Parvatibai Chowgule College of Arts & Science, Margao Goa.

(Higher Secondary Section)

Class: - XI Science | **Max Marks:- 60**

Day: – Saturday | **(Subject:-Chemistry)** | **Date:- 3-11-2012**

Time: - 8.15 am. TO 10.45 am. | **ANSWER-KEY** | **Duration: - 2 $\frac{1}{2}$Hours**

Total No of Questions: - 6 | **First Terminal Examination- 2012** | **Total No Of Printed ages: 4**

Q No	INSTRUCTIONS:	Marks
	(1) All questions are compulsory. *(2) Answer each main question on a fresh page.* *(3) Figures to the right-indicate full marks.* *(4) Use of calculators is not permitted, however mathematical tables will be provided on request.* *Atomic masses & Constants:-H=1,Ca=40,N=14,O=16 ,F = 96500 C mol^{-1}, N_A=6.023×10^{23} ,h=6.626 x 10^{-34}*	

Q 1 A Define the following and write their mathematical expression **3**

a) Mole fraction

b) Mass percentage

c) Molality

Ans:- a) Mole fraction

It is the ratio of number of moles of a particular component to the total number of moles of the solution. If a substance 'A' dissolves in substance 'B' and their number of moles are nA and nB respectively; then the mole fractions of A and B are given as

$$\text{Mole fraction of A} = \frac{\text{No. of moles of A}}{\text{No. of moles of solution}} = \frac{n_A}{n_A + n_B}$$

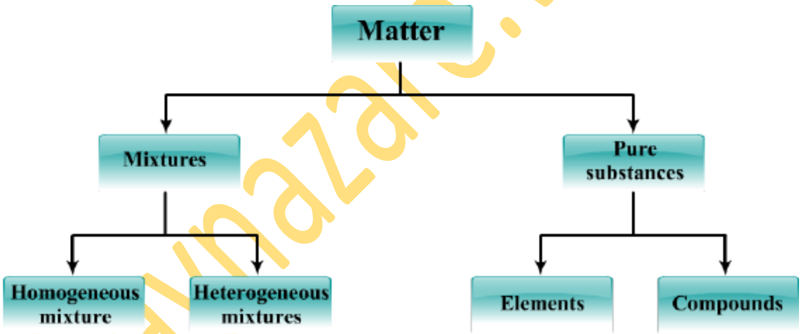
$$\text{Mole fraction of B} = \frac{\text{No. of moles of B}}{\text{No. of moles of solution}} = \frac{n_B}{n_A + n_B}$$

b) Mass percentage

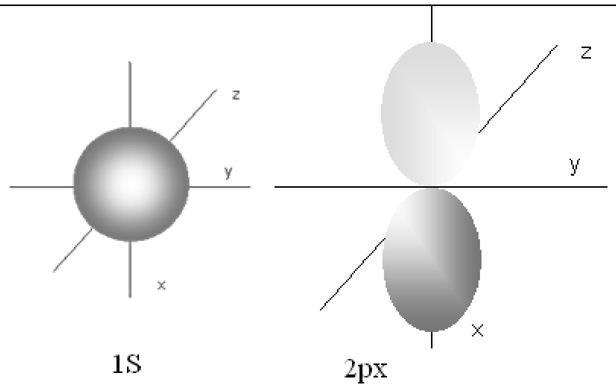
It is the ratio of mass of solute to that of solution (weight by weight or volume by volume) multiplied by hundred.

It is obtained by using the following relation:

	$$\text{Mass per cent} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$ **<u>c) Molality</u>** It is defined as the number of moles of solute present in 1 kg of solvent. It is denoted by m. $$\text{Thus, Molality (m)} = \frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$$	
Q 1 B **Ans:-**	Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation: $$N_2\,(g) + 3H_2\,(g) \rightarrow 2NH_3\,(g)$$ Write the information that is available from the above balanced chemical equation? From the above balanced chemical equation, the following information is obtained: • N_2 (g) + H_2 (g) are reactants & NH_3 (g) is a product. • One mole of N_2 (g) reacts with three moles of H_2 (g) to give two moles of NH_3(g) • One molecule N_2 (g) reacts with three molecules of H_2 (g) to give two moles of NH_3(g) • 28 g of N_2 (g) reacts with (3 × 2) = 6 g of H_2 (g) to give (2 × 17 = 34) g of NH_3(g) • 22.4 L of N_2 (g) reacts with (3 × 22.4) L=67.2 L of H_2 (g) to give (2 × 22.4) L=44.8L of NH_3 (g).	**2**
Q 1 C **Ans:-**	Write a point of difference between Molecular mass and Formula Mass giving one example of each. **Molecular Mass** Sum of the atomic masses of all the elements present in a molecule • Example – Molecular mass of CO_2 = 1 × Atomic mass of carbon + 2 × Atomic mass of oxygen = (1 × 12.011 u) + (2 × 16.00 u) = 12.011 u + 32.00 u = 44.011 u **Formula Mass:**	**2**

