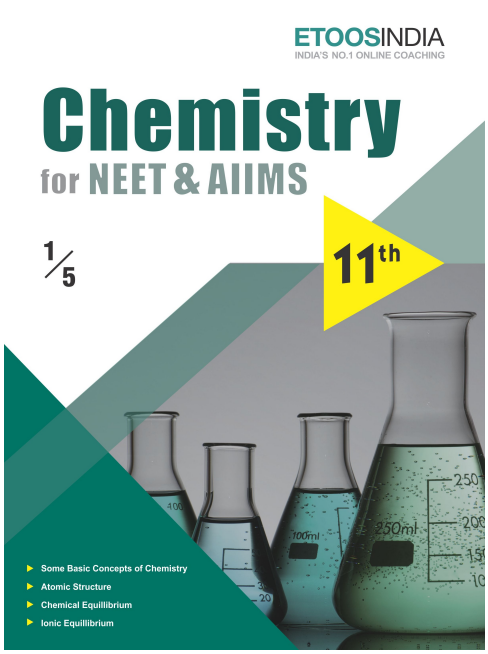
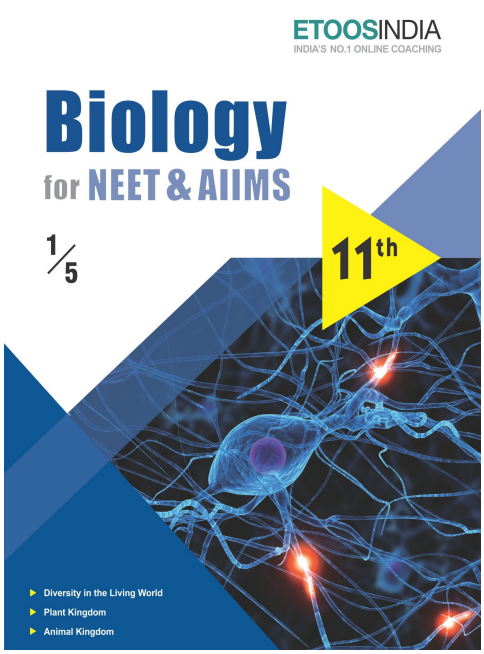
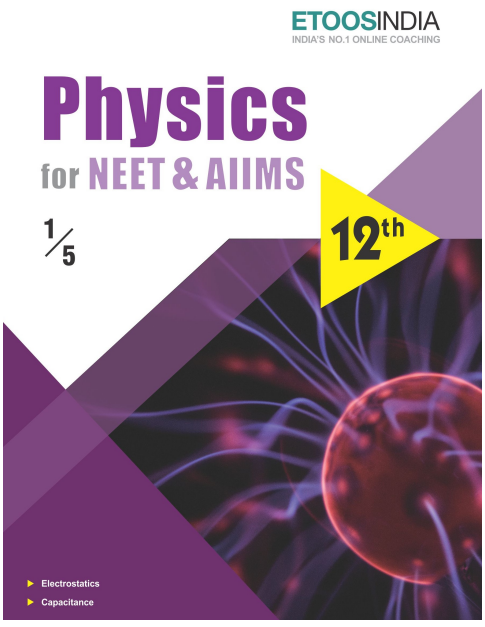
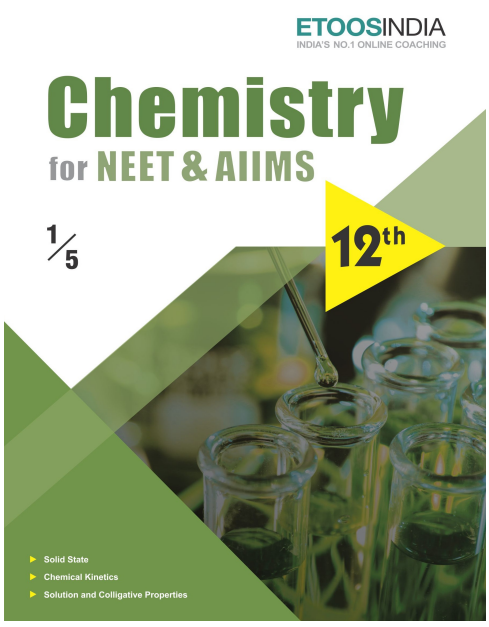
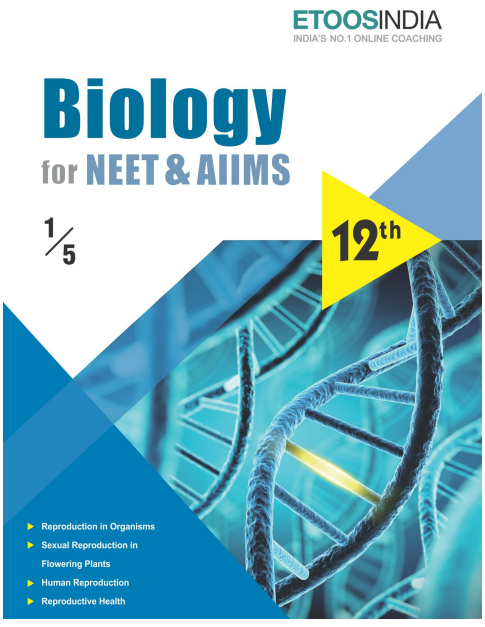












