

Strictly As Per
Boards
New Syllabus

My Favorite Guide on **CHEMISTRY**

रसायनशास्त्र

STD - 11th (Science)



महाराष्ट्रात प्रथमच...

11th आणि 12th (Science) ची पुस्तके
English व Scientific मराठी मधून...

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TOPIC - 01

SOME BASIC CONCEPTS OF CHEMISTRY

1.1 Introduction:

Chemistry is the study of matter, its physical and chemical properties and the physical and chemical changes it undergoes under different conditions.

Chemistry is a central science. Its knowledge is required in the studies of physics, biological sciences, applied sciences, and earth and space sciences. The scope of chemistry is in every aspect of life, for example, the air we breathe, the food we eat, the fluids we drink, our clothing, transportation and fuel supplies, and so on.

Though it is an ancient science, due to development and advancement in science and technology, chemistry has developed as modern science. Technological development in sophisticated instruments expanded our knowledge of chemistry which, now, has been used in applied sciences such as medicine, dentistry, engineering, agriculture and in daily home use products.

1.2 Nature of Chemistry

Q.1 Define Chemistry

Ans: *Chemistry is the study of matter, its physical and chemical properties and the physical and chemical changes it undergoes under different conditions.*

Q.2 Give the names of Various branches of chemistry

Ans: Chemistry is traditionally classified into five branches:

- i) Organic chemistry
- ii) Inorganic chemistry
- iii) Physical chemistry
- iv) Biochemistry
- v) Analytical chemistry

Q.3. Explain the following terms:

- i) Organic chemistry
- ii) Inorganic chemistry
- iii) Physical chemistry

Ans: i) Organic chemistry: *It deals with properties and reactions of compounds of carbon.*

ii) Inorganic chemistry: *It deals with the study of all the compounds which are not organic.*

iii) Physical chemistry: *It deals with the study of properties of matter, the energy changes and the theories, laws and principles that explain the transformation of matter from one form to another. It also provides basic framework for all the other branches of chemistry.*

Q.4 Explain: Types of matter on the basis of chemical composition

Ans: Matter on the basis of chemical composition can be classified as follows:

A) Pure substances: They always have a definite chemical composition. They always have the same properties regardless of their origin.
e.g. Pure metal, distilled water, etc.

They are of two types:

- a) Elements
- b) Compounds

a) Elements: *They are pure substances, which cannot be broken down into simpler substances by ordinary chemical changes.*

Elements are further classified into three types:

1) Metals:

- i) They have a lustre (a shiny appearance).
- ii) They conduct heat and electricity.
- iii) They can be drawn into wire (ductile).
- iv) They can be hammered into thin sheets (malleable).
e.g. Gold, silver, copper, iron. Mercury is a liquid metal at room temperature.

2) Nonmetals:

- i) They have no lustre (except diamond, iodine)
- ii) They are poor conductors of heat and electricity. (except graphite)
- iii) They cannot be hammered into sheets or drawn into wire, because they are brittle.
e.g. Iodine

3) Metalloids: *Some elements have properties that are intermediate between metals and nonmetals and are called metalloids or semimetals.*

e.g. Arsenic, silicon and germanium.

b) Compounds: *They are the pure substances which are made up of two or more elements in fixed proportion.*
e.g. Water, ammonia, methane, etc.

B) Mixtures: They have no definite chemical composition and hence no definite properties. They can be separated by physical methods.
e.g. Paint (mixture of oils, pigment, additive), concrete (a mixture of sand, cement, water), etc.

Mixtures are of two types:

1) Homogeneous mixture: *In homogeneous mixture, constituents remain uniformly mixed throughout its bulk.*
e.g. Solution, in which solute and solvent molecules are uniformly mixed throughout its bulk.

2) Heterogeneous mixture: *In heterogeneous mixture, constituents are not uniformly mixed throughout its bulk.*
e.g. Suspension, which contains insoluble solid in a liquid.

Q.5 Give one example of each

i) Homogeneous mixture

ii) Heterogeneous mixture

iii) Element

iv) Compound

Ans: i) Homogeneous mixture: Solution

ii) Heterogeneous mixture: Suspension

iii) Element: Gold

iv) Compound: Distilled water

Q.6 Distinguish between

1) Mixtures and pure substances

2) Mixtures and compounds

Ans: 1) Mixtures and pure substances

No	Mixtures	Pure substances
i	Mixtures have no definite chemical composition.	Pure substances have a definite chemical composition.
ii	Mixtures have no definite properties.	Pure substances always have the same properties regardless of their origin.
iii	e.g. Paint (mixture of oils, pigment, additive), concrete (a mixture of sand, cement, water), etc.	e.g. Pure metal, distilled water, etc.

2) Mixtures and compounds:

No	Mixtures	Compounds
i	Mixtures have no definite chemical composition.	Compounds are made up of two or more elements in fixed proportion.
ii	The constituents of a mixture can be easily	The constituents of a compound cannot be

	separated by physical method.	easily separated by physical method.
iii	e.g. Paint (mixture of oils, pigment, additive), concrete (a mixture of sand, cement, water), etc.	e.g. Water, table salt, sugar, etc.

Q.7 Explain: States of matter

Ans: There are three different states of matter as follows:

i) Solid: Particles are held tightly in perfect order. They have definite shape and volume.

ii) Liquid: Particles are close to each other but can move around within the liquid.

iii) Gas: Particles are far apart as compared to that of solid and liquid. These three states of matter can be interconverted by changing the conditions of temperature and pressure.

1.3 Properties of matter and their measurement:

Q.8 Explain: Physical and chemical properties

Ans: i) Physical properties: *These are properties which can be measured or observed without changing the identity or the composition of the substance.*

e.g. Colour, odour, melting point, boiling point, density, etc.

ii) Chemical properties: *These are properties in which substances undergo change in chemical composition.*

e.g. Coal burns in air to produce carbon dioxide, magnesium wire burns in air in the presence of oxygen to form magnesium oxide, etc.

Q.9 How are properties of matter measured?

Ans: Measurement of properties of matter:

i) Measurement involves comparing a property of matter with some fixed standard which is reproducible and unchanging.

ii) Properties such as mass, length, area, volume, time, etc. are quantitative in nature and can be measured.

iii) A quantitative measurement is represented by a number followed by units in which it is measured.

iv) These units are arbitrarily chosen on the basis of universally accepted standards.

e.g. Length of class room can be expressed as 10 m. Here, 10 is the number and 'm' is the unit 'metre' in which the length is measured.

Scientific मराठी स्पष्टीकरण:

Analytical chemistry (विश्लेषणात्मक रसायानशास्त्र): हि chemistry ची अशी branch आहे कि, यामध्ये substances च्या separation (विभक्तन), Identification (ओळख), composition (संघटन) व quantitative determination (परिमाणात्मक निर्धारण) यांचा अभ्यास केला जातो.

Quantitative analysis (मापात्मक विश्लेषण) - organic compounds मधील एखाद्या element चे percentage composition (शेकडा प्रमाण) ठरविण्यासाठी वापरण्यात येणा-या techniques ला quantitative analysis म्हणतात.

Accuracy (अचुकता): Measurement (मापनातील) True value (सत्य किंमत) किंवा known value (माहित असलेल्या किंमतीशी) असलेला closeness (निकटवर्तीपणा) म्हणजेच accuracy (अचुकता) होय.

Absolute error (केवल दोष): Mean value (मध्य किंमत) व each measured value (मोजलेली प्रत्येक किंमत) यांच्यामधील difference (फरकाला) absolute error असे म्हणतात. उदा. वरील प्रश्नातील formula पहा.

Relative error (सापेक्ष दोष): भौतिक राशीच्या मापनामध्ये mean absolute error व mean value यांच्या ratio (गुणोत्तराला) relative error असे म्हणतात, याचे सूत्र प्रश्नामध्ये दिले आहे.

Chemical Stoichiometry (रासायनिक सूत्रमिती): Chemical Stoichiometry (रासायनिक सूत्रमिती) ही एक अशी process (प्रक्रिया) आहे कि, यामध्ये formula (सुत्रे) व balanced chemical equations (संतुलीत रासायनिक समीकरणाद्वारे), calculation केले जाते.

Significant Figures (सार्थ अंक): Significant figure हि एक significance (सार्थ) figure असते, त्याच्यामध्ये certainty (निश्चितता) ची आवश्यकता नसते

Rules for determining the significant figures (सार्थ अंक ठरविण्याचे नियम):

- Physical quantity (भौतिक राशीच्या) मापनामध्ये एकच uncertain (अनिश्चित) retain (बाकी) ठेवा.
- जेव्हा measurement (मापनाची) किंमत, दिलेल्या सार्थ अंकांपर्यंत अंदाजे लिहायची असेल, तेव्हा जर सोडून देण्याचा अंक ५ पेक्षा लहान असेल, तर शेवटचा सार्थ अंक तसाच ठेवावा. जर सोडून देण्याचा अंक ५ किंवा ५ पेक्षा मोठा असेल तर शेवटचा सार्थ अंक एकाने वाढवावा.

iii) कोणत्याही अंकाची उजवीकडची शुन्ये significant (सार्थ) असतात, कारण त्यामुळे measurement (मापनासाठी) वापरलेल्या instruments (उपकरणाच्या) accuracy (अचूकतेचा) निर्देश होतो.

iv) अंकाच्या डावीकडची शुन्ये not significant (निरर्थक) असतात. उदा. Number ०.०७५३ या संख्येत तीनच significant figures आहेत.

iv) जर significant figures (सार्थ अंकापेक्षा) जास्त digits (अंकाचा) आकडा असेल, तर तो १० च्या घातात दाखवावा.