	Sum of the masses of all the atoms present in a formula unit of a compound • Used for compounds whose constituent particles are ions • Example – Formula mass of sodium chloride (NaCl) = Atomic mass of sodium + Atomic mass of chlorine = 23.0 u + 35.5 u => 58.5 u	
Q 1 D **Ans:-**	Calculate the following i. Number of moles of carbon dioxide which contain 8g of oxygen ii. Numbers of moles present in 7.9 mg of calcium **I)Ans.** In CO_2, 32 g of oxygen is present in 1 mole of CO_2 Therefore 8 g of oxygen is present in $= \frac{1 \times 8}{32} = 0.25 mol\ of\ CO_2$ **ii)Ans.** Number of moles $= \frac{\text{massingrams}}{\text{atomic mass}} = \frac{7.9 \times 10^{-3}}{40} = 1.975 \times 10^{-4}$	**2**
Q 1 E **Ans:-**	Draw a flow sheet diagram showing classification of matter  	**1**
Q 2 A **Ans:-**	Answer the following: (i) What sub shells are possible in n = 3 energy level? (ii) How many orbitals of all kinds are possible in this level? **Ans.** (i)Subshells in n = 3 energy level We know that the subshells are given by different values of ℓ . For n = 3, the possible values of ℓ are 0, 1 and 2. The corresponding subshells are: ℓ = 0, s-subshell ℓ = 1, p-subshell ℓ = 2, d-subshell. (ii) Number of orbitals For n = 3, there are one s, three p and five d-orbitals. This makes total of nine orbitals in n = 3 level.	**(3)** **2** **1**

Q 2 B **Ans:-**	Write the electronic configurations of the following ions & write the number of protons present in them. (a) Na^{+} (b) O^{2-} Na^{+} =10 electrons, EC= $1s^2 2s^2 2p^6 3s^0$ or $[Ne]3s^0$ <u>Protons</u> = 11 O^{2-} =10 electrons, EC= $1s^2 2s^2 2p^6 3s^0$ or $[Ne]3s^0$ <u>Protons</u> = 08	**2**
Q 2 C **Ans:-**	How does Bohr's theory account for stability of an atom? According to Bohr, as long as an electron remains in a particular permitted circular orbit or stationary state, it neither emits nor absorbs energy. As a result, an electron can not spiral down towards the nucleus loosing energy continuously (as per Maxwell's theory of electromagnetic radiation). This explains why atoms are stable and do not collapse due to electrostatic attraction between the nucleus and the electrons. **OR**	**2**
Q 2 C **Ans:-**	Define isobars and isotopes giving examples? Isotopes are atoms of the same element having same atomic number but different mass numbers. They have similar chemical properties but different physical properties. Examples. carbon atoms containing 6, 7 and 8 neutrons besides 6 protons are ($^{12}_{6}C$, $^{13}_{6}C$, $^{14}_{6}C$) Isobars are atoms of different elements having same mass numbers (i.e. the sum of their Protons and Neutrons are same). Examples. $^{14}_{6}C$ and $^{14}_{7}N$.	**2**
Q 2 D **Ans:-**	Calculate the uncertainty in velocity of a cricket ball of mass 0.15 kg if its uncertainty in position is of the order of $1A^0$ We know, $\Delta X.\ m\Delta V \geq h/4\pi$ Hence, $\Delta V = 6.626 \times 10^{-34} / 4 \times 3.14 \times 0.15 \times 10^{-10} = 3.51 \times 10^{-24}$ m/s	**2**
Q 2 E **Ans:-**	Draw diagrams depicting the shapes of **1s** and **$2p_x$** orbital.	**1**



Q 3 A Define the following terms **3**

Ans:-

a) **Bond Length**

Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule.