CHAPTER 14

GENERAL ORGANIC CHEMISTRY

We define chemistry as the chemistry of carbon compounds.

"AUGUST KEKULE"

INTRODUCTION

General organic chemistry is the base of organic chemistry If we want to under stand GOC well, then definitely we are going to be a pro in organic chemistry overall.

Topics which mention in GOC

1. Inductive effect
2. Mesomeric effect
3. Resonance effect
4. Hyperconjugation.

We have to remember the condition for every effect and when they are applicable for e.g. If resonance and inductive effect both are operating, then resonance is dominating effect there.

In GOC we also know about the reaction intermediate which is a molecular entity that is promed from the reactants and reacts further to give the directly observed products of a chemcial reaction most chemical reaction are stepwise, that is take more than one chemistry step to complete.

Reaction : Breaking of old bond and formation of new bond is known as chemical reaction

A sequential account of each step, describing details of electron movement, energetics during bond cleavage and bond formation, and the rates of transformation of reactants into products (kinetics) is referred to as reaction mechanism.

Species on which reagent is attacking is known as substrate or reactant.

Species which attack on substrate, is known as reagent.

Type of cleavage of bond

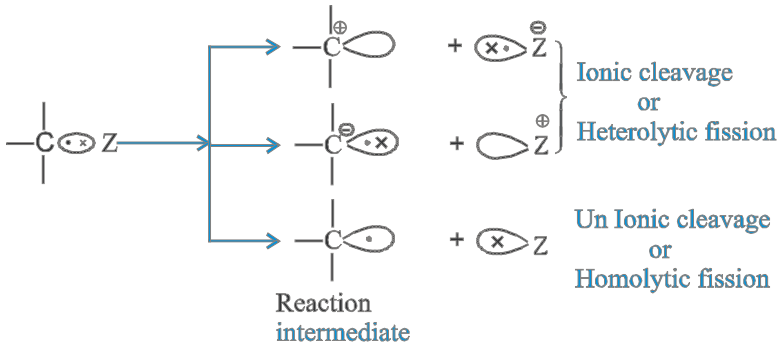
(I) Heterolytical cleavage/fission :

Cleavage in which unequal distribution of electrons takes place during the bond cleavage is known as heterolytical cleavage. Due to unequal distribution of electrons, ions are formed. That's why it is also known as ionic cleavage or heterolytical cleavage.

(II) Homolytical cleavage/fission :

Cleavage in which equal distribution of e^-s takes place during the chemical reaction is known as homolytical cleavage.

- Due to equally distribution of electrons, without charge unpaired electrons species is formed, which is known as free radical and cleavage is known as unionic cleavage/homolytical fission.
- By both cleavage [ionic/non ionic] three type of species are formed [One carrying positive charge, other carrying negative charge and third one is neutral with unpaired electrons] is known as reaction intermidiate.



Attacking reagents

The species which attack on a substrate molecule or intermediate and form a product is called as attacking reagent. These are of two types :

(I) Electrophilic reagent or electrophiles

Electrophilic (electro + philic)

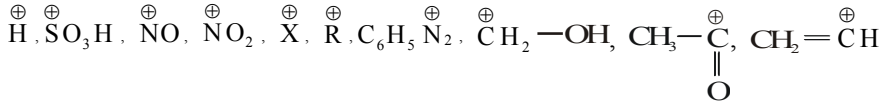
↓

(electron + loving)

The reagent which attacks on the **negative of the molecule** or loves electrons are called electrophiles.