उदा. पृथ्वीचे mass ५.९८×१०^{२४} kg हे असे दाखविले जाते, कारण ते mass तीनच significant figures पर्यंत माहिती आहे.

Empirical formula (अनुमात्रिक सूत्र)- एखाद्या संयुगाच्या एका रेणुमधील प्रत्येक मुलद्रव्याच्या अणुंचे एकमेकाशी असलेले पूर्णांकातील गुणोत्तर म्हणजेच त्या organic compound चा empirical formula होय.

Molecular formula (रेण्वीय सूत्र)- एखाद्या संयुगाच्या एका रेणुमधील प्रत्येक मुलद्रव्याचे प्रत्यक्ष असलेले atoms (अणु) म्हणजेच त्या compound चा molecular formula होय.

Mole fraction (ग्रॅमरेणू अंश) - एखाद्या solute चा mole fraction म्हणजेच त्या solute मध्ये असणारे number of moles (ग्रॅम रेणू) आणि दिलेल्या solution आणि solute मधील एकूण ग्रॅम रेणू यांच्या ratio ला Mole fraction (ग्रॅमरेणू अंश) असे म्हणतात. प्रश्नातील formula पहा.

Molarity (ग्रॅमरेणुता)- १ लिटर द्रावणातील द्राव्याच्या number of mole (ग्रॅम रेणूच्या अंशाला) Molarity (ग्रॅमरेणुता) असे म्हणतात. प्रश्नातील formula पहा.

Molality (मोललता) - प्रति १ किलो (१००० gm) solvent (द्रावकामध्ये) विरघळणा-या solute (द्राव्याच्या) number of moles (ग्रॅम रेणूला) Molality (मोललता) म्हणतात. प्रश्नातील formula पहा.

SI units - १९६० मध्ये general conference of weights and measure (वजने व मापे यांच्या आंतरदेशिय सर्वसाधारण परिषदेत) International system of unit (SI system) अशा नावाची सामाईक एकक पद्धती अवलंबण्यात आली, या आंतरराष्ट्रीय मान्यतेच्या SI units या एकक पद्धतीमध्ये सात fundamental SI units (मुलभुत एकके) समाविष्ट करण्यात आली.

जसे कि, mass चे SI unit, kilogram आहे.

2.7 Concentration of solution

Q.49 Give the formula to obtain mass percent.

Ans: Mass percent (w/w%) = $\frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 100$

Q.50 Explain the following terms

i) Mole fraction

ii) Molarity

iii) Molality

Ans: i) Mole fraction: Mole fraction is the ratio of number of moles of a particular component of a solution to the total number of moles of the solution.

If a substance 'A' dissolves in substance 'B' and their number of moles are n_A and n_B , respectively, then the mole fraction of A and B are given as:

$$\begin{aligned}\text{Mole fraction of A} &= \frac{\text{Number of moles of A}}{\text{Number of moles of solution}} \\ &= \frac{n_A}{n_A + n_B}\end{aligned}$$

$$\begin{aligned}\text{Mole fraction of B} &= \frac{\text{Number of moles of B}}{\text{Number of moles of solution}} \\ &= \frac{n_B}{n_A + n_B}\end{aligned}$$

ii) Molarity: Molarity is defined as the number of moles of the solute present in 1 litre of the solution. It is the most widely used unit and is denoted by M.

Molarity is expressed by,

$$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$$

iii) Molality: Molality is the number of moles of solute present in 1 kg of solvent. It is denoted by m.

Molality is expressed by,

$$\text{Molality (m)} = \frac{\text{Number of moles of solute}}{\text{Mass of solvent in kilograms}}$$

Q.51 Why does molarity of a solution depend upon temperature?

Ans: i) Molarity is the number of moles of the solute present in 1 litre of the solution. Therefore, molarity depends on the volume of the solution.

ii) Volume of the solution varies with the change in temperature.

Hence, molarity of a solution depends upon temperature.

Q.52 What do you mean by SI units? What is the SI unit of mass?

Ans: SI units: In 1960, the general conference of weights and measures proposed revised metric system, called International system of Units i.e. SI units, abbreviated from its French name.

The SI unit of mass is kilogram (kg).

2.8 Use of graph in analysis

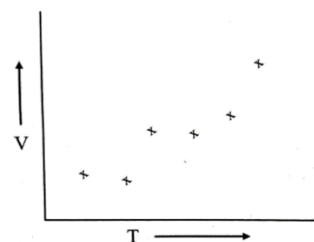
Q.53 Explain use of graphs in analytical chemistry.

Ans: Use of graphs in analytical chemistry:

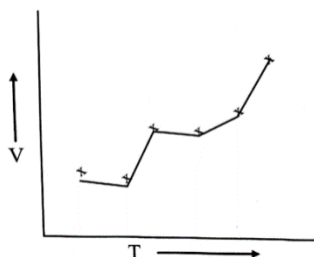
i) Analytical chemistry often involves deducing some relation between two or more properties of matter under study.

ii) For example, the relation between temperature and volume of a given amount of gas.

A set of experimentally measured values of volume and temperature of a definite mass of a gas upon plotting on a graph paper appears as in the figure below:

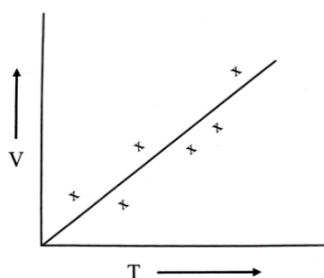


iii) When the points are directly connected, a zig zag pattern results as shown below:

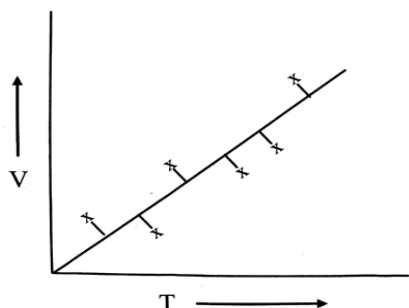


From the above pattern, no meaningful result can be deduced.

iv) A smooth curve (or average curve) passing through these points can be drawn as shown below. This straight line is consistent with the $V \propto T$.



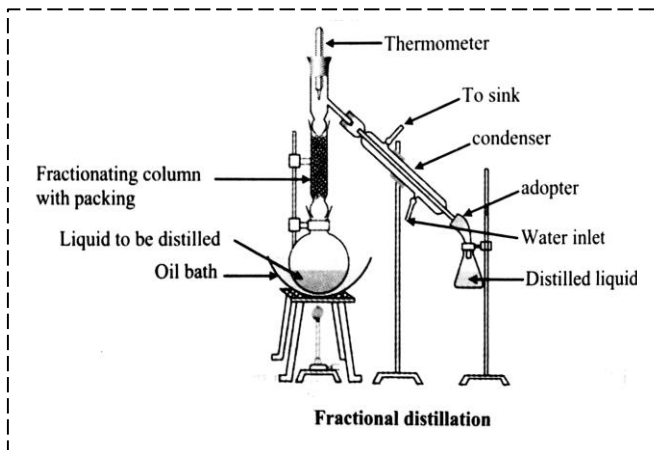
v) While fitting the points into a smooth curve, all the plotted points should be evenly distributed. This can be verified mathematically, by drawing a perpendicular from each point to the curve. The perpendicular represents deviation of each point from the curve. Take sum of all the perpendiculars on side of the line and sum of all the perpendiculars on another side of the line separately. If the two sums are equal (or nearly equal), the curve drawn shows the experimental points in the best possible representation.



Q.15 Explain fractional distillation process.

Ans: Fractional distillation process:

- i) In fractional distillation, vapours first pass through the fractionating column.
- ii) Vapours of more volatile liquid with lower boiling point rise up more than the vapours of liquid having higher boiling point.



e.g. a) Suppose we have a mixture of two liquid 'A' and 'B' having boiling points 363 K and 373 K respectively.

b) 'A' is more volatile and 'B' is less volatile. As the mixture is heated, vapours of 'A' along with a little vapours of 'B' rise up and come in contact with the large surface of the fractionating column.

c) Vapours of 'B' condense rapidly into the distillation flask. While passing through the fractionating column, there is an exchange between the ascending vapours and descending liquid. The vapours of 'B' are scrubbed off by the descending liquid, this makes the vapours richer in 'A'.

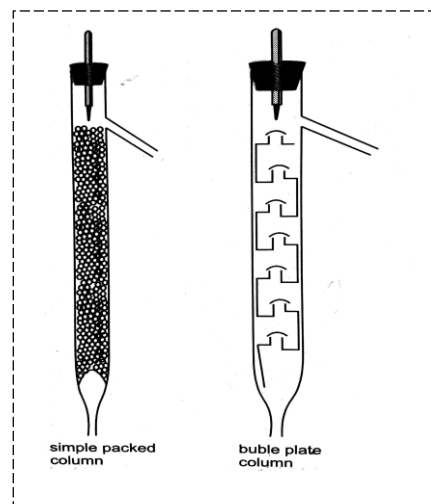
d) This process is repeated each time the vapours and liquid come in contact with the surface in the fractionating column.

e) Rising vapours become richer in 'A' and escape through the fractionating column and reach the condenser while the liquid in the distillation flask is richer in 'B'.

f) The separated components are further purified by repeating the process.

Q.16 Draw the figure of commonly used fractionating columns.

Ans:



Q.17 Distinguish between simple distillation and fractional distillation.