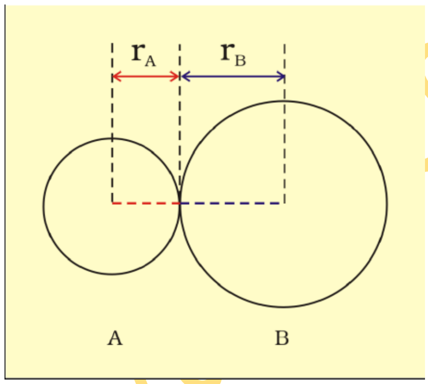


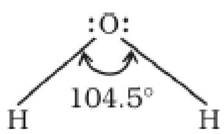
Fig. *The bond length in a covalent molecule AB.*

R = rA + rB

(R is the bond length and rA and rB are the covalent radii of atoms A and B respectively)

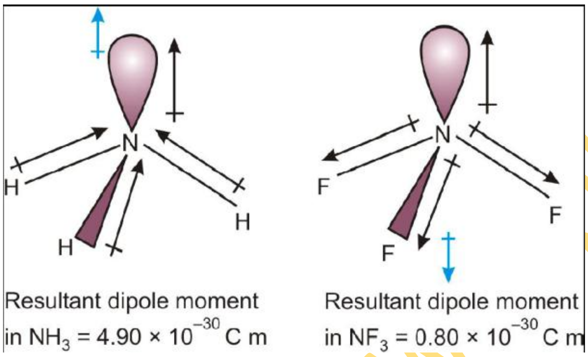
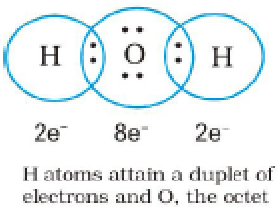
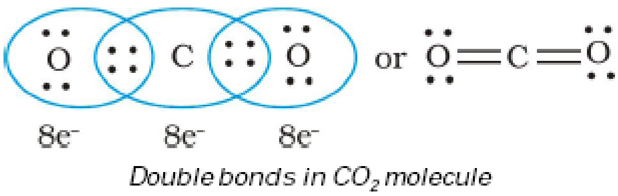
b) **Bond angle**

It is defined as the angle between the orbitals containing bonding electron pairs around the central atom in a molecule/complex ion.
Bond angle is expressed in degree .For example H–O–H bond angle in water can be represented as under :



c) **Bond order**

In the Lewis description of covalent bond, the Bond Order is given by the number of bonds between the two atoms in a molecule.
The bond order, for example in H_2 (with a single shared electron pair), in O_2 (with two shared electron pairs) and in N_2 (with three shared electron pairs) is 1,2,3 respectively. Similarly in CO (three shared electron pairs between C and O) the bond order is 3. For N_2, bond order is 3

Q 3 B **Ans:-**	Explain why the net dipole moment in NH_3 is much higher than NF_3? Both the molecules have pyramidal shape with a lone pair of electrons on nitrogen atom. Although fluorine is more electronegative than nitrogen, the resultant dipole moment of NH3 (4.90×10^{-30} C m) is greater than that of NF_3 (0.8×10^{-30} C m). This is because, in case of NH_3 the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N – H bonds, whereas in NF_3 the orbital dipole is in the direction opposite to the resultant dipole moment of the three N–F bonds. The orbital dipole because of lone pair decreases the effect of the resultant N – F bond moments, which results in the low dipole moment of NF_3 as represented below 	**2**
Q 3 C **Ans:-**	Write the Lewis dot structure for each of the following molecules. 1. H_2O  2. CO_2 	**2**
Q 3 D **Ans:-**	Write any two points of difference between Sigma and Pi bonds	**2**

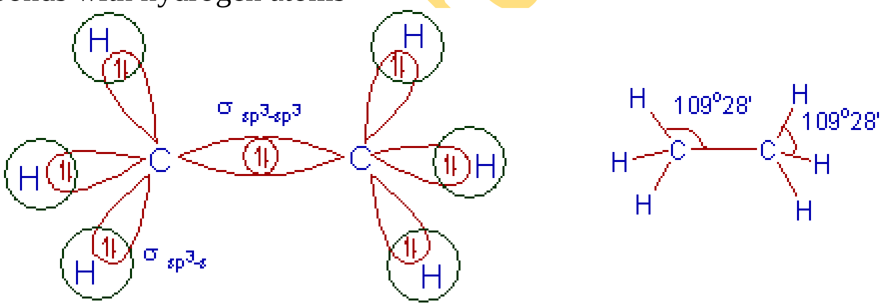
The following are the differences between sigma and pi-bonds:

Sigma (σ) Bond	Pi (π) Bond
(a) It is formed by the end to end overlap of orbitals.	It is formed by the lateral overlap of orbitals.
(b) The orbitals involved in the overlapping are *s*–*s*, *s*–*p*, or *p*–*p*.	These bonds are formed by the overlap of *p*–*p* orbitals only.
(c) It is a strong bond.	It is weak bond.
(d) The electron cloud is symmetrical about the line joining the two nuclei.	The electron cloud is not symmetrical.
(e) It consists of one electron cloud, which is symmetrical about the internuclear axis.	There are two electron clouds lying above and below the plane of the atomic nuclei.
(f) Free rotation about σ bonds is possible.	Rotation is restricted in case of pi-bonds.

Q 3 E Draw the orbital picture of ethane molecule & show the type of hybridization **1**

Ans:-

sp^3* *Hybridisation in C_2H_6 molecule: In ethane molecule both the carbon atoms assume *sp^3* hybrid state. One of the four *sp*3 hybrid orbitals of carbon atom overlaps axially with similar orbitals of other atom to form *sp^3-sp^3* sigma bond while the other three hybrid orbitals of each carbon atom are used in forming *sp^3–s* sigma bonds with hydrogen atoms



Structure of Ethane molecule

Q 4 A Write any six postulates of Kinetic Molecular theory of gases **3**

Ans:-

1. Gases are composed of a large number of particles that behave like hard, spherical objects in a state of constant, random motion.
2. These particles move in a straight line until they collide with another particle or the walls of the container.
3. These particles are much smaller than the distance between particles. Most of the volume of a gas is therefore empty space.
4. There is no force of attraction between gas particles or between the particles and the walls of the container.
5. Collisions between gas particles or collisions with the walls of the container are perfectly elastic. None of the energy of a gas particle is lost when it collides with another particle or with the walls of the container.
6. The average kinetic energy of a collection of gas particles depends on the

temperature of the gas and nothing else.

OR

Q 4 A Answer the following **3**

Ans:-

i. Derive Ideal gas equation

The three Gas laws can be combined together in a single equation which is known as **ideal gas equation**.

Ans:-

At constant T and n; $V \propto \frac{1}{p}$ **Boyleís Law**

At constant p and n; $V \propto T$ **Charlesí Law**

At constant p and T; $V \propto n$ **Avogadro Law**

Thus,

$$V \propto \frac{nT}{p} \qquad (5.15)$$

$$\Rightarrow \quad V = R\frac{nT}{p} \qquad (5.16)$$

where R is proportionality constant. On rearranging the equation (5.16) we obtain

$$pV = n\,RT \;\ldots\ldots\ldots\ldots (5.17)$$

R is called gas constant. It is same for all gases. Therefore it is also called **Universal Gas Constant**. Equation (5.17) is called **ideal gas equation.**

ii. State Daltons law of partial pressures

Daltons law of partial pressures states that **the total pressure exerted by the mixture of non-reactive gases is equal to the sum of the partial pressures of individual gases**

Mathematically,

$p_{Total} = p_1 + p_2 + p_3 + \ldots\ldots$ (at constant T, V)

where p_{Total} is the total pressure exerted by the mixture of gases and p_1, p_2, p_3 etc. are partial pressures of gases.

Q 4 B Explain with a neat labeled diagram dispersion forces in non-polar molecules **2**

Ans:- Atoms and nonpolar molecules are electrically symmetrical and have no dipole moment because their electronic charge cloud is symmetrically distributed. But a dipole may develop momentarily even in such atoms and molecules. This can be understood as follows.

Suppose we have two atoms 'A' and 'B' in the close vicinity of each other (Fig. 5.1a). It may so happen that momentarily electronic charge distribution in one of the atoms, say 'A' becomes unsymmetrical ***i.e.,*** the charge cloud is more on one side than the other (Fig. 5.1 b and c). This results in the development of instantaneous dipole on the atom 'A' for a very short time. This instantaneous or transient dipole distorts the electron density of the other atom 'B', which is close to it and as a consequence a dipole is induced in the atom 'B'.

The temporary dipoles of atom 'A' and 'B' attract each other. Similarly temporary dipoles are induced in molecules also. This force of attraction was first proposed by the German physicist Fritz London, and for this reason force of attraction between two temporary dipoles is known as **London force**. Another name for this force is **dispersion force**.

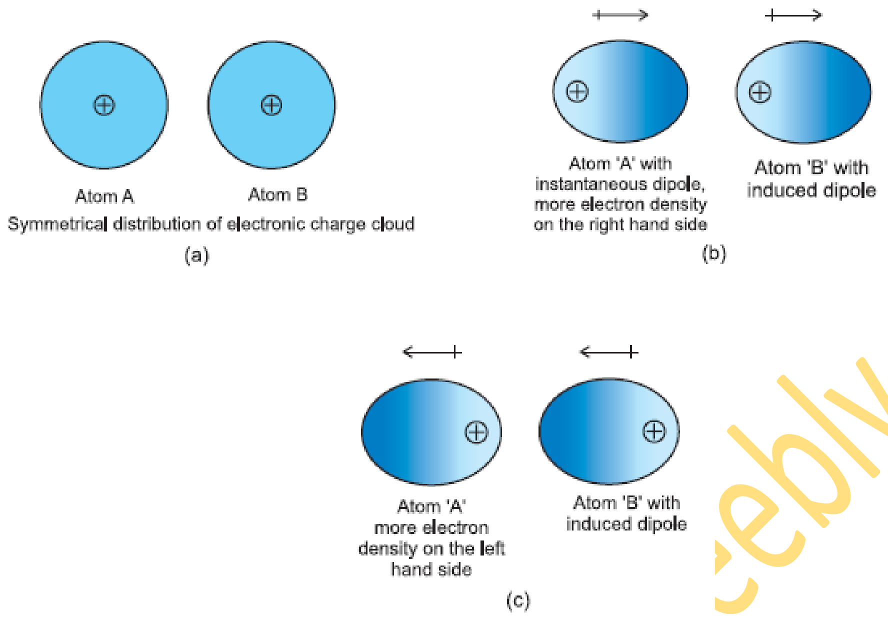


Fig 5.1 Dispersion forces or London forces between atoms.

Q 4 C At 27°C and 760 mm of Hg pressure a gas occupies 600 ml volume. What will be its pressure at a height where temperature is 20° C and volume of the gas is 660 ml? **2**

P_1 = 760 mm
V_1 = 600 ml
T_1= 27° c=273+27=300K
P_2=?
V_2 = 660 mL
T_2 = 20° c=273+20=293K
Using relation: $P_1V_1/T_1 = P_2V_2/T_2$
760 X 600/ 300 = P2 X 660 / 293
P_2= 760 X 600x 293 / 660 x 300
P_2= 675 mm.
Its pressure at a height where temperature is 20° C and volume of the gas is 660 ml is 675 mm.

OR

Q 4 C What is the temperature at which 80 cm^3 of a gas should be heated to increase its volume by 20% without changing the pressure? *(Given that the initial temperature of the gas is 25°C)* **2**

Ans:- The desired increase in the volume of the gas

	$= 20\%\ \text{of}\ 80\ cm^3 = \frac{80}{100} \times 20 = 16\ cm^3$ Final volume of the gas $= 80 + 16 = 96\ cm^3$ $V_1 = 80\ cm^3$; $V_2 = 96\ cm^3$ $T_1 = 25^\circ C = 298\ K$; $T_2 = ?$ Applying Charles law $T_2 = \frac{V_2 T_1}{V_1} = \frac{96\ cm^3 \times 298\ K}{80\ cm^3} = 357.6\ K\ \text{or}\ 84.6^\circ C$	
Q 4 D **Ans:-** **Ans:-**	Give reasons 1) Viscosity of liquids decreases with the increase in temperature. Viscosity of liquids decreases as the temperature rises because at high temperature molecules have high kinetic energy and can overcome the intermolecular forces to slip past one another between the layers. 2) Liquid drops have nearly spherical shape. Liquid drops have nearly spherical shape due to the characteristic property of liquids, called **surface tension**. The lowest energy state of the liquid will be when surface area is minimum. Spherical shape satisfies this condition,	**2**
Q 4 E **Ans:-**	State Charles Law. Charles Law states that pressure remaining constant, the volume of a fixed mass of a gas is directly proportional to its absolute temperature.	**1**
Q 5 A **Ans:-**	Define the following **a. Open system** A system in which, there is **exchange** of **energy** and **matter** between system and surroundings is defined as open system. **b. Entropy** Entropy can be thought of as a measure of the randomness of a system. **c. Intensive property** Those thermodynamic properties which do not depend on the quantity or size of matter present are known as **intensive properties.** **For example** temperature, density, pressure etc. are intensive properties	**3**
Q 5 B **Ans:-**	What are Dobereiner's triads? Explain these triads with suitable example. Classification of elements into groups and development of Periodic Law and Periodic Table are the consequences of systematizing the knowledge gained by a number	**2**