Electrophiles may be positively charged or electron deficient molecule (molecule with sextet or septet).

(i) Positively charged electrophiles



(ii) Neutral electrophiles :- Which possess a electron dificiency.

(a) All Lewis acids as :

BF_3, $AlCl_3$, SO_3, $ZnCl_2$, $BeCl_2$, $FeCl_3$, $SnCl_2$, CO_2, $SnCl_4$.

Ex. Which of the following has minimum heat of hydrogenation.
(i) ethene (ii) Propene (iii) cis-2-butene (iv) trans-2-butene

Sol. (iv) maximum stable alkene means minimum reactive.

Ex. If Heat of hydrogenation of 1-butene is 30 Kcal then heat of hydrogenation of 1,3-butadiene is ?
(i) 30 (ii) 60 (iii) 57 (iv) 25

Sol. (iii) 1,3-butadiene requires two moles of hydrogen so heat of hydrogenation should be 60 Kcal but 1,3-butadiene is stabilized by resonance than propane so heat of hydrogenation of 1,3-butadiene will not be twice of 30.
Actual ΔH - 60 > ΔH > 30 Kcal.

Ex. Which of the following is maximum stable.
(i) Conjugated alkadiene ($CH_2=CH-CH=CH_2$)
(ii) Isolated alkadiene ($CH_2=CH-CH_2-CH=CH_2$)
(iii) Cumulated alkadiene ($CH_2=C=CH_2$)
(iv) All are equal.

Sol. (i) Due to resonance conjugated alkadiene is maximum stable. Isolated is more stable than cumulated alkadiene due to H-effect.

ETOOS KEY POINTS

Reactivity of Benzene : H-effect of R groups increases electron density in benzene ring.

due to CH_3 group there is more e^- density at ortho and para position so CH_3 is ortho/para directing and activating group.
If H-effect is more than e^- density will be more.

Ex. Give electrophilic sustitution reaction order :

Maximum α-H.
So maximum H-effect
So maximum e^- density
So maximum reactive
ESR order I > II > III > IV

Etoos Tips & Formulas

1. All the +ve charge species are electrophile except H_3O^+ and NH_4^+.

2. Relative electron withdrawing order (–1 order)

$$-NO_2 > -CN > -COOH > -F > -OR > -OH > -C_6H_5 > -CH = CH_2$$

3. + I order

$$-NO^- > -O > -COO^- > 3° \text{ alkyl} > 2° \text{ alkyl} < 1° \text{ alkyl}$$

4. Greater the number of α-Hydrogen, more stable is carbocation and free radical due to hyperconjugation.

(A) Carbocation

$$> (Ph)_3\overset{+}{C} > (Ph)_2\overset{+}{C}H > Ph-\overset{+}{C}H_2 > CH_2=CH-\overset{+}{C}H_2$$

$$(CH)_3\overset{+}{C} > (CH_3)_2\overset{+}{C}H > CH_3\overset{+}{C}H_2 > \overset{+}{C}H_3 > CH_2=\overset{+}{C}H > CH\equiv\overset{+}{C}$$

(B) Free radical

$$(Ph)_3\dot{C} > (Ph)_2\dot{C}H > Ph\dot{C}H_2 > CH_2=CH-\dot{C}H_2 >$$

$$(CH_3)_3\dot{C} > (CH_3)_2\dot{C}H > CH_3\dot{C}H_2$$

(C) Carbanion

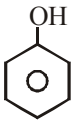
$$(Ph)_3\overset{\ominus}{C} > (Ph)_2\overset{\ominus}{C}H > Ph-\overset{\ominus}{C}H_2 > CH_2=CH-\overset{\ominus}{C}H_2 > \overset{\ominus}{C}H_3 >$$

$$CH_3\overset{\ominus}{C}H_2 > (CH_3)_2\overset{\ominus}{C}H > (CH_3)_3\overset{\ominus}{C}$$

Acidic Strength

(i) $H_2O > CH\equiv CH > NH_3$

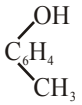
(ii) $CH\equiv CH > CH_2=CH_2 > CH_3-CH_3$