Ans: Simple distillation and Fractional distillation:

No	Simple distillation	Fractional distillation
i	If in a mixture the difference in boiling points of two liquids is appreciable/large, they are separated from each other using the simple distillation.	If in a mixture the difference in boiling points of two liquids is not appreciable/large, they are separated from each other using the fractional distillation.

ii	Simple distillation assembly is used.	fractionating column is fitted in distillation assembly.
e.g.	Mixture of acetone (b.p. 329 K) and water (b.p. 373 K) can be separated by this method.	Mixture of acetone (b.p. 329 K) and methanol (b.p. 337.7 K) can be separated by this method.

Q.18 Explain distillation under reduced pressure.**Ans: Distillation under reduced pressure:**

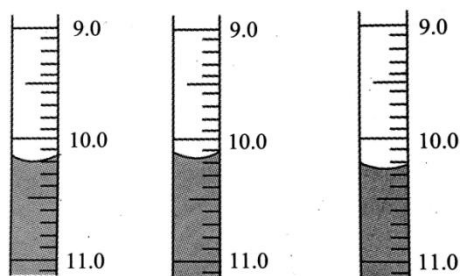
- i) Liquids having very high boiling points or which decompose on heating are purified by the method of distillation under reduced pressure.
 - ii) In this method, the liquid is made to boil at a temperature lower than its normal boiling point by reducing the pressure on its surface.
 - iii) The external pressure is reduced using a water pump or vacuum pump.
- e.g. Glycerol can be separated from soap by using this method.

Q.13 Define: Least count

Ans: Least count: *The smallest quantity that can be measured by the measuring equipment is called least count.*

Q.14 With the help of-burette readings, Explain accuracy depends upon the sensitivity.

Ans: A burette reading of 10.2 mL is as shown in the figure below:



- i) For all the three situations in the above figure, the reading would be noted is 10.2 mL.
- ii) It means that there is an uncertainty about the digit appearing after the decimal point in the reading 10.2 mL because the least count of the burette is 0.1 mL.
- iii) The meaning of the reading 10.2 mL is that the true value of the reading lies between 10.1 mL and 10.3 mL.
- iv) This is indicated by writing 10.2 ± 0.1 mL.

- v) Here the burette reading has an error of ± 0.1 mL.
- vi) Smaller the error, higher is the accuracy.

Q.15 Your laboratory partner was given the task of measuring the length of a box (approx. 5 in) as accurately as possible, using a metre stick graduated in millimeters. He supplied you with the following measurement:

12.65 cm, 12.6 cm, 12.65cm, 12.655cm, 126.55mm, 12cm.

- a) State which of the measurement you would accept, giving the reason.
- b) Give your reason for rejecting each of the others.

Ans: The metre stick is graduated in millimetres i.e. 1 mm = 0.1 cm. Therefore, if length is measured in centimetres, the least count of metre stick is 0.1 cm. The results 12.6 cm has the least count of 0.1 cm and is acceptable result.

Since, the least count of metre stick is 0.1 cm or 1 mm, the results such as 12.65 cm, 12.655 cm, 126.55 mm cannot be measured using this stick and hence, these results are rejected. The result, 12 cm doesn't include the least count and is rejected.

Q.16 Explain the terms:

- a) Absolute error
- b) Relative error
- c) Precision in measurement

Ans: a) Absolute error: Absolute error is calculated by subtracting true value from observed value.

Absolute error = Observed value – True value

b) Relative error: i) Relative error is the ratio of an absolute error to the true value.

ii) Relative error is generally a more useful quantity than absolute error.

iii) Relative error is expressed as a percentage and can be calculated as follows:

$$\text{Relative error} = \frac{\text{Absolute error}}{\text{True value}} \times 100\%$$

c) Precision in measurement: i) Multiple readings of the same quantity are noted to minimize the error.

ii) If the multiple readings of the same quantity match closely, they are said to have high precision.

iii) High precision implies reproducibility of the readings.

iv) High precision is a prerequisite for high accuracy.

v) Precision is expressed in terms of deviation (i.e. absolute deviation and relative deviation).

Postulates of valence shell electron repulsion theory (इलेक्ट्रॉनसच्या जोडीतील प्रतिसारण सिध्दांत):

- कोणत्याही molecules चा आकार central atom (केंद्रिय अणुच्या) सभोवतालच्या valance shell (संयुज कवचातील) electron pair (इलेक्ट्रॉनच्या जोड्यांच्या) संख्येवर अवलंबून असते.
- Electrons pair (जोड्यांमधील) cloud (ढग) ऋण प्रभारीत असल्याने एकमेकांना repel (प्रतिसारीत) करतात
- त्यांच्यातील repulsion कमी करण्यासाठी electrons pair चे space मध्ये ठराविक स्थितीमध्ये occupation होते व त्यांच्यातील distance वाढते.
- Molecule मधील central atoms ची valence shell (संयुजा कवच) म्हणजे sphere (गोल) होय आणि ह्या electrons pairs त्याच्या पृष्ठावर असतात व त्यांच्यातील एकमेकांपासूनचे अंतर maximum असते.
- Multiple bond (बहुबंधातील) २ वा ३ electrons च्या जोड्या, एकच super pair (अधि-अति) जोडी म्हणून धरली जाते.
- एखादा molecule दोन किंवा जास्त resonance structure (प्रारूप रचनांमध्ये) असतो. तेव्हा त्याला VSEPR (संयुज कवच electron) जोडी प्रतिसारण सिध्दांत लागू पडतो.

a) NH₃ (अमोनिया) molecules चे VSEPR सिध्दांतानुसारचे structure: Ammonia (NH₃) molecule मध्ये एक nitrogen व तीन hydrogen atom असतात. NH₃ molecule मध्ये central nitrogen atom हा SP³ hybridisation करतो. central nitrogen atom चे SP³ hybridisation होत असताना चार SP³ hybridised orbital हे त्यांच्या समवेत मधील चार tetrahedron कडे कलते. ह्या molecule मधील ground state चे electron configuration 1s²2s²2p³ असे आहे, यामधील N-atom मधील SP³ hybridisation वरील प्रश्नामध्ये दिले आहे. NH₃ molecule चे molecular structure आणि त्याची Geometry (भूमीतीय रचना) याचे स्पष्टिकरण व त्याची figure प्रश्नामध्ये दिली आहे. त्याचे व्यवस्थित अवलोकन करा.

b) H₂O (water) molecule चे structure- Water molecule मध्ये एक oxygen व दोन hydrogen atom असतात, त्यामधील central atom oxygen हा SP³ hybridisation करतो यामधील चार SP³ hybridised orbitals चे tetrahedron च्या चार corner (कोपऱ्यांकडे) झुकतात.

Ground state मधील ह्या molecule चे electronic configuration वरील प्रश्नामध्ये दिले आहे. Water molecules मधील sp³ hybridisation प्रक्रिया व त्यांचे molecular structure आणि त्याची geometry चे स्पष्टिकरण प्रश्नामध्ये व्यवस्थित दिले आहे, त्याचे व्यवस्थित अवलोकन करा.

Valence (संयुज) bond theory ची गृहीतके:

- दोन atoms मधील covalent bond हा त्यांच्या atomic orbitals च्या अणुच्या अर्धरिक्त कक्षा चे overlapping झाल्यावर निर्माण होतो.

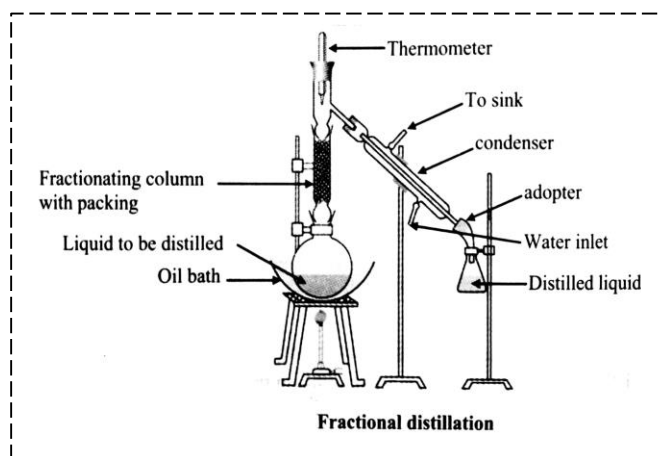
- Overlapping (ओलांडन किंवा आच्छादन) मध्ये सहभागी होणारे atomic orbitals (अणु कक्षा) हि opposite spins (विरुद्ध चक्रीय) गतीचा एकल अणु बाळगणारी पाहिजे.
- Overlapping मध्ये सहभागी होणाऱ्या atomic orbitals च्या उर्जा जवळपास सारख्याच हव्यात.
- Overlapping (अच्छादन प्रक्रियेदरम्यान) electrons ची spin (चक्रीय गती) neutralize (उदासिन) केली जाते.
- ह्या प्रक्रियेदरम्यान निर्माण होणाऱ्या covalent bond ची संख्या हि अणुच्या संयुज कक्षेतील unpaired electrons (एकल इलेक्ट्रॉन) इतकी असते.
- Covalent bond ची strength हि दोन अणुकक्षांच्या overlapping च्या extension (विस्तारावर) अवलंबून असते. यामध्ये जेवढे energy चे evolution (निर्मीती) जास्त, तेवढे overlapping जास्त होते व त्यामुळे bond अधिक मजबुत होतो.
- Overlapping ह्या प्रक्रियेदरम्यान दोन अणुंच्या केंद्रकांमधील electron density (घनता) वाढते, त्यामुळे bonded atoms च्या केंद्रकांमधील repulsion (प्रतिसारण) कमी होते, त्यामुळे system मधील उर्जा कमी होते.
- Molecules ची geometry (भूमीतीय रचना) व bond angle (बंध कोन) हा overlapping च्या orientation (दिशादेशनावर) अवलंबून असते.

i) Sigma (σ) bond (सिग्मा बंध): दोन atoms च्या दोन half filled (अर्धव्याप्त) atomic orbitals चे co-axil (समकक्षीय) किंवा रेखीय overlapping (अच्छादनामुळे) निर्माण झालेल्या covalent bond ला σ-bond असे म्हणतात. σ-bond तयार होताना, प्रत्यक्ष overlapping (अच्छादनाचा) भाग किंवा त्याचा overlapping region (विस्तार) जास्त असतो. त्यामुळे σ-bond जास्त strong (मजबुत) होतो तसेच मध्ये internuclear axis (आंतर अक्षावरील) दोन केंद्रकांदरम्यानची density (घनता) वाढते. प्रश्नामध्ये H₂ molecules मधील σ-bond दर्शविला आहे. त्याचे व्यवस्थित निरीक्षण करा.

ii) Pi (Π) bond (पाय बंध): दोन वेगवेगळ्या atoms च्या दोन half filled (अर्धव्याप्त) p-कक्षांच्या बाजूने lateral overlapping मुळे तयार झालेल्या covalent bond ला Pi (Π) bond असे म्हणतात. Pi bond तयार होताना, region of overlapping (अच्छादन विस्तार) कमी असतो. यामधील electron density area हा internuclear axis ला perpendicular असतो. वरील प्रश्नामध्ये दिलेली figure पहा, तुम्हाला pi bond ची संकल्पना लक्षात येईल.

Q.17 Distinguish between accuracy and precision.**Ans: Accuracy and Precision:**

No.	Accuracy	Precision
i	Accuracy refers to nearness of the measured value to the true value.	Precision refers to closeness of multiple readings of the same quantity.
ii	Accuracy represents error with respect to true value.	Precision represents error in the repeated measurements.
iii	Accuracy is expressed in terms of absolute error and relative error.	Precision is expressed in terms of absolute deviation and relative deviation.



e.g. a) Suppose we have a mixture of two liquid 'A' and 'B' having boiling points 363 K and 373 K respectively.

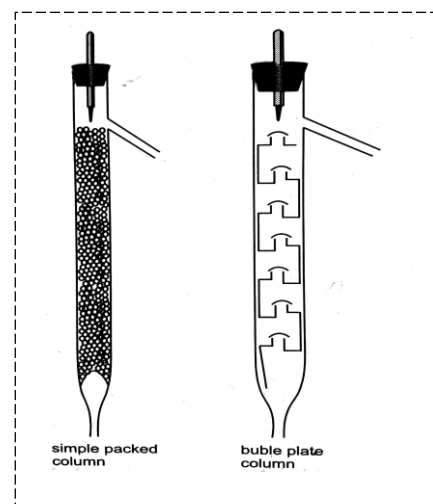
b) 'A' is more volatile and 'B' is less volatile. As the mixture is heated, vapours of 'A' along with a little vapours of 'B' rise up and come in contact with the large surface of the fractionating column.

c) Vapours of 'B' condense rapidly into the distillation flask. While passing through the fractionating column, there is an exchange between the ascending vapours and descending liquid. The vapours of 'B' are scrubbed off by the descending liquid, this makes the vapours richer in 'A'.

d) This process is repeated each time the vapours and liquid come in contact with the surface in the fractionating column.

e) Rising vapours become richer in 'A' and escape through the fractionating column and reach the condenser while the liquid in the distillation flask is richer in 'B'.

f) The separated components are further purified by repeating the process.

Q.16 Draw the figure of commonly used fractionating columns.**Ans:****Q.17 Distinguish between simple distillation and fractional distillation.****Ans: Simple distillation and Fractional distillation:**

No	Simple distillation	Fractional distillation
i	If in a mixture the difference in boiling points of two liquids is appreciable/large, they are separated from each other using the simple distillation.	If in a mixture the difference in boiling points of two liquids is not appreciable/large, they are separated from each other using the fractional distillation.
ii	Simple distillation assembly is used.	fractionating column is fitted in distillation assembly.
e.g.	Mixture of acetone (b.p. 329 K) and water (b.p. 373 K) can be separated by this method.	Mixture of acetone (b.p. 329 K) and methanol (b.p. 337.7 K) can be separated by this method.

Q.18 Explain distillation under reduced pressure.**Ans: Distillation under reduced pressure:**

i) Liquids having very high boiling points or which decompose on heating are purified by the method of distillation under reduced pressure.

ii) In this method, the liquid is made to boil at a temperature lower than its normal boiling point by reducing the pressure on its surface.

iii) The external pressure is reduced using a water pump or vacuum pump.

e.g. Glycerol can be separated from soap by using this method.

3.4 Solvent Extraction

Q.19 Define: Solvent extraction

Ans: Solvent extraction: Solvent extraction is a method used to separate an organic compound present in an aqueous solution, by shaking it with a suitable organic solvent in which the compound is more soluble than water.

Q.20 Which properties of solvents are useful for solvent extraction?

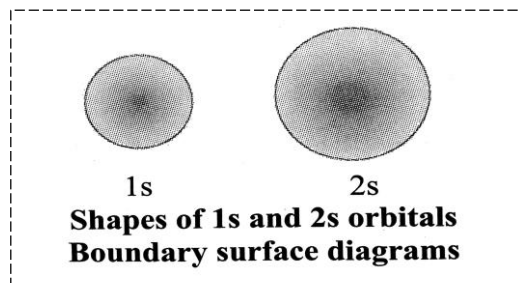
Ans: i) Organic compound must be more soluble in the organic solvent, than in water.

Q.39 What is 'boundary surface diagram'?

Ans: Boundary surface diagram: A boundary surface is drawn in space for an orbital such that the value of probability density (Ψ^2) is constant and encloses a region where the probability of finding electron is typically more than 90%. Such a boundary surface diagram is a good representation of shape of an orbital. e.g. Boundary surface diagram of 1s and 2s orbitals are spherical in shape.

Q.40 Explain the shape of s orbital.

Ans: Shape of s orbital:



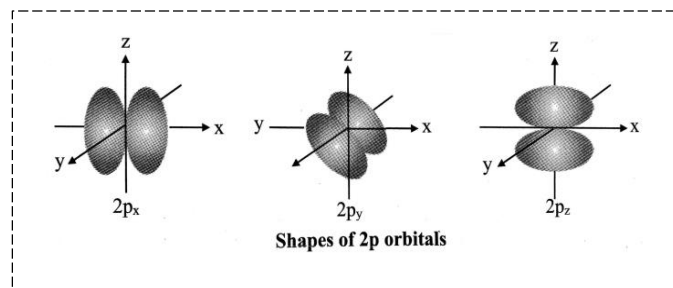
i) For each value of principal quantum number 'n', there is only one s-orbital.

ii) For s-orbital, $l = 0$ and $m_l = 0$, hence s-orbital has only one orientation i.e., the probability of finding the electrons is same in all directions. Thus, s-orbital is spherically symmetrical around the nucleus.

iii) The value of n determines the size of an orbital. With increase in the value of n , the size of the s-orbital increases.

Q.41 Explain the shape of 2p orbitals.

Ans: Shape of 2p orbitals:



i) For p orbital, $l = 1$. For $l = 1$, $m_l = +1, 0, -1$. Thus, p orbitals have three orientations.

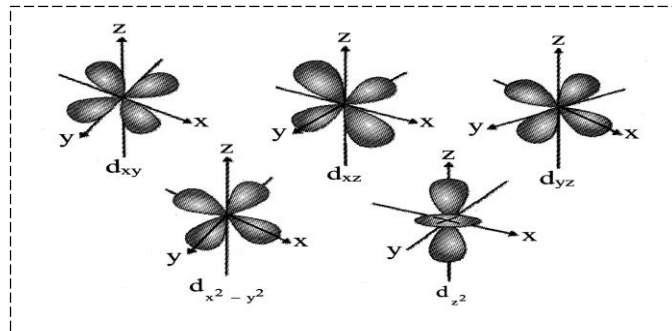
ii) Each orbital has two lobes on the two sides of a nodal plane passing through the nucleus.

iii) Shape of 2p orbitals resembles a dumbbell.

iv) The size and energy of the three 2p orbitals are the same. However, their orientations in space are different. The lobes of the three 2p orbitals are along the x, y and z axes. Accordingly, the corresponding orbitals are designated as $2p_x$, $2p_y$ and $2p_z$. The size and energy of the orbitals in p subshell increase with the increase of principal quantum number.

Q.42 Explain shape of 3d orbitals.

Ans: Shape of 3d orbitals:



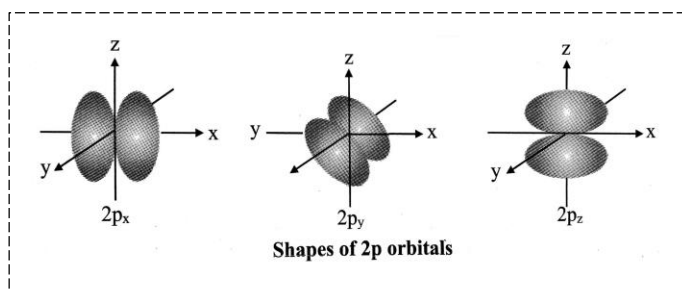
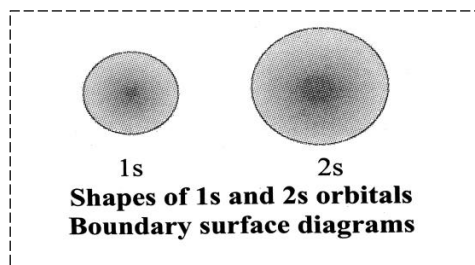
i) For d orbital, $l = 2$. For $l = 2$, $m = +2, +1, 0, -1, -2$. Thus, d orbitals have five orientations.

ii) They are designated as d_{xy} , d_{yz} , d_{zx} , $d_{x^2-y^2}$ and d_{z^2} .

iii) Shape of 3d orbitals are shown in the following figure. The first three have double dumb-bell shape. They lie in xy, yz and xz plane, respectively. The $d_{x^2-y^2}$ is also dumb-bell shape and lies along the x and y axes.

iv) In spite of difference in their shapes, the five d orbitals are equivalent in energy. The shapes of 4d, 5d, 6d orbitals are similar to those of 3d orbitals, but their respective size and energies are large or they are said to be more diffused.

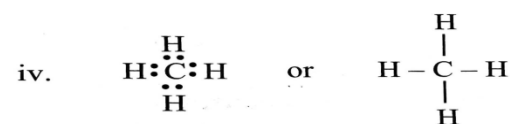
Ans: Shapes of 2s and 2p orbitals:



i) Hydrogen (H_2) ii) Water (H_2O)
iii) Carbon dioxide (CO_2) iv) Methane (CH_4)
v) Lithium fluoride (LiF)

ii. $\text{H}:\ddot{\text{O}}:\text{H}$ or $\text{H}-\ddot{\text{O}}-\text{H}$

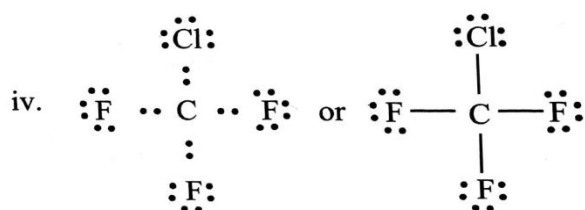
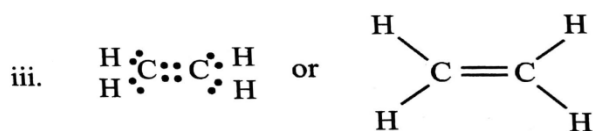
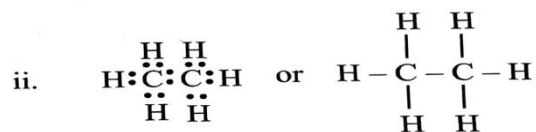
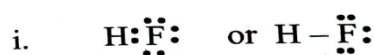
iii. $\ddot{\text{O}}::\text{C}::\ddot{\text{O}}$ or $\ddot{\text{O}}=\text{C}=\ddot{\text{O}}$



v. $\text{Li} \cdot \cdot \ddot{\text{F}} \cdot \cdot$ or $\text{Li} - \text{F}$

i) HF ii) C₂H₆ iii) C₂H₄
iv) CF₃Cl v) SO₄

Ans:



Ans: Formal Charge: Formal charge is the charge assigned to an atom in a molecule, assuming that all electrons are shared equally between atoms, regardless of their relative electronegativities. While determining the best Lewis structure per molecule the structure is chosen such that the formal charge is as close to zero as possible. The structure having the lowest formal charge has the lowest energy. Formal charge is assigned to an atom based on electron dot structures of the molecule/ion.

Formal charge on an atom in a Lewis structure of a polyatomic species can be determined using the following formula:

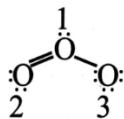
$$\left[\begin{array}{l} \text{Formal charge} \\ \text{on an atom in a} \\ \text{Lewis structure} \end{array} \right] = \left[\begin{array}{l} \text{Total no. of} \\ \text{valence electrons} \\ \text{in free atom} \end{array} \right]$$

$$-\left[\begin{array}{c} \text{Total no. of non} \\ \text{bonding or lone} \\ \text{pairs of electrons} \end{array} \right] - 1/2 \left[\begin{array}{c} \text{Total no. of} \\ \text{bonding or} \\ \text{shared electrons} \end{array} \right]$$

OR

$$\mathbf{F.C.} = \mathbf{V.E.} - \mathbf{N.E.} - (\mathbf{B.E./2})$$

Lewis structure of O_3 :



Here three oxygen atoms are numbered as 1, 2, 3. The formal charge on the central oxygen atom no. 1

$$= 6 - 2 - 1/2(6) = +1$$

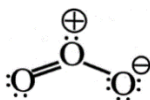
Formal charge on the end oxygen atoms is marked as 2

$$= 6 - 4 - 1/2(4) = 0$$

Formal charge on the end oxygen atoms marked as 3

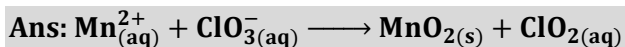
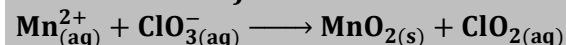
$$= 6 - 6 - 1/2(2) = -1$$

Hence, O_3 molecule can be represented along with formal charge as follows:

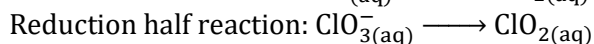
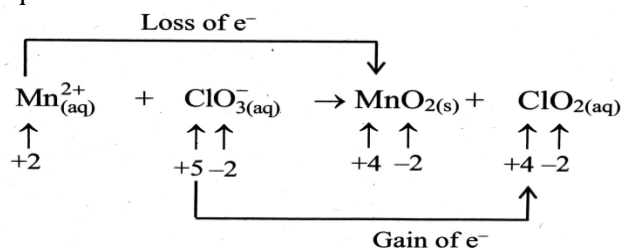


The lowest energy structure can be selected using formal charge from the number of possible Lewis structures, for a given species.

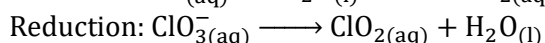
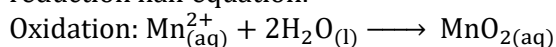
Q.34 Balance the following unbalanced equation (in acidic medium) by ion electron method (half reaction method).



Step 1: Write unbalanced equation for the redox reaction. Assign oxidation number to all the atoms in reactants and products. Divide the equation into two half equations.

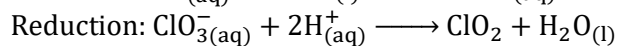
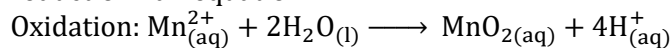


Step 2: Balance the atoms except O and H in each half equation. Balance half equations for O atoms by adding H_2O to the side with less O atoms. Add $2H_2O$ to left side of oxidation half equation and $1H_2O$ to the right side of reduction half equation.

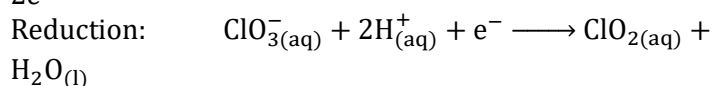
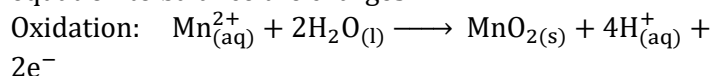


Step 3: Balance H atoms by adding H^+ ions to the side with less H. Hence add $4H^+$ ions to the right side of

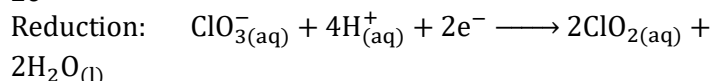
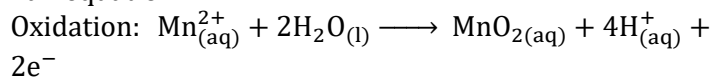
oxidation half equation and $2H^+$ ions to the left side of reduction half equation.



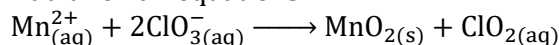
Step 4: Now add 2 electrons to the right side of oxidation half equation and 1 electron to the side of reduction half equation to balance the charges.



Step 5: Multiply reduction half equation by 2 to equalize number of electrons in two half equations. Then add two half equation.

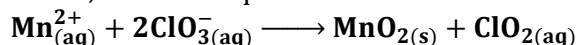


Add two half equations:

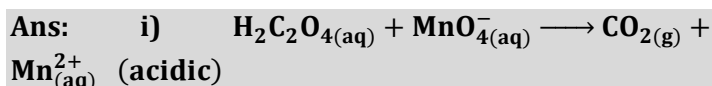
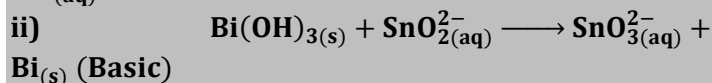
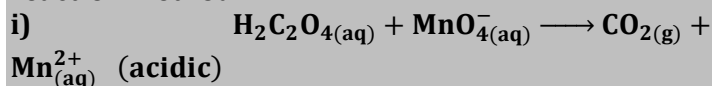


The equation is balanced in terms of number of atoms and the charges.

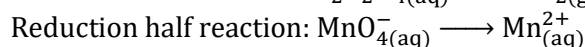
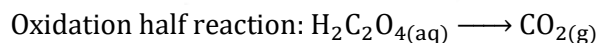
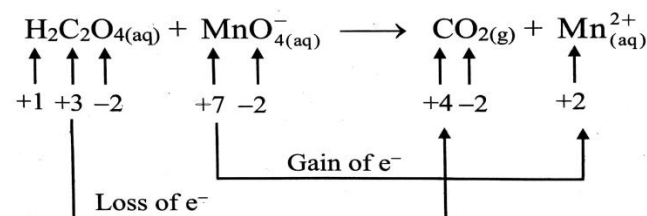
Hence, balanced equation:



Q.35 Balance the following redox equation by half reaction method:



Step 1: Write unbalanced equation for the redox reaction. Assign oxidation number to all the atoms in reactants and products. Divide the equation into two half equations.



i) Intermolecular forces (आंतररेणू बल / आंतर रेण्वीय बल):

हि अशी forces of attraction (आकर्षीय बले) आहेत कि, त्यांच्या molecular diameter (रेण्वीय व्यासापेक्षा) कमी अंतरावर असणा-या शेजारच्या रेणूंमधील आकर्षणाची बले असतात. Molecular interaction (रेण्वीय अन्योन्य क्रिया) या बलांना कारणीभूत असतात.

ii) Intramolecular forces (अंतररेणू बले): हि अशी बले आहेत कि, यामुळे atoms of molecules (रेणूंमधील घटक अणू) एकत्रित ठेवले जातात आणि यासाठी रेणूच्या आतील chemical bonds (रासायनिक बंध) जबाबदार असतात.

Intermolecular Interaction (आंतररेण्वीय अन्योन्य क्रियेचे प्रकार:

- Dipole- dipole interaction (द्विध्रुव- द्विध्रुव अन्योन्य क्रिया)
- Dipole- induced dipole interactions (द्विध्रुव-प्रेरित द्विध्रुव अन्योन्य क्रिया)
- Ion-dipole (आयन-द्विध्रुव अन्योन्य क्रिया)
- Dispersion forces (अपस्करण बले) किंवा London forces (लंडन बले)
- Hydrogen bonding

Dipole-dipole interaction (द्विध्रुव-द्विध्रुव अन्योन्य क्रिया):

i) ज्या molecules (रेणूंमध्ये) permanent dipole moment (स्थायी द्विध्रुव आघूर्ण) असते, अशा neighbouring (निकटच्या) molecules मध्ये dipole-dipole (द्विध्रुव-द्विध्रुव) interactions निर्माण होते, याचा परिणाम intermolecular (आंतररेण्वीय अन्योन्य क्रियेत) होतो.

ii) मुख्यत्वेकरून electrostatic force of attraction (विद्युत स्थितिक आकर्षण बले) हि dipole-dipole interactions चे मुळ असते.

उदा: HCl या द्विध्रुवी molecule मध्ये Hydrogen atom हा electropositive (विद्युत धन) atom आहे, आणि Chlorine हा electronegative (विद्युत ऋण) atom आहे.

H-Cl हि electron pair, Cl atom कडे जास्त खेचली जाते, त्यामुळे Cl वर सूक्ष्म negative charge (ऋण प्रभार) acquires (उपार्जित) होतो, त्याला ($\text{Cl}^{\delta-}$) असे दर्शविले जाते व Hydrogen वर सूक्ष्म positive charge (धन प्रभार) उपार्जित होतो, तो ($\text{H}^{\delta+}$) असे दर्शविले जाते. वरिल प्रश्नामध्ये figure मध्ये charge separate (प्रभार विभक्तन) झालेला HCl molecule दाखविला आहे.

iii) Charge separate झाल्यामुळे HCl चे molecule अशा रितीने align (संरेखित) होतात कि, oppositely charged ends (विरुद्ध प्रभाराची टोके) एकमेकांच्या जवळ येतात. प्रश्नामधील (figure) पहा.

iv) Dipole-dipole interaction (ध्रुव-ध्रुव अन्योन्य क्रिया) ची strength (सामर्थ्य) हे interaction करण्या-या molecules च्या dipole-moment (द्विध्रुवी आघूर्णावर) अवलंबून असते, म्हणजेच जितके moment अधिक तितके dipole-dipole interaction हि stronger असते.

v) केवळ polar molecules कि, ज्यामध्ये permanent non-zero dipole moment (स्थायी शुन्येतर द्विध्रुवी आघूर्ण) असते, तेंव्हा dipole-dipole interactions शक्य असते.

Dipole-induced dipole interaction (द्विध्रुवी-प्रेरित द्विध्रुव अन्योन्य क्रिया):

i) हे interaction (अन्योन्य क्रिया) permanent non-zero dipole moment (स्थायी द्विध्रुव अशुन्य आघूर्ण असणारे रेणू) व non-polar molecule with zero-dipole moment (शुन्य द्विध्रुव आघूर्ण असलेले अध्रुवी रेणू) यांच्या मध्ये होते.

ii) जेव्हा polar molecules (ध्रुवी रेणू) व non-polar molecules (अध्रुवी रेणू) हे रेणू परस्परांना निकट येतात, तेंव्हा polar molecules हे non-polar molecules वर dipole (द्विध्रुव) प्रेरित करतात, यामुळे electron charge cloud (इलेक्ट्रॉनिक प्रभाराचा अभ्र विरूपित होतो) आणि temporary charge separation (तात्पुरते प्रभाराचे विभक्त होते).

iii) याचे रुपांतर म्हणून charge separated polar molecules व charge induced non-polar molecules यांच्यामध्ये force of attraction (आकर्षणाचे बल) निर्माण होते. प्रश्नामध्ये याची diagram व्यवस्थीत दिली आहे.

उदा: polar ammonia molecules व non-polar benzene molecules यांच्यामध्ये force of attraction निर्माण होते, हे dipole-induced dipole interaction चे उदाहरण आहे.

Ion-dipole interaction (आयन-द्विध्रुव अन्योन्य क्रिया):

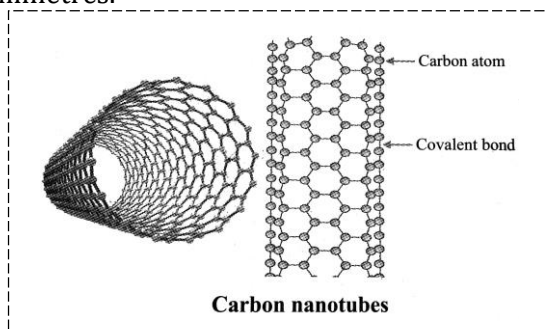
i) कोणत्याही ion, (anion किंवा cation) व oppositely charged (विरुद्ध प्रभार) असलेला polar molecule (ध्रुवी रेणू) यांच्यामधील interaction (अन्योन्य क्रिया) म्हणजेच ion-dipole interactions होय.

ii) Ion-dipole interaction (आयन-द्विध्रुव अन्योन्य क्रिया) ची strength खालील घटकांवर अवलंबून असते.

- Polar molecular च्या dipole moment (द्विध्रुव आघूर्णाचे) magnitude
- Polar molecules (ध्रुवी रेणू) ची size (आकार)
- Ion ची size
- Ion वरिल charge (प्रभार)

Structure of carbon nanotubes:

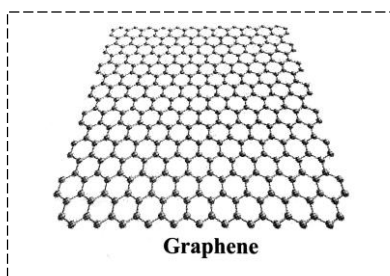
- i) Carbon nanotubes are cylindrical in shape consisting of rolled-up graphite sheet.
- ii) Nanotubes can be single – walled (SWNTs) with a diameter of less than 1 nm or multi – walled (MWNTs) with diameter reaching more than 100 nm.
- iii) Their lengths range from several micrometres to millimetres.



- iv) Carbon nanotubes are robust. They can be bent, and when released, they will spring back to the original shape.
- v) Carbon nanotubes have high electrical or heat conductivities and highest strength- to-weight ratio for any known material to date.
- vi) The researchers of NASA are combining carbon nanotubes with other materials into composites that can be used to build light weight spacecraft.

Q.26 What is graphene?**Ans: Graphene:**

- i) Isolated layer of graphite is called graphene.
- ii) Graphene sheet is a two dimensional solid.
- iii) It has unique electronic properties.

**Q.27 Find out the difference between: Diamond and graphite.****Ans: Diamond and graphite:**

No	Diamond
i	It has a three-dimensional network structure.
ii	In diamond, each carbon atom is sp^3 hybridized.

iii	Each carbon atom in diamond is linked to four other carbon atoms.
iv	Diamond is poor conductor of electricity due to absence of free electrons.
v	Diamond is the hardest natural substance.

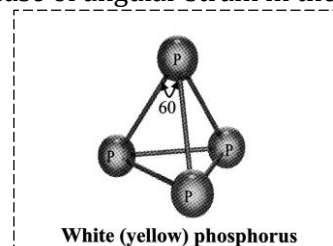
No	Graphite
i	It has a two-dimensional hexagonal layered structure.
ii	In graphite, each carbon atom is sp^2 hybridized.
iii	Each carbon atom in graphite is linked to three other carbon atoms.
iv	Graphite is good conductor of electricity due to presence of free electrons in its structure.
v	Graphite is soft and slippery.

Q.28 Explain the structure of various allotropes of phosphorus.

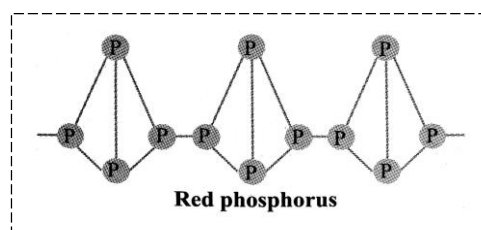
Ans: Allotropes of phosphorus: phosphorus is found in different allotropic forms. White and red phosphorus are important allotropes of phosphorus.

1) White (yellow) phosphorus:

- i) White (yellow) phosphorus consists of discrete tetrahedral P_4 molecules.
- ii) The $P - P - P$ bond angle is 60° .
- iii) White phosphorus is less stable and hence more reactive, because of angular strain in the P_4 molecule.

**2) Red phosphorus:**

- i) Red phosphorus consists of chains of P_4 linked together by covalent bonds.
- ii) Thus, it is polymeric in nature.



Boyles law (बॉईलसचा नियम)-Temperature (तापमान) स्थिर असताना दिलेल्या वस्तुमानाच्या वायुचा pressure (दाब) हा त्याच्या volume (आकारमानाच्या) व्यस्त प्रमानात असतो. म्हणजेच $P \propto \frac{1}{V}$ यानंतरचे सर्व simplification प्रश्नामध्ये दिले आहे.

Boyles law हा दुस-या प्रकारे असा मांडता येतो कि, दिल्याच्या वस्तुमानाच्या gas चा pressure व त्याचे volume यांचा गुणाकार हा constant temperature (स्थिर तापमानाला) constant स्थिर असतो.

Density (घनता) व pressure (दाब) यांच्यातील relation (संबंध) वरिल प्रश्नामध्ये formula (सुत्रांच्या) स्वरूपात दिला आहे. Density व pressure यांच्या definition व त्यांचे formula यावरून हे relation तयार केले आहे. यामध्ये महत्वाचे म्हणजे त्यांच्या formula किंवा equations मधील simplification तुमच्या लक्षात आले पाहिजे. सर्व काळजीपूर्वक वाचा व लक्षात ठेवा.

Charles law (चार्ल्सचा नियम): Constant pressure (दाब स्थिर) असताना दिलेल्या वस्तुमानाच्या gas चे volume (आकारमान) हे त्याच्या absolute temperature (निरपेक्ष तापमानाच्या) समप्रमाणात असते.

म्हणजेच $V \propto T$, $V = K.T$ यामध्ये K हा constant स्थिरांक असतो. यानंतर gas ची वेगवेगळी volume व त्यांचे समप्रमाणातील temperature वरून तयार झालेल्या formula (सुत्र), वरिल प्रश्नामध्ये दिले आहे. ते लक्षात ठेवा.

Gay Lussacs law (गे-ल्युसॅकचा नियम): At constant volume (आकारमान स्थिर) असताना दिलेल्या वस्तुमानाच्या gas चा pressure (दाब) हा त्याच्या temperature (तापमानाच्या) समप्रमाणात असतो. म्हणजेच $P \propto T$, $\therefore P = K.T$ यामध्ये K हा constant (स्थिरांक) आहे. यानंतर gas ची वेगवेगळी pressure व त्यांचे समप्रमाणातील वेगवेगळी Temperature (तापमाने) यावरून तयार झालेल्या formula प्रश्नामध्ये दिले आहे, ते लक्षात ठेवा.

Avogadros law (एव्होगाद्रोचा नियम)-

At constant temperature and pressure (तापमान व दाब स्थिर असताना), equal volume of all gases (सर्व वायुंच्या समसमान आकारमानात) equal number of molecules (समसमान संख्येचे रेणु) असतात. या statement चे simplification प्रश्नामध्ये दिले आहे, ते पहा.

Statement-II- At Constant temperature and pressure (स्थिर तापमान व दाब) असताना कोणत्याही gas चे volume (आकारमान) हे त्यात असलेल्या moles च्या संख्येच्या समप्रमाणात असतात.

Ideal gas equation (आदर्श वायुचा नियम)- ज्या expression (समिकरणावरून) pressure (दाब) व temperature (तापमान) यांचा gas च्या volume (आकारमानावर) होणारा combined effect (एकत्रित परिणाम) दाखविणारे expression म्हणजेच Ideal gas equation होय.

Ideal gas equation हे Boyles law, Charles law व Avogadros law यांच्या combination (एकत्रिकरणातून) तयार करता येते.

प्रश्नामध्ये आता उल्लेख केलेल्या तिनही laws वरून Ideal gas चे equation कसे तयार होते याचे simplification दिले आहे, त्याचे व्यवस्थित अवलोकन करा.

Gas constant (वायुच्या स्थिरांकाची) value (मुल्य) वेगवेगळ्या units मध्ये म्हणजेच R ची value हि L atm मध्ये, CGS units मध्ये joules मध्ये व calories मध्ये किती येते, याचे simplification वरील प्रश्नामध्ये दिले आहे, त्याचा व्यवस्थित अभ्यास करा.

Kinetic theory of gases ची postulates (आधारतत्त्वे)-

i) प्रामुख्याने gases (वायुमध्ये) अतिसूक्ष्म molecules असतात, म्हणजेच त्यामध्ये सूक्ष्मकण असतात. एकाच gas मध्ये असणाऱ्या molecules चे वस्तुमान व आकार हा एकसारखाच असतो, मात्र वेगवेगळ्या gases चे molecules चे वस्तुमान व आकार हा वेगवेगळा असतो.

ii) Gas molecules हे continuous (एकसलग) motion (गतिमध्ये) असतात. यामधील molecules हे शेजारच्या molecules वर तसेच container च्या wall वर collides (आदळतात).

iii) Gas मधील molecules च्या collisions (आघात) मुळे gas वर pressure (दाब) निर्माण होतो व हा सर्व दाब container (टार्की / पात्रा) च्या walls वर लावला जातो.

iv) Molecules- molecules मधील collision हे perfectly elastic असते, यामध्ये collision मुळे kinetic energy चा loss होत नाही, त्यामुळे निर्माण झालेले pressure तसेच स्थिर राहते.

v) Gas molecules मधील continuous (एकसलग) motion मुळे सर्व molecules हे एकाच स्थिर motion मध्ये असतात व त्यामुळे त्या molecules मध्ये kinetic energy निर्माण होते, ही kinetic energy ही तापमानावर अवलंबून असते.

vi) जर pressure कमी असेल व temperature जास्त असेल तर दोन gas molecules मधील average distance (सरासरी अंतर) हे खूप असते व त्यामुळे त्यांच्यामध्ये force of attraction (आकर्षीय बल) हे खूपच कमी असते.

vii) pressure कमी असताना व temperature जास्त असताना, एखाद्या gas molecules ने occupied (सामावलेले) volume (आकारमान) हे container च्या volume (आकारमानाच्या) तुलनेत अतिशय कमी असते. त्यामुळे प्रत्येक gas molecule ला त्यांच्या motion साठी पूर्ण container खुला असतो.

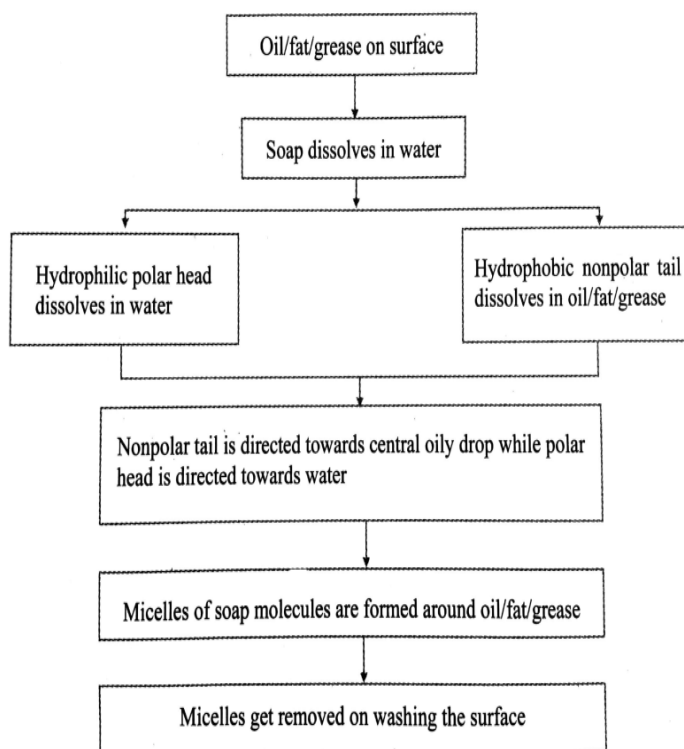
Q.52 Match the pairs.

	A group		B group
i	Paracetamol	a	Antibiotic
ii	Chloramphenicol	b	Synthetic detergent
iii	BHT	c	Soap
iv	Sodium stearate	d	Antioxidant
		e	Analgesic

Ans: i)=e, ii)=a, iii)=d, iv)=c

Q.53 Explain: Mechanism of cleansing action of soap with flow chart.

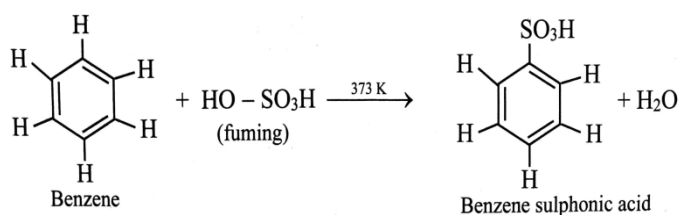
Ans: The following flow chart shows mechanism of cleansing action soap.



Q.94 Write a short note on sulphonation of benzene.

Ans: Sulphonation of benzene:

i) When benzene is heated with fuming sulfuric acid (oleum) at 373 K, it gives benzene sulfonic acid.



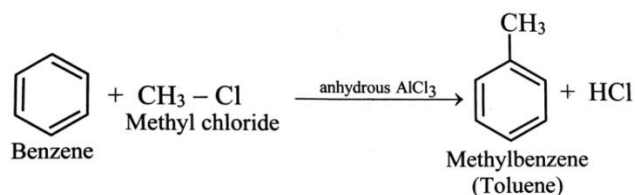
ii) Electrophile involved in the reaction: SO_3 , free sulphur trioxide

Formation of the electrophile: $2\text{H}_2\text{SO}_4 \longrightarrow \text{H}_3\text{O}^+ + \text{HSO}_4^- + \text{SO}_3$

Q.95 Write a short note on Friedel- Craft's alkylation reaction of benzene.

Ans: Friedel-Craft's alkylation reaction of benzene:

i) When benzene is treated with an alkyl halide like methyl chloride in the presence of anhydrous aluminium chloride, it gives toluene.

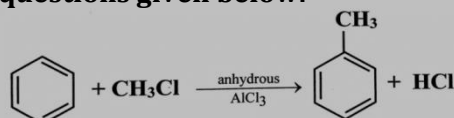


ii) Electrophile involved in the reaction: R^+

Formation of the electrophile: $R-Cl + AlCl_3 \longrightarrow R^+ + AlCl_4^-$

iii) Friedel-Craft's alkylation reaction is used to extend the chain outside the benzene ring.

Q.96 Read the following reaction and answer the questions given below:



i) Write the name of the reaction.

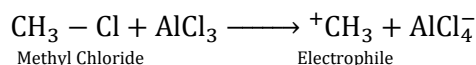
ii) Identify the electrophile in it.

iii) How is this electrophile generated?

Ans: i) The name of the reaction is Friedel-Craft's alkylation reaction.

ii) The electrophile in the reaction is $^+\text{CH}_3$.

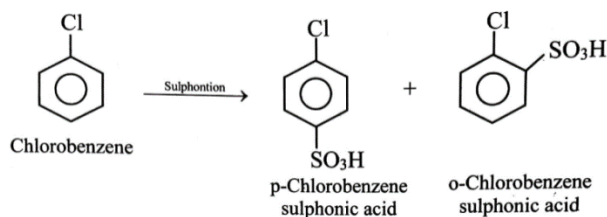
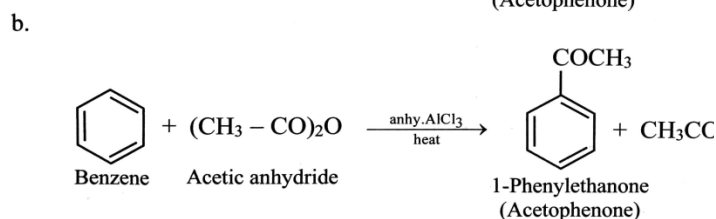
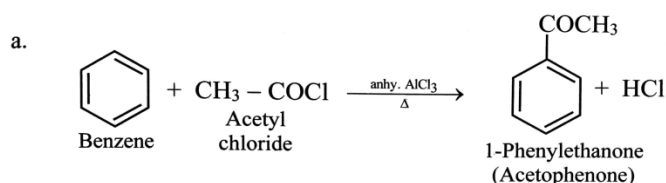
iii) The electrophile $^+\text{CH}_3$ is generated as follows:



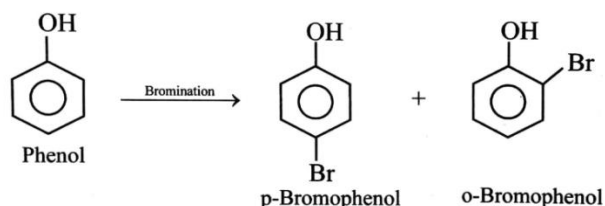
Q.97 Explain Friedel-Craft's acylation reaction of benzene. Give example reactions.

Ans: Friedel-Craft's acylation reaction of benzene:

i) When benzene is heated with an acyl halide or acid anhydride in the presence of anhydrous aluminium chloride, it gives corresponding acyl benzene.



iii) Phenolic -OH group is group and para directing group. So, bromination of phenol gives p-bromophenol and o-bromophenol.



ii) Electrophile involved in the reaction: $R-C^+=O$, acylium ion

Formation of the electrophile: $R-COCl + AlCl_3 \longrightarrow R-C^+=O + AlCl_4^-$

Q.98 Name two reagents used for acylation of benzene.

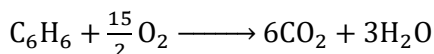
Ans: The two reagents used for acylation of benzene are:

i) CH3COCl (acetyl chloride) and anhydrous AlCl3

ii) (CH3CO)2O (acetic anhydride) and anhydrous AlCl3

Q.99 Write the combustion reaction of benzene.

Ans: When benzene is heated in air, it burns with sooty flame forming carbon dioxide and water.



Q.100 Predict the possible products of the following reactions.

i) Chlorination of nitrobenzene

ii) Sulphonation of chlorobenzene

iii) Bromination of phenol

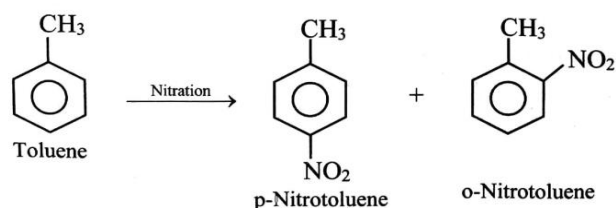
iv) Nitration of toluene

Ans: i) Nitro group is meta directing group. So, chlorination of nitrobenzene gives m-chloronitrobenzene.



ii) Chloro group is ortho and para directing group. So, sulphonation of chlorobenzene gives p-chlorobenzenesulphonic acid and o-chlorobenzenesulphonic acid.

iv) Methyl group is ortho and para directing group. So, nitration of toluene gives p-nitrotoluene and o-nitrotoluene.



Multiple Choice Questions

1) Which of the following compound has highest boiling point?

a) n-pentane b) Iso-butane c) Butane d) Neopentane

2) Acidic hydrogen is present in :

a) acetylene b) ethane
c) ethylene d) dimethyl acetylene

3) Major product of chlorination of ethyl benzene is --

a) m-chlorethyl benzene b) p - chloroethyl benzene
c) chlorobenzene d) o - chloroethylbenzene

4) 1 - chloropropane on treatment with alc. KOH produces:

a) propane b) propene c) propyne d) propyl alcohol

5) Which of the following compound is alkanes?

a) C5H10 b) C10H22 c) C15H28 d) C9H16

6) Alkanes are commonly called _____.

- a) arenes b) paraffins c) olefins d) acetylenes

7) Isomerism is the phenomenon in which two or more organic compounds have _____.

- a) same molecular formula but different structural formula
b) same structural formula but different molecular formula
c) same general formula, but different structural formula
d) same empirical formula, same structural formula

8) Pentane exhibits _____ chain isomers.

- a) two b) three c) four d) five

9) Alkanes can be prepared by _____ of unsaturated hydrocarbons.

- a) hydrogenation b) oxidation c) hydrolysis d) cracking

10) Catalytic hydrogenation of ethene or acetylene gives _____.

- a) ethane b) propylene c) methane d) propane

11) Ethyl iodide when reduced by zinc and dilute HCl, leads to the formation of _____.

- a) Methane b) Ethane c) Ethylene d) Butane

12) The reaction of alkyl halides with sodium in dry ether to give higher alkanes is called _____.

- a) Wurtz reaction b) Kolbe's reaction
c) Frankland's reaction d) Williamson's reaction

13) Methane is _____ molecule.

- a) polar b) nonpolar c) highly polar d) none of these

14) Alkanes are _____ in water.

- a) soluble b) sparingly soluble
c) insoluble d) none of these

15) As branching increases, boiling point of alkanes.

- a) increases b) decreases
c) remains same d) None of these

16) Halogenation of alkane is an example of _____ reaction.

- a) dehydration b) substitution
c) addition d) elimination

17) The thermal decomposition of alkanes in absence of air to give lower alkanes, alkenes and hydrogen is called _____.

- a) vapour phase nitration b) pyrolysis
c) polymerisation d) combustion

18) But-1-ene and But-2-ene are _____.

- a) chain isomers b) position isomers
c) geometrical isomers d) metamers

19) Hex-2-ene and 2-Methylpent-2-ene exhibit _____.

- a) chain isomerism b) position isomerism
c) geometrical isomerism d) optical isomerism

20) Which of the following shows position isomerism?

- a) Propene b) Ethene
c) 2-Methylpropene d) Pent-2-ene

21) When ethyl bromide is heated with alcoholic KOH, _____ is formed.

- a) ethane b) ethanol c) ethene d) acetylene

22) Alkenes are insoluble in _____.

- a) benzene b) water c) ether d) chloroform

23) Markownikov's rule is applicable to _____.

- a) symmetrical alkenes b) alkanes
c) unsymmetrical alkenes d) alkynes

24) When propene is treated with HBr in the dark and in absence of peroxide, then the main product formed is _____.

- a) 1-bromopropane b) 2-bromopropane
c) 1, 2-dibromopropane d) 1, 3-dibromopropane

25) The ozonolysis of $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)_2$ followed by treatment with zinc and water will give _____.

- a) acetone b) acetone and acetaldehyde
c) formaldehyde and acetone d) acetaldehyde

26) Treatment of ethylene with ozone followed by decomposition of the product with $\text{Zn}/\text{H}_2\text{O}$ gives two moles of _____.

- a) formaldehyde b) acetaldehyde
c) formic acid d) acetic acid

27) Ethylene reacts with Baeyer's reagent to give a/an _____.

- a) glycol b) aldehyde c) acid d) alcohol

28) Baeyer's reagent is _____.

- a) aqueous KMnO_4 b) neutral KMnO_4
c) alkaline KMnO_4 d) aqueous bromine water

29) Aliphatic unsaturated hydrocarbons containing two carbon-carbon triple bonds in their structure are called as _____.

- a) alkadiynes b) alkatriynes c) alkynes d) alkanes

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