	of scientists through their observations and experiments. The German chemist, Johann Dobereiner in early 1800's was the first to consider the idea of trends among properties of elements. By 1829 he noted a similarity among the physical and chemical properties of several groups of three elements (**Triads**). In each case, he noticed that the middle element of each of the **Triads** had an atomic weight about half way between the atomic weights of the other two (Table 3.1). Also the properties of the middle element were in between those of the other two members. This Dobereiner's relationship, referred to as the **Law of Triads.** **Examples of** Dobereiner's triads	

Element	Atomic weight	Element	Atomic weight	Element	Atomic weight
Li	7	Ca	40	Cl	35.5
Na	23	Sr	88	Br	80
K	39	Ba	137	I	127

OR

Q 5 B Differentiate between s and p block elements. **2**

Ans:-

s block elements	**p block elements**
i) The general configuration of s-block elements is ns^{1-2}	i) The general electronic configuration of p block elements is ns^2np^{1-6}
ii) They are soft metals.	ii) Most of them are non-metals.
iii) The compounds of s-block elements are predominantly ionic except lithium and beryllium which forms covalent compounds.	iii) They form ionic as well as covalent compounds.
iv) They show oxidation state of +1 and +2.	iv) They show variable oxidation states.

Q 5 C What do you mean by isoelectronic species? Which of the following are isoelectronic species? **Na^+, K^+, Mg^{2+}, Ca^{2+}, S^{2-}, Ar.** **2**

Ans:-

	Isoelectronic species have the same number of electrons. Number of electrons in sodium (Na) = 11 Number of electrons in (Na^{+}) = 10 A positive charge denotes the loss of an electron. Similarly, Number of electrons in K^{+} = 18 Number of electrons in Mg^{2+} = 10 Number of electrons in Ca^{2+} = 18 A negative charge denotes the gain of an electron by a species. Number of electrons in sulphur (S) = 16 ? Number of electrons in S^{2-} = 18 Number of electrons in argon (Ar) = 18 Hence, the following are isoelectronic species: **1)** Na^{+} and Mg^{2+} (10 electrons each) **2)** K^{+}, Ca^{2+}, S^{2-} and Ar (18 electrons each) Concept inight: Positive sign means the loss of electrons whereas negative sign means gain of electrons.	
Q 5 D **Ans:-**	Give reasons. a) There are only 18 elements in the 5th period. The fifth period begins with the filling of 5f orbital and continues till the filling of sixth energy (6s) starts. The sub shells that follow up the filling pattern are 4d, 5p, 6s… So we can say that the elements which involve filling of 5s, 4d and 5p sub shell are accommodated in the fifth period .The total number of orbitals which these sub shell can have is nine and these orbitals can accommodate 18 electrons. So there are 18 elements in the fifth period. b) Ionic radii of sodium ion are less than that of sodium atom. The removal of an electron from an atom results in the formation of a **cation** A cation is smaller than its parent atom because it has fewer electrons while its nuclear charge remains the same. *(the atomic radius of sodium is 186 pm compared to the ionic radius of 95 pm for* Na^{+}*.)*	**2**
Q 5 E **Ans:-**	Write the IUPAC name and symbol of an element whose atomic number 108. The roots for the numbers 1, 0 and 8 are **Un, Nil** and **Oct** respectively. So IUPAC name and symbol for the element are unnilotium and **Uno** respectively.	**1**

Q 6 A Explain the following with examples — **3**

Ans:-

i. Position isomerism

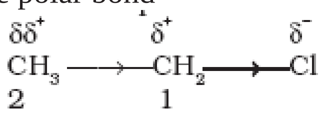
When two or more compounds differ in the position of substituent atom or functional group on the carbon skeleton, they are called position isomers and this phenomenon is termed as position isomerism. For example, the molecular formula C_3H_8O represents two alcohols

Propan-1-ol Propan-2-ol

ii. Inductive effect

Polarisation of σ-bond caused by the polarisation of adjacent σ-bond is referred to as the **inductive effect**.

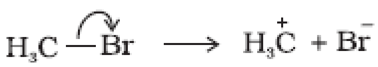
Let us consider cholorethane (CH_3CH_2Cl) in which the C–Cl bond is a polar covalent bond. It is polarised in such a way that the carbon-1 gains some positive charge (δ^+) and the chlorine some negative charge (δ^-). The fractional electronic charges on the two atoms in a polar covalent bond are denoted by symbol δ(delta) and the shift of electron density is shown by an arrow that points from δ^+ to δ^- end of the polar bond



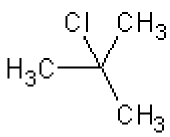
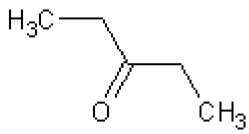
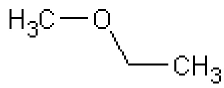
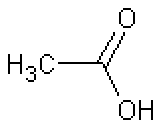
In turn carbon-1, which has developed partial positive charge (δ^+) draws some electron density towards it from the adjacent C-C bond. Consequently, some positive charge ($\delta\delta^+$) develops on carbon-2 also, where $\delta\delta^+$ symbolises relatively smaller positive charge as compared to that on carbon – 1. In other words, the polar C – Cl bond induces polarity in the adjacent bonds. Such polarisation of σ-bond caused by the polarisation of adjacent σ-bond is referred to as the **inductive effect**. This effect is passed on to the subsequent bonds also but the effect decreases rapidly as the number of intervening bonds increases and becomes vanishingly small after three bonds.

iii. Heterolytic fission

A covalent bond can get cleaved either by : (i) ***heterolytic cleavage***, or by (ii) ***hemolytic cleavage***.
In ***heterolytic cleavage***, the bond breaks in such a fashion that the shared pair of electrons remains with one of the fragments. After heterolysis, one atom has a sextet electronic structure and a positive charge and the other, a valence octet with at least one lone pair and a negative charge. Thus, heterolytic cleavage of bromomethane will give $CH_3^{\,+}$ and Br^- as shown below.



Q 6 B Write the IUPAC names for the following compounds by rewriting the structures — **2**

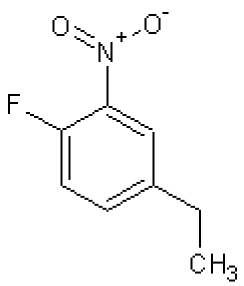
I  II  III  IV 

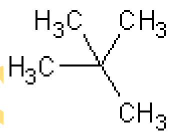
Ans:- 2-chloro-2-methylpropane pentan-3-one Methoxy ethane Ethanoic acid

OR

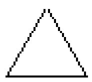
Q 6 B Write the structures for the following compounds by rewriting their IUPAC names — **2**

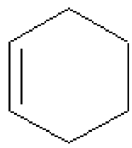
Ans:-





I. 4-Ethyl-1-fluoro-2-nitrobenzene II. 2,2-Dimethylpropane





III. Cyclopropane IV. Cyclohexene.

Q 6 C Write the bond line formulas for the following compounds — **2**

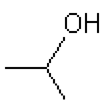
a) Propan-2-ol

b) 1,2-dimethylcyclohexane

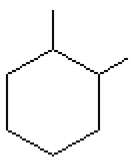
c) But-2-ene

d) 2-methylpentane

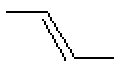
Ans:-



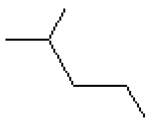
a)



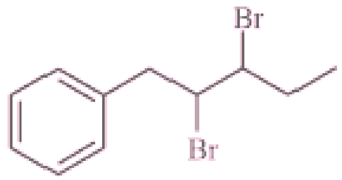
b)



c)



d)

Q 6 D	Differentiate between nucleophiles and electrophiles giving examples of each. A reagent that brings an electron pair is known as nucleophile, and a reagent that takes away an electron pair is called as Electrophile. Exmples. Nucleophile among the following are : HS^-, $C_2H_5O^-$, NH_2^- Electrophile among the following are : BF_3, NO_2^+	**2**
Q 6 E	Draw the structural formula of 2,3 - Dibromo -1 - phenylpentane, 	**1**

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