(iii) $R-SO_3H > R-COOH >$  $> R-OH$

(iv) $HCOOH > CH_3COOH > CH_3CH_2COOH$

(v) $CCl_3COOH > CHCl_2COOH > CH_2ClCOOH$

(vi) $CH_3-CH_2-\underset{\underset{F}{|}}{CH}-COOH > CH_3-\underset{\underset{F}{|}}{CH}-CH_2-COOH > CH_2-\underset{\underset{F}{|}}{CH_2}CH_2COOH$

(vii)  Phenol > m > p > 0

(viii)  p > o > m > Phenol

SOLVED EXAMPLE

Ex.1 Which one of the following species is most stable

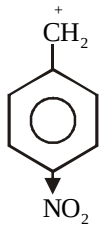
(A) $p-O_2N-C_6H_4-\overset{+}{C}H_2$

(B) $p-CH_3O-C_6H_4-\overset{+}{C}H_2$

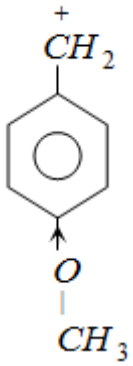
(C) $p-Cl-C_6H_4-\overset{+}{C}H_2$

(D) $C_6H_5-\overset{+}{C}H_2$

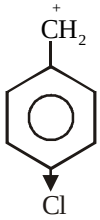
Sol. **(B)**



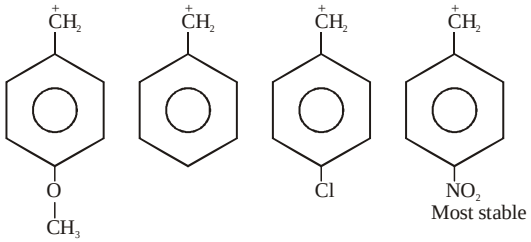
Nitro-group is electron withdrawing therefore decreases stability.



Methoxy group is electron releasing.
Therefore increases stability by donating electron.



Chlorine is also electron withdrawing but its effect is less than $-NO_2$ group.
Hence, correct order of stability.



Ex.2 Which of the following gives most stable carbocation by dehydration

(A) $(CH_3)_2CH-OH$

(B) $(CH_3)_3C-OH$

(C) CH_3-CH_2-OH

(D) $CH_3-CH_2-O-CH_2-CH_3$

Sol. **(B)** 3° alcohols $Me-\overset{\oplus}{\underset{|}{C}}(Me)-Me$ is most stable carbocation

Ex.3 Which of the following orders regarding relative stability of free radicals is correct

(A) $3°<2°<1°$ **(B)** $3°>2°>1°$

(C) $1°<2°>3°$ **(D)** $3°>2°<1°$

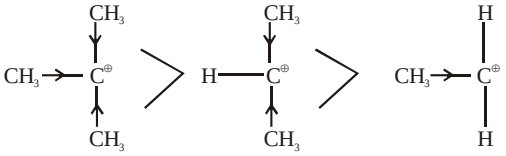
Sol. **(B)** Due to the increasing no. of hyperconjugative structures free radical stabilise following as $3°>2°>1°$.

Ex.4 The +I effect of alkyl groups is in the order

(A) $2°>3°>1°$ **(B)** $1°>2°>3°$

(C) $3°>2°>1°$ **(D)** None of these

Sol. **(C)** $3°>2°>1°$



Ex.5 Which of the following compounds will show metamerism

(A) $CH_3COOC_2H_5$ **(B)** $C_2H_5-S-C_2H_5$

(C) CH_3-O-CH_3 **(D)** $CH_3-O-C_2H_5$

Sol. **(B)** $\underset{\text{Diethyl thioether}}{C_2H_5-S-C_2H_5}$ and $\underset{\text{Methyl propyl thioether}}{CH_3-S-C_3H_7}$

are metamers.

Ex.6 How many carbon atoms in the molecule $HCOO-(CHOH)_2-COOH$ are asymmetric

(A) 1 **(B)** 2

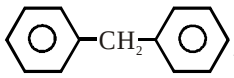
(C) 3 **(D)** None of these

Sol. **(B)** $HCOO-\underset{(1)}{\overset{*}{C}H}(OH)-\underset{(2)}{\overset{*}{C}H}(OH)-COOH$

Two carbon atoms in the molecule are asymmetric.

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. The molecular formula of diphenyl methane,


, is $C_{13}H_{12}$

How many structural isomers are possible when one of the hydrogens is replaced by a chlorine atom

(A) 8 **(B)** 7

(C) 6 **(D)** 4

2. SN^1 reaction is faster in

(A) CH_3CH_2Cl **(B)** $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!\!CH - Cl$

(C) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-Cl$ **(D)** $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_2}{\overset{|}{\underset{|}{CH}}}}-Cl$

3. How many enantiomer pairs are obtained by monochlorination of 2, 3-dimethylbutane

(A) Nil **(B)** Four

(C) Two **(D)** Three

(E) One

4. Among the following compounds which can be dehydrated very easily is

(A) $CH_3-CH_2-\underset{\displaystyle OH}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-CH_3$

(B) $CH_3-CH_2-CH_2-\underset{\displaystyle OH}{\overset{|}{CH}}-CH_3$

(C) $CH_3-CH_2-CH_2-CH_2-CH_2-OH$

(D) $CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-CH_2-OH$

5. Which of the following statements is not characteristic of free radical chain reaction

(A) It gives major product derived from most stable free radical

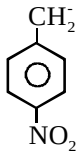
(B) It is usually sensitive to change in solvent polarity

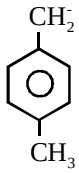
(C) It proceeds in three main steps like initiation, propagation and termination

(D) It may be initiated by U.V. light

6. Most stable carbanion is

(A) CH_3^- **(B)** $CH_3CH_2^-$

(C) 

(D) 

7. Which one is electrophilic addition

(A) $CH_3-CH_3+Cl_2\rightarrow C_2H_5Cl+HCl$

(B) $CH_3CH=O+HCN\rightarrow (CH_3)_2C(OH)CN$

(C) $(CH_3)_2C=O+HCN\rightarrow CH_3CH(OH)CN$

(D) $CH_2=CH_2+Br_2\rightarrow CH_2BrCH_2Br$

8. A compound has 3 chiral carbon atoms. The number of possible optical isomers it can have

(A) 3 **(B)** 2

(C) 8 **(D)** 4

9. How many chiral isomers can be drawn from 2-bromo, 3-chloro butane

(A) 2 **(B)** 3

(C) 4 **(D)** 5

10. Number of isomers of C_4H_{10} is

(A) 2 **(B)** 3

(C) 4 **(D)** Isomerism not exist

11. The number of possible isomers for compound $C_2H_3Cl_2Br$ is

(A) 2 **(B)** 3

(C) 4 **(D)** 5

12. The optically active tartaric acid is named as D-(+)-tartaric acid because it has a positive

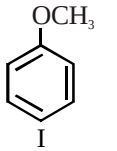
(A) Optical rotation and is derived from D-glucose

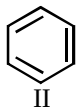
(B) pH in organic solvent

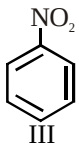
(C) Optical rotation and is derived from D(+) glyceraldehyde

(D) Optical rotation only when substituted by deuterium

13. Among the following compounds (I-III) the correct order of reaction with electrophilic reagent is


I


II


III

(A) II > III > I **(B)** III < I < II

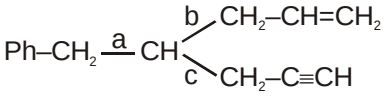
(C) I > II > III **(D)** I = II > III

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. Observe the following statements and choose the correct option.

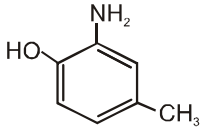
S1 : Inductive effect is more powerful than mesomeric effect.

S2 : The bond polarity order of bonds a, b, and c in the given molecule (I) is c > a > b



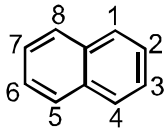
(I)

S3 : The hybrid structure has always have equal contribution from all the resonating structures.

S4 :  shows inductive effect, resonance, hyperconjugation & intramolecular hydrogen bonding.

(A) TFTF **(B)** FTFTC **(C)** FTTF **(D)** TTFF

2. Which of the following is correct about the following compound



(Naphthalene)

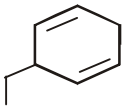
(A) All the C-C bond length are same

(B) C_1–C_2 bond length is shorter than C_2–C_3 bond length

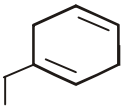
(C) C_1–C_2 bond length is greater than C_2–C_3 bond length

(D) All the C-C bond length are equal to C-C bond length of benzene

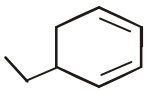
3. The stability order of alkene in following compounds is :



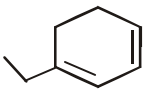
(I)



(II)



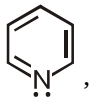
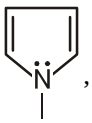
(III)



(IV)

(A) I < II < III < IV **(B)** II < I < III < IV **(C)** II < III < I < IV **(D)** II < IV < I < III

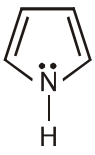
4. Number of π electrons in conjugation for these compounds


Pyridine ,

Pyrrole ,

Furan &

Benzene will be respectively :

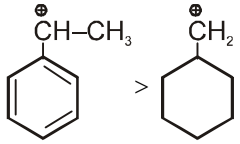
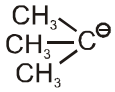
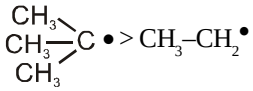
(A) 8, 6, 6, 6 **(B)** 6, 4, 6, 6 **(C)** 6, 6, 6, 6 **(D)** 6, 6, 8, 6

5. The hybridisation of nitrogen in  (pyrrole) is :

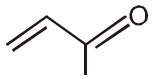
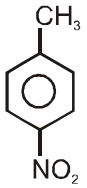
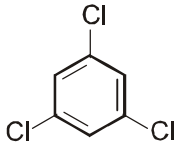
(A) sp^3 **(B)** sp^2 **(C)** sp **(D)** Cann't be predicted

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1.

Column-I (Stability order)	**Column-II (Responsible effect)**
(A) $\overset{\oplus}{C}H_2–OH > CH_3–\overset{\oplus}{C}H–CH_3$	**(p)** Inductive effect
(B) 	**(q)** Resonance
(C) $CH_3–CH_2^- >$ 	**(r)** Hyperconjugation
(D) 	**(s)** Mesomeric effect

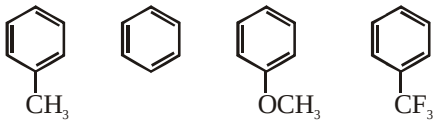
2. Match the following

Coulmn - I (Compounds)	**Coulmn - II (Characteristics)**
(A) 	**(p)** Mesomeric effect / resonance
(B) Ph–CH=CH–CH_3	**(q)** Inductive effect.
(C) 	**(r)** Hyperconjugative effect
(D) 	**(s)** Nonpolar
	(t) Polar

Exercise # 4

PART - 1 | PREVIOUS YEAR (NEET/AIPMT)

1. Among the following compounds the decreasing order of reactivity towards electrophilic substitution is **[CBSE AIPMT 2000]**



I II III IV

(A) II > I > III > IV **(B)** III > I > II > IV
(C) IV > I > II > IV **(D)** I > II > III > IV

2. In HS^-, I^-, RNH_2, NH_3 order of proton accepting tendency will be **[CBSE AIPMT 2001]**

(A) $I^- > NH_3 > RNH_2 > HS^-$
(B) $NH_3 > RNH_2 > HS^- > I^-$
(C) $RNH_2 > NH_3 > HS^- > I^-$
(D) $HS^- > RNH_2 > NH_3 > I^-$

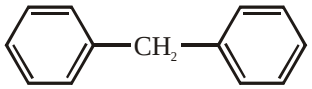
3. The correct order of reactivity towards the electrophilic substitution of the compounds aniline (I). benzene (II) and nitrobenzene (III) is **[CBSE AIPMT 2002]**

(A) II < III > I **(B)** I > II > III
(C) III > II > I **(D)** II > III > I

4. Which of the following is least reactive in a nucleophilic substitution reaction ? **[CBSE AIPMT 2004]**

(A) $(CH_3)_3C-Cl$ **(B)** $CH_2=CHCl$
(C) CH_3CH_2Cl **(D)** $CH_2=CHCH_2Cl$

5. The molecular formula of diphenyl methane

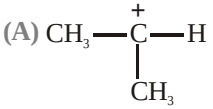


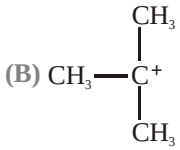
is $C_{13}H_{12}$

How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom? **[CBSE AIPMT 2004]**

(A) 6 **(B)** 4
(C) 8 **(D)** 7

6. Which amongst the following is the most stable carbocation? **[CBSE AIPMT 2005]**

(A) 

(B) 

(C) $\overset{+}{C}H_3$ **(D)** $CH_3\overset{+}{C}H_2$

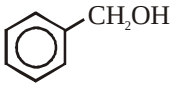
7. The correct order regarding the electronegativity of hybrid orbitals of carbon is **[CBSE AIPMT 2005]**

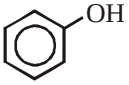
(A) $sp > sp^2 < sp^3$ **(B)** $sp > sp^2 > sp^3$
(C) $sp < sp^2 > sp^3$ **(D)** $sp < sp^2 < sp^3$

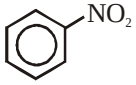
8. The order of decreasing reactivity towards an electrophilic reagent, for the following
(i) Benzene (ii) Toluene
(iii) Chlorobenzene (iv) Phenol
would be **[CBSE AIPMT 2007]**

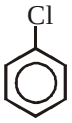
(A) (i) > (ii) > (iii) > (iv) **(B)** (ii) > (iv) > (i) > (iii)
(C) (iv) > (iii) > (ii) > (i) **(D)** (iv) > (ii) > (i) > (iii)

9. Which one of the following is most reactive towards electrophilic attack? **[CBSE AIPMT 2008]**

(A) 

(B) 

(C) 

(D) 

10. Base strength of

(i) $H_3C\overset{\ominus}{C}H_2$ (ii) $H_2C=\overset{\ominus}{C}H$

(iii) $H-C\equiv C^{\ominus}$

is in the order of **[CBSE AIPMT 2008]**

(A) (ii) > (i) (iii) **(B)** (iii) > (ii) > (i)
(C) (i) > (iii) > (ii) **(D)** (i) > (ii) > (iii)

11. The stability of carbanions in the following

(i) $RC\equiv\overset{\ominus}{C}$ **(B)** 

(ii) $R_2C=\overset{\ominus}{C}H$ **(D)** $R_3C=\overset{\ominus}{C}H_2$

is in the order of **[CBSE AIPMT 2008]**

(A) (i) > (ii) > (iii) > (iv) **(B)** (ii) > (iii) > (iv) > (i)
(C) (iv) > (ii) > (iii) > (i) **(D)** (i) > (iii) > (ii) > (iv)

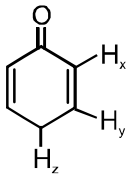
12. In the hydrocarbon

$\underset{6}{CH_3}-\underset{5}{CH}=\underset{4}{CH}-\underset{3}{CH_2}-\underset{2}{C}\equiv\underset{1}{CH}$

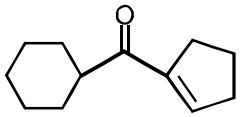
the state of hybridisation of carbons 1,3 and 5 are in the following sequence **[CBSE AIPMT 2008]**

(A) sp^2, sp, sp^3 **(B)** sp, sp^3, sp^2
(C) sp, sp^2, sp^3 **(D)** sp^3, sp^2, sp

MOCK TEST

1. Molecule  can be enolised by which hydrogen.

(A) x–H **(B)** y–H **(C)** z–H **(D)** None of these

2. 

How many enolisable –H are present in the above compound ?

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5

3. How many total enolic forms (including stereoisomers) are possible for $CH_3–\overset{\overset{O}{\|}}{C}–CH_2–\overset{\overset{O}{\|}}{C}–CH_2–CH_3$.

(A) 3 **(B)** 7 **(C)** 4 **(D)** 5

4. Which statement about tautomerism is incorrect ?

(A) Tautomers always exist in equilibrium.

(B) Tautomers can be separated by physical / chemical process.

(C) Tautomerism is a chemical phenomenon which takes place in liquid and gaseous state and catalysed by acid as well as base.

(D) All tautomers are always functional group isomers.

5. The enolic form of acetone contains :

(A) 9 σ bonds, 1 π bond and 2 lone pairs **(B)** 8 σ bond, 2 π bond and 2 lone pairs

(C) 10 σ bond, 1 π bond and 1 lone pair **(D)** 9 σ bond, 2 π bond and 1 lone pair

6. Keto-enol tautomerism does not observe in :

(A) $C_6H_5–\overset{\overset{O}{\|}}{C}–H$ **(B)** $C_6H_5–\overset{\overset{O}{\|}}{C}–CH_3$

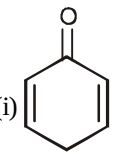
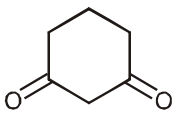
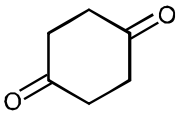
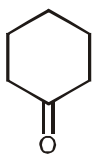
(C) $C_6H_5–\overset{\overset{O}{\|}}{C}–CH(CH_3)_2$ **(D)** $C_6H_5–\overset{\overset{O}{\|}}{C}–CH_2–\overset{\overset{O}{\|}}{C}–CH_3$

7. Which among the following compound will give maximum enol content in solution :

(A) $C_6H_5–\overset{\overset{O}{\|}}{C}–CH_2–\overset{\overset{O}{\|}}{C}–CH_3$ **(B)** $CH_3–\overset{\overset{O}{\|}}{C}–CH_2–\overset{\overset{O}{\|}}{C}–CH_3$

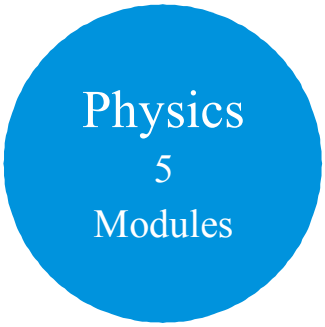
(C) $CH_3–\overset{\overset{O}{\|}}{C}–CH_2–CH_2–CH_3$ **(D)** $CH_3–\overset{\overset{O}{\|}}{C}–CH_2–COOC_2H_5$

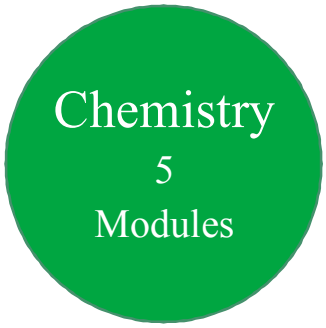
8. Arrange the followings in decreasing order of percentage enol content.

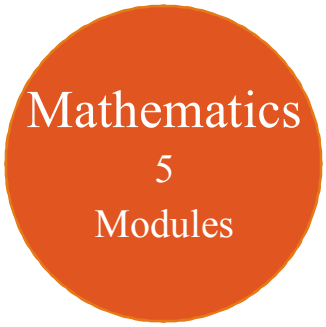
(i)  (ii)  (iii)  (iv) 

(A) I > II > III > IV **(B)** II > I > III > IV **(C)** II > III > I > IV **(D)** III > II > IV > I

11th Class Modules Chapter Details







PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

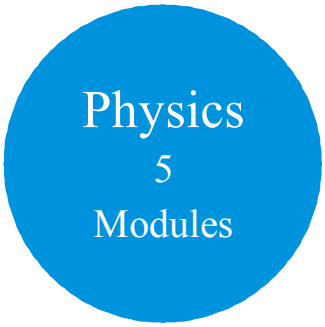
Module-4

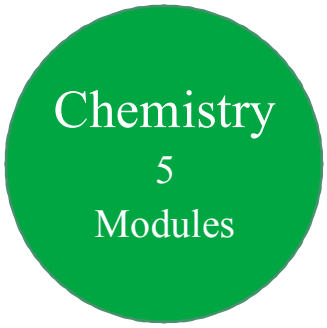
1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

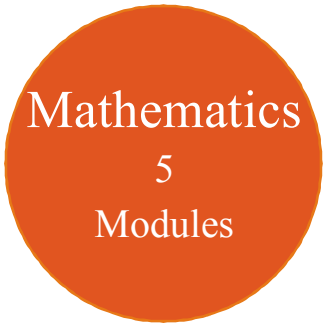
Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details







PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues