Roll No. _____   Code : 11201819CH-A

Class : XI
CHEMISTRY (THEORY)

Time Allowed : 3 Hours   Maximum Marks : 70

General Instructions :
- All the questions are compulsory.
- There are 27 questions in total.
- Questions 1 to 5 are very short answer type questions and carry one mark each.
- Questions 6 to 12 carry two marks each.
- Questions 13 to 24 carry three marks each.
- Questions 25 to 27 carry five marks each.
- There is no overall choice. However internal choice has been provided in two question of one marks, two questions of two marks, four questions of three marks and one question of five marks each. You have to attempt only one of the choices in such questions.
- Use of calculator is not permitted. However, you may use log tables if necessary.

SECTION - A

1.   Write the IUPAC name and symbol of the element with atomic number 149?   1

OR

Write the formulae of compounds which are formed by the following pairs of elements.   1

(a)   Silicon and bromine

(b)   Aluminium and Sulphur

2.   Given the standard electrode potentials,   1

$E^{o}(K^{+}/K) = -2.93V$

$E^{o}(Ag^{+}/Ag) = 0.80V$

$E^{o}(Hg^{+2}/Hg) = 0.79V$

$E^{o}(Mg^{+2}/Mg) = -2.37V,$

Which metal has maximum reducing power?

3. How does H_2O_2 behave as a bleaching agent?   1

4. Write the name of the element which is estimated quantitatively in an
    organic compound, when it is heated with dry copper oxide in the atmosphere
    of CO_2 gas.   1

<div align="center">**OR**</div>

Diphenyl Ketone $(C_6H_5 - \overset{\overset{O}{\|}}{C} - C_6H_5)$ does not show tautomerism. Why?   1

5. Write the names of the two gases which are responsible for green house effect.   1

6. Explain giving reasons, why the following sets of quantum numbers are not
    possible.   2
    (a) $n = 0, l = 0, m_l = 0, m_s = +½$
    (b) $n = 3, l = 3, m_l = -3, m_s = +½$

7. Write Molecular orbital configuration of Ne_2 molecule. Also show that Ne_2
    molecule does not exist.   2

8. (i) Gold with atomic radius 0.144nm crystallises in a face centred unit
         cell. Calculate the length of the side of the unit cell.   1
    (ii) Classify the following as being either a p-type or n-type semiconductor,
         when B doped with Si   1

<div align="center">**OR**</div>

    (i) Refractive index of a solid is observed to have the same value along all
         the directions. Comment on the nature of the solid.   1
    (ii) Define F-centre.   1

9. The following reaction represents a gaseous system at equilibrium.   2
    $$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + heat$$
    Indicate the direction in which the equilibrium will shift
    (i) When temperature is decreased
    (ii) When pressure is increased.

10. When water is added to a compound (A) of Calcium, the solution of the compound (B) is formed. When CO_2 is passed into this solution, it turns milky due to formation of a compound (C). If excess of CO_2 is passed into the solution, the milkiness disappears due to formation of the compound (D). Identify the compounds (A). (B), (C) and (D). 2

OR

When an alkali metal dissolves in liquid ammonia, It acquires different colour. Explain.

(i) Why does solution appeared to be coloured. 1

(ii) Under what condition the solution acquire different colours. 1

11. Select the members of group 14 that 2

(i) forms the most acidic oxide.

(ii) is commonly found in +2 oxidation state.

(iii) used as semiconductor.

(iv) exhibits highest catenation tendency.

12. Convert Benzene into m-nitrochlorobenzene. 2

13. Copper (II) carbonate reacts with H_2SO_4 to give copper sulphate, carbondioxide and water

(i) Write the balanced chemical equation for this reaction. 1

(ii) What mass of $CuCO_3$ is required to react completely with 8.1 ml of 0.5M H_2SO_4? 2

14. (i) Why are Bohr's orbits called stationary states? 1

(ii) Calculate the energy required for the process 2

$$He^+(g) \longrightarrow He^{+2}(g) + e^-$$

the ionization energy for the H-atom in the ground state is 2.18×10^{-18} J $atom^{-1}$.

OR

(i) Which of the following transition will have minimum wavelength and why? 1

$$n_4 \longrightarrow n_1, n_4 \longrightarrow n_2, n_2 \longrightarrow n_1$$
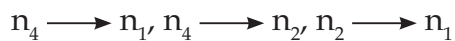
(ii) The uncertainity in the position of a moving bullet of mass 10g is 10^{-5} m. Calculate the uncertainity in its velocity. 2

15. Account for the following

(i) Fluoride ion can not be formed as easily as compared to chloride ion from their respective elements. 1

(ii) The increasing order of reactivity among group I elements is 1

Li < Na < K < Rb < Cs

(iii) Mg^{+2} is smaller than O^{-2} in size, though both have same electronic configuration. 1

16. (i) In SF_4 molecule, the lone pair of electrons occupies an equitorial position rather than axial position in the overall trigonal bipyramidal arrangement. Why? 1

(ii) In the given molecule 2

$$\overset{(5)}{CH_3} - \overset{(4)}{C} \equiv \overset{(3)}{C} - \overset{(2)}{CH_2} - \overset{(1)}{\overset{\overset{O}{\|}}{C}} - OH$$
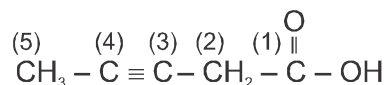
Mention the hybrid state of Carbon atoms numbered as 1, 2 and 3, and arrange them in the decreasing order of S-character.

17. (i) Draw the graph for a gas for wich PV is plotted against P at constant temperature. 1

(ii) A gas occupies a volume of 250 ml at 745 mm Hg and 25^0c. What additional pressure is required to reduce the gas volume to 200 ml at the same temperature? 2

OR

(i) In a compound, oxide ions from hcp while Al^{3+} ions occupy two third of octahedral voids. What is the formula of the compound? 1

(ii) An element with molar mass 2.7×10^{-2} kg mol^{-1}, forms a cubic cell with Edge length 405 pm. If density is 2.7×10^3 kg m^{-3}, what is the nature of unit cell.   2

18. The ionization constant of acetic acid is 1.74×10^{-5}. Calculate the degree of dissociation of acetic acid in its 0.05 M solution. Calculate the concentration of acetate ion in the solution and its pH.   3

OR

(i) Define solubility product.   1

(ii) The value of K_{SP} of a sparingly soluble salt $Ni(OH)_2$ is 3.2×10^{-14}, calculate its solubility.   2

19. (i) Represent the galvanic cell in which the following reaction takes place.   1
$$Zn(s) + 2Ag^+(aq) \longrightarrow Zn^{+2}(aq) + 2Ag_{(s)}$$

(ii) Balance the following equation is basic medium by half reaction method   2
$$AsO_3^{-3} + MnO_4^- \longrightarrow AsO_4^{-3} + Mn_2O_3$$

20. (i) What do you mean by autoprotolysis of water? What is its significance?   2

(ii) Name the class of hydrides to which H_2O and NaH belongs.   1

21. State as to why -

(i) Beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so.   1

(ii) In an aqueous solution, Li$^+$ ion has lowest ionic mobility among all the alkali metals.   1

(iii) Lithium shows similarities to magnesium in its chemical behaviour.   1
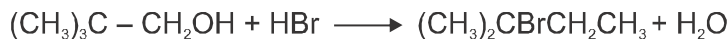
22. (i) Write structural formula for   1

2, 3 – dibromo – 1 – phenylpentane

(ii) Identify the most stable carbocation from the following :   1

$$\overset{+}{C}H_3, \quad (CH_3)_2\overset{+}{C}H, \quad CH_3\overset{+}{C}H_2 \quad \text{and} \quad (CH_3)_3\overset{+}{C}$$

Give reason for your choice.

(iii) Classify the following reaction in one of the reaction type :   1

$$(CH_3)_3C - CH_2OH + HBr \longrightarrow (CH_3)_2CBrCH_2CH_3 + H_2O$$

OR

(a) Which of the two : $O_2NCH_2CH_2O^-$ or $CH_3CH_2O^-$ is expected to be more stable and why?   1

(b) What are electrephiles and nucleophiles? Explain with examples.   2

23. Write the structure of the following compound named as -

(i) 4, 4 - dimethyl - 3 - ethylpentane

Write its correct name if required.   1

(ii) 0.16g of an organic substance was heated in carius tube and the sulphuric acid formed was precipitated as $BaSO_4$ with $BaCl_2$. The mass of dry $BaSO_4$ was 0.35g. Calculate the percentage of sulphur in the organic compound.   2

24. Give reasons for the following :

(i) The presence of CO reduces the amount of haemoglobin available in the blood for carrying oxygen to the body cells.   1

(ii) Statues and monuments in India are affected by acid rain.   1

(iii) Fishes die in a water body with abundance of phytoplankton.   1
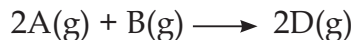
25. (i) State Hess's law   1

(ii) Give one point to differentiate the following thermodynamic terms   1

(a) Extensive properties and intensive properties.

(b) Isothermal process and isobaric process

(ii) For the reaction to be occur at 298K.   3

$$2A(g) + B(g) \longrightarrow 2D(g)$$

$\Delta U^0 = -10.5KJ$ and $\Delta S^0 = -44.1 \; JK^{-1} \; mol^{-1}$

Calculate Δ^0G for the reaction. Also predict whether the reaction may occur spontaneously.

OR

(i) Predict in which of the following, entropy increases / decreases.

    (a) Temperature of crystalline solid is raised from 0 K to 115 K   1

    (b) $H_2(g) \longrightarrow 2H(g)$ 1

(ii) The combustion of 1 mole of benzene takes place at 298 K and 1 atm. After combustion, $CO_2(g)$ and $H_2O(l)$ are produced and 3267.0 kJ of heat is liberated. Calculate the standard enthalpy of formation $\Delta_f H^0$ of benzene. Standard enthalpies of formation of $CO_2(g)$ and $H_2O(l)$ are –393.5 kJ mol–1 and –285.83 KJ mol^{-1} respectively.   3

26. (i) Draw the structure of Diborane   1

(ii) What happens when :   2

    (a) Boric acid is added to water?

    (b) Aluminium is treated with dilute NaOH?

(iii) Give suitable reason for the following :   2

    (a) Nitrogen does not form pentahalide.

    (b) Ammonia is more basic than PH_3

OR

(i) Write Balanced chemical equations for the followings.

    (a) Borax is heated strongly   1

    (b) Silicon is heated with methyl chloride at high temperature in the presence of copper.   1

    (c) Boron trifluoride reacts with Lithium hydride.   1

(ii) Arrange the following in order of property indicated for each set.

    (a) NH_3, PH_3, AsH_3, SbH_3, BiH_3 - increasing base strength   1

    (b) NH_3, PH_3, AsH_3, SbH_3, BiH_3 - increasing boiling point.   1

27. (i) $\langle\!\!\!\!\!=\!\!CH_2$ is not aromatic. Why?   1

(ii) An alkene is subjected to ozonolysis followed by reduction of ozonide with zinc and water. The main products formed are ethanal and propanone. Predict the structure of alkene and write its IUPAC name.   2

(iii) Addition of HBr to propene in presence of benzoyl peroxide yields 1-bromopropane. Explain with suitable mechanism steps. 2

OR

(i) Out of benzene, chlorobenzene and toluene which one will undergo nitration more easily and why? 2

(ii) Give a three step mechanism for the following reaction : 3

$$\bigcirc + CH_3Cl \xrightarrow{AlCl_3} \overset{CH_3}{\bigcirc} + HCl$$

CLASS–XI
SUBJECT–CHEMISTRY (THEORY)

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1.   Give values of n and l for an unpaired electron in Cu (29).

2. The plots of volume verses temperature of an ideal gas at different pressures are given below. Arrange the pressure in increasing order.
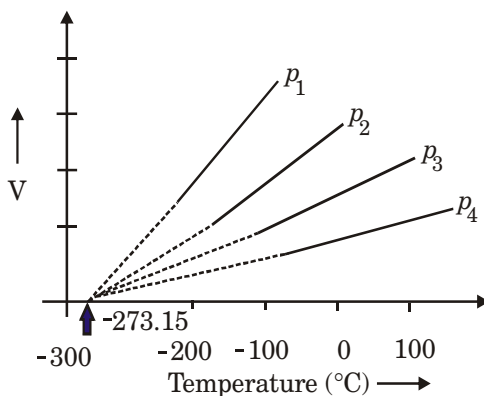
3. Predict which of the following reaction proceeds nearly to completion, with reason :

   (a) H_2 (g) + Cl_2 (g) $\rightleftharpoons$ 2HCl (g) at 300 K with K_C = 4 × 10^{31}

   (b) N_2 (g) + O_2 (g) $\rightleftharpoons$ 2NO (g) at 298 K with K_C = 4.8 × 10^{-31}

4. What happens when quicklime is heated with silica ?

5. Identify the electrophilic centre in

   $$CH_3-C\overset{\displaystyle O}{\underset{\displaystyle H}{<}}$$
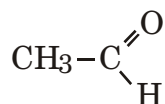
   Support your answer with appropriate reason.

6. The density of 3 molal solution of NaOH is 1.110 g/mL. Calculate the molarity of the solution.

   At. mass of Na = 23, O = 16 and H = 1 g mol^{-1}.

7. Consider the following species :

   P^{3-}, S^{2-}, Cl^-, K^+ and Ca^{2+}

   (a)   What is common in them ?

   (b)   Arrange them in order of increasing ionic radii.

8. Give reason for the following :

   (a) Oxygen has less negative electron gain enthalpy than sulphur.

   (b) Oxygen has lower first ionization enthalpy than nitrogen and fluorine.

9. Explain the following facts :

   (a) Though the electronegativities of nitrogen and chlorine are same. However NH_3 exist as liquid whereas HCl as gas.

   (b) Carbon-Oxygen bond lengths are equal in carbonate ion.

10. Write balanced equation for–

   (a) Dimethyldichlorisilane is hydrolysed followed by condensation polymerisation.

   (b) Boric acid is added to water.

OR

Give chemical equation to show the reaction between :

   (a) Borontrifluoride with sodium hydride.

   (b) Silica is treated with hydrogen fluoride.

11. (a) Why are the atomic masses of most of the elements fractional ?

   (b) What is the law called which deals with the ratios of the volume of the gaseous reactants and products under similar conditions of temperature and pressure ?

   (c) How many significant figures are present in 0.04597 ?

12. (a) Write two conditions required for the linear combination of atomic orbitals to form molecular orbitals.

   (b) Draw the shape of the molecular orbitals formed by linear combination of 2p-orbitals.

      (i) End to end overlap

      (ii) Side by side overlap

13. (i) Which type of intermolecular forces exist among the following molecules

    (a) H_2S molecules   (b) Cl_2 and CCl_4 molecules

  (ii) A mixture of dihydrogen and dioxygen at one bar pressure contains 20% by weight of dihydrogen. Calculate the partial pressure of dihydrogen.

14. Calculate the equilibrium constant for the following reaction at 298 K and 1 atm pressure :

$$NO\ (g) + \frac{1}{2}\ O_2\ (g) \rightleftharpoons NO_2\ (g)$$

Given $\Delta_f\ H°$ at 298 K

For NO (g) = 90.4 kJ mol^{-1}

For NO_2 (g) = 33.8 kJ mol^{-1}

$\Delta S°$ at 298 K for the reaction = $-$ 70.8 J $K^{-1}\ mol^{-1}$

R = 8.31 J $K^{-1}\ mol^{-1}$

15. (i) Predict the feasibility of a reaction when both ΔH & ΔS increase.

  (ii) How do heat capacity at constant volume and that at constant pressure are related ? Derive the relationship.

16. (i) Depict the galvanic cell in which following reaction takes place :

    Ni (s) + 2Ag$^+$ (aq) $\longrightarrow$ Ni^{2+} (aq) + 2Ag (s)

  (ii) The Mn^{3+} ion is unstable in solution and under goes disproportionation to give Mn^{2+}, MnO_2 and H$^+$ ion. Write an ionic equation for the reaction and balance it using ION e$^-$ method.

17. State as to why :

  (a) In aqueous solution, Li$^+$ ion has lowest ionic mobility among all the alkali metals.

  (b) Alkali metals are prepared by electrolysis of their fused chlorides.

  (c) When an alkali metal dissolves in liquid ammonia the solution acquires different colours.

18. Account for the following :

   (a) Elemental silicon does not form graphite like structure.

   (b) Boron does not form B^{3+} ion.

   (c) +2 oxidation state of lead is more stable than +4 oxidation state.

19. (i) What conclusion would you draw if during Lassaigne's test, a blood red coluration is obtained ?

   (ii) Give structural formula of

   Methyl 4-oxopentanoate

   (iii) Draw resonance structure of

   CH_3COO^-

<div align="center">***OR***</div>

   (i) Write the name of isomerism shown by the pair of following compounds :

   $CH_3 - O - CH_2\ CH_2\ CH_3$ and

   $C_2H_5 - O - C_2H_5$

   (ii) An organic compound is fused with sodium for testing halogen, nitrogen and sulphur. Why ?

   (iii) Give the IUPAC name of :
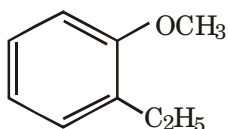
20. (i) Explain the terms inductive and electromeric effects.

   (ii) Which electron displacement effect explains the following correct order of the acidity of the carboxylic acids ?

     (a) $FCH_2\ COOH > Cl\ CH_2\ COOH > CH_3\ COOH$

     (b) $CH_3CH_2COOH > (CH_3)_2\ CHCOOH > (CH_3)_3C{-}COOH$

21. (i) Justify the following :

(a) Isolation of staggered and eclipsed forms of ethane at room temperature is not possible.

(b) Rotation around carbon-carbon single bond of ethane is not completely free.

(ii) Arrange the following alkanes in increasing order of their boiling points, also explain the basis for your order :

2, 2–dimethylbutane, 3–methylpentane, n–hexane

22. Explain the following terms :

(a) Photochemical smog

(b) Ozone layer depletion

(c) Eutrophication

23. In India, we have a lot of shortage of drinking water. Green Park association has started rain water harvesting which will increase level of underground water. Rain water is almost pure form of water after heavy shower. First shower contains dissolved gases from atmosphere. Being a good solvent, when it flows on the surface of the earth, it dissolves many salts in the form of hydrogen carbonate, chloride and sulphate in water which makes it hard.

Answer the following questions :

(i) Define soft water.

(ii) State one disadvantage of hard water.

(iii) Mention one method to remove permanent hardness of water.

(iv) What are the values possessed by office bearer of Green Park association ?

24. (a) How many radial and angular nodes will be there in 5f orbital ?

(b) The unpaired electrons in Al and Si are present in 3p orbital. Which electron will experience more effective charge from the nucleus ? Give reason for your answer.

(c) A tennis ball of mass 6×10^{-2} kg is moving with a speed of 62 m/sec. Calculate the wavelength associated with this moving tennis ball. Will the movement of this ball exhibit a wave character ? Explain. Plank's constant h = 6.626×10^{-34} Js.

OR

(a) State Heisenberg's Uncertainty Principle. How does it contradicts the Bohr's Model of Atom ?

(b) Calculate the frequency and wavelength of the radiation in nanometers emitted when an electron in the hydrogen atom jumps from third orbit to the ground state.

Rydberg constant (R) = 109, 677 cm^{-1}.

25. (a) In reaction

$$CO \text{ (g) } + 2H_2 \text{ (g) } \rightleftharpoons CH_3OH \text{ (g)} \qquad \Delta_r H° = - 92.0 \text{ KJ mol}^{-1}$$
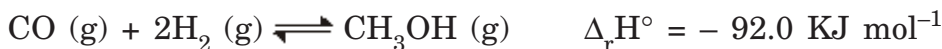
Concentration of hydrogen, carbon monoxide and methanol becomes constant at equilibrium. What will happen if–

(i) Volume of reaction vessel in which reactants and products are contained is suddenly reduced by half ?

(ii) Temperature of reaction vessel increases ?

(b) 20 ml of 0.001 M $AgNO_3$ solution is added to one litre of 0.002 M K_2CrO_4 solution. Will there be any precipitation ?

Ksp for Ag_2CrO_4 is 2.4×10^{-12}

OR

(i) Write the conjugate acid of NH_3.

(ii) Calculate pH of a 1.0×10^{-8} M solution of HCl.

(iii) The equilibrium constant at 278 K for

$$Cu \text{ (s) } + 2Ag^+ \text{ (aq) } \rightleftharpoons Cu^{2+} \text{ (aq) } + 2Ag \text{ (s)}$$

is 2×10^{15}. In a solution in which copper has displaced some silver ions from the solution, the concentration of Cu^{2+} ion is 1.8×10^{-2} mol L^{-1} and the concentration of Ag^+ ions is 3×10^{-9} mol L^{-1}. Is the system at equilibrium ? Justify your answer.

26. (i) Write one chemical equation each to illustrate the following reactions

    (a) Friedal–Crafts alkylation

    (b) Decarboxylation

(ii) An alkene 'A' on ozonolysis gives a mixture of benzaldehyde and butan-2-one. Write structure and IUPAC name of 'A'.

(iii) Give one chemical test to distinguish between ethane and ethene.

OR

(i) Give mechanism of the following reaction :
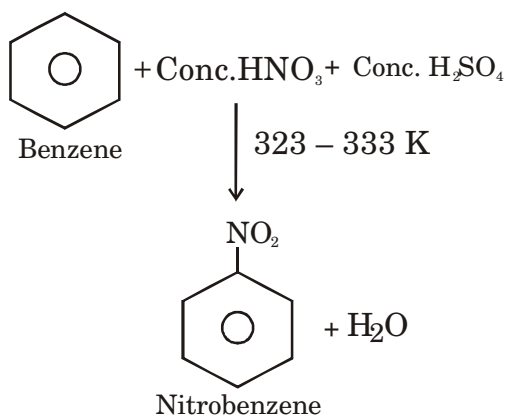
(ii) Carry out the following conversions :

    (a) Benzene to acetophenone

    (b) Ethanoic acid to methane

    (c) Propyne to propanone

☐☐☐

> Please check that this question paper contains **26** questions and **7** printed pages.

CLASS-XI
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(vii) *There is no overall choice. However, there is an internal choice in one question of 2 marks and one question of 3 marks and all the three questions of 5 marks. You have to attempt only one of the choices in such questions.*

(viii) *Use log tables if required. Use of calculators is not permitted.*

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1.   The following data are obtained when dihydrogen and dioxygen reacts together to form different compounds :

	Mass of dihydrogen	Mass of dioxygen
(i)	8g	64g
(ii)	8g	128g

State the law of chemical combination which is obeyed by the above experimental data.

2.   Draw PV vs P curve for an ideal gas.

3.   Identify the lewis bases amongst the following :

PH_3, H^+, AlH_3, H_2O

4. Assign the position in terms of period and group to the element having outer electronic configuration ns^2np^1, where $n = 6$

5. Why magnesium does not impart colour to the flame while calcium does ?

6. Applying aufbau principle, write the electronic configuration of element with $Z = 21$. Also, write the possible values of principle and azimuthal quantum numbers for the unpaired electron in the atom.

7. Using the valence shell electron pair repulsion (VSEPR) model, predict the shape of the following molecules :

   (i) ClF_3

   (ii) H_2O

8. Explain the following :

   (i)   Gallium has higher ionization enthalpy than aluminium

   (ii) PbX_2 is more stable than PbX_4

<div align="center">***OR***</div>

   Give reasons :

   (i)   Diamond is used as an abrasive

   (ii) Conc. HNO_3 can be transported in aluminium container

9. Draw the cis and trans structure of hex-2-ene. Which isomer will have higher boiling point and why ?

10. Among NH_3, H_2O and HF, which would you expect to have highest magnitude of hydrogen bonding. Give reason to support your answer.

11. One litre of oxygen at STP is made to react with three litres of carbon monoxide at STP, according to the following reaction :

   $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

   Calculate the mass of each substance found after the reaction.

   Which one is the limiting reactant ?

12. Arrange the following as instructed :

   (i)   O, S, Cl, F

        (decreasing order of electron gain enthalpy)

   (ii) F, Cl, Br, l

        (increasing order of reactivity)

   (iii) F^-, Ne, Na^+, N^{3-}

        (decreasing order of ionic radii)

13. (i)   State the hybridization of Nitrogen in NH_3.

   (ii) Why is bond angle in ammonia less than the tetrahedral bond angle ?

   (iii) Why is the resultant dipole moment of NH_3 greater than NF_3 ?

                              OR

   (i)   Explain the paramagnetic nature of O_2 on the basis of molecular orbital theory.

   (ii) Arrange the following in decreasing order of stability (O_2), superoxide ion (O_2^-) and peroxide ion (O_2^{2-})

14. 35 ml of oxygen was collected at 6°C and 758 mm pressure. Calculate its volume at STP.

   (ii) What is the value of compressibility factor 'Z' for :

        (a) Ideal gas

        (b) Real gas above Boyle's temperature

15. Calculate the work done by 1 mole of the gas in each of the following cases :
    (Given : $\log 5 = 0.6989$ and $R = 8.314$ $JK^{-1}mol^{-1}$)

   (i)   For expansion of the gas from volume 1L to 5L against constant external pressure of 1 bar

   (ii) For reversible isothermal expansion of the gas from volume 1L to 5L at 27°C.

   (iii) For free expansion of the gas from 1L to 5L.

16. (i) Write the conditions in terms of ΔH and ΔS when a reaction would be always spontaneous.

(ii) The value of $\Delta_f H^0$ for NH_3 is -91.8 kJmol^{-1}. Calculate enthalpy change for the following reaction:

$$2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$$
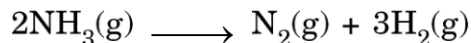
17. The K_p for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is 640 mm at 775 K. Calculate the percentage dissociation of N_2O_4 at equilibrium pressure of 160 mm.

18. (i) Magnesium is precipitated from a solution of its salt by NH_4OH as per the following reaction :

$$Mg^{2+}(aq) + 2NH_4OH(aq) \longrightarrow Mg(OH)_2 + 2NH_4^+(aq)$$
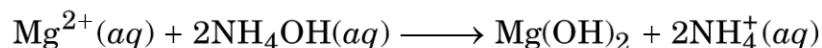
If NH_4Cl is also added to the reaction mixture, precipitate of $Mg(OH)_2$ is not obtained. Explain.

(ii) Calculate the pH at which $Mg(OH)_2$ begins to precipitate from a solution containing 0.1M Mg^{2+} ions. K_{sp} of $Mg(OH)_2 = 1 \times 10^{-11}$.

19. (i) Balance the following redox reaction in acidic medium :

$$MnO_4^-(aq) + SO_{2(g)} \longrightarrow Mn^{2+}(aq) + HSO_4^-(aq)$$
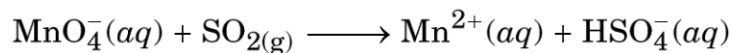
(ii) Given the standard electrode potentials,
$K^+/K = 2.93$ V, $Ag^+/Ag = 0.88$ V, $Mg^{2+}/Mg = -2.37$ V, $Hg^{2+}/Hg = 0.79$ V

Arrange these metals in increasing order of their reducing power.

20. (i) When aqueous solution of borax is acidified with hydrochloric acid, a white crystalline solid is formed, which is soapy to touch. Name the solid formed. Is this solid acidic or basic in nature. Explain with the help of chemical equation.

(ii) Why is borazine also called 'inorganic benzene' ?

21. (i) Write the IUPAC name for the following compound :
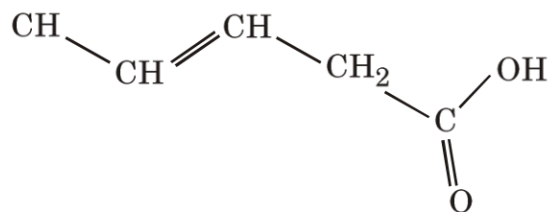
(ii) Describe the basic principle of paper chromatography ?

(iii) Give one example of a mixture of liquids which can be separated by the process of fractional distillation.

22. (i) How can you apply green chemistry to reduce the use of chlorine in bleaching?

(ii) From where does ozone come in photochemical smong ?

(iii) Why is classical smog also called reducing smog ?

23. Gaurav, a brilliant football player, was suffering from muscle cramp, fatigue, irritability and headache since past few days. He feared that he would not be allowed to play in the coming up tournament. His coach consoled him and assured him that increase in the intake of potassium rich food in his diet would help him recover fast. Answer the following questions :

(i) What is the importance of potassium in the cell fluid ? (any two)

(ii) Name any other metal which is also involved in the transmission of nerve signals.

(iii) Write two values shown by Gaurav's coach.

24. When electromagnetic radiation of wavelength 306 nm falls on the surface of sodium, electrons are emitted with a kinetic energy of 1.7×10^5 Jmol^{-1}.

What is the minimum energy needed to remove an electron from a sodium atom ?
What is the maximum wavelength that will cause a photoelectron to be emitted ?
(h = 6.626×10^{-34}Js)

OR

The angular momentum of an electron in the Bohr's orbit of hydrogen atom is $4.22 \times 10^{-34} \mathrm{kgm^2s^{-1}}$. Calculate the wavelength of the spectral line when the electron falls from this level to the next lower level. Identify (a) the series of spectral line corresponding to this transition, and (b) spectral region in which the transition takes place.

25. Arrange the following carbocations in the order of decreasing stability :

CH_3^+, $(CH_3)_2CH^+$, $(CH3)_3C^+$, $CH_3CH_2^+$
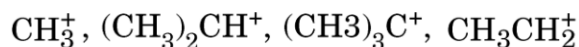
How can inductive and hyperconjugation effect explain the stability of primary, secondary and tertiary carbocations. Draw the orbital diagram for methyl carbocation indicating the shape and hybridization involved.
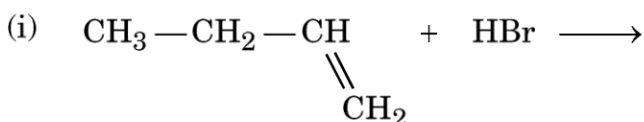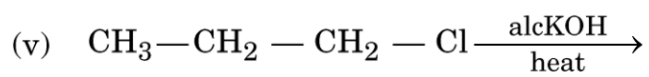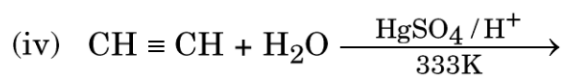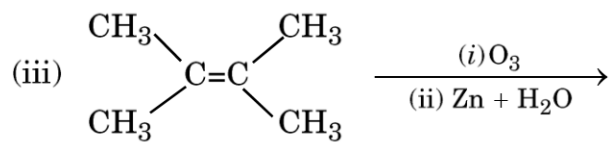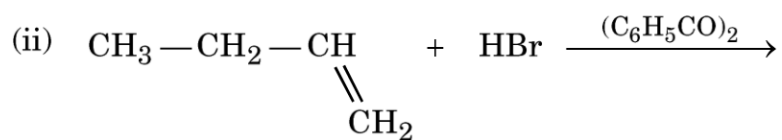
OR

(a) What conclusion would you draw if during Lassaigne's test a blood red colouration is obtained ? Discuss the principle underlying the estimation of phosphorus. Write the chemical formula of the yellow precipitate formed in the test for phosphorus.

(b) 0.2 g of an organic compound containing phosphorus gave 1.877 g of ammonium phosphomolybdate (molar mass = 1877) by usual analysis. Calculate the percentage of phosphorus in the organic compound.

26. (i) Discuss the mechanism of halogenation of benzene.

(ii) How will you convert benzene into :

(a) p-nitrochlorobenzene

(b) m-nitrochlorobenzene

OR

Complete the following reactions :

(i) $CH_3-CH_2-CH \overset{\|}{\underset{CH_2}{}}$ + HBr $\longrightarrow$

(ii) CH_3-CH_2-CH with $\|$ CH_2 (i.e. $CH_2=$) $+$ HBr $\xrightarrow{(C_6H_5CO)_2}$

(iii)

$\begin{array}{c} CH_3 \\ CH_3 \end{array}\!\!\!\!\!\!C=C\!\!\!\!\!\!\begin{array}{c} CH_3 \\ CH_3 \end{array}$ $\xrightarrow[\text{(ii) Zn + H}_2\text{O}]{(i)\,O_3}$

(iv) $CH \equiv CH + H_2O \xrightarrow[333K]{HgSO_4/H^+}$

(v) $CH_3-CH_2-CH_2-Cl \xrightarrow[\text{heat}]{\text{alcKOH}}$

▢▢▢

Please check that this question paper contains **26** questions and **7** printed pages.

CLASS-XI
CHEMISTRY (THEORY)

Time Allowed : 3 Hrs.   **Maximum Marks : 70**

General Instructions :

(i)   All questions are compulsory.

(ii) There are 26 questions in all. Questions 1 to 5 carry one mark each, Questions 6 to 10 carry two marks each, questions 11 to 22 carry three marks each, question 23 carry four marks and questions 24 to 26 carry five marks each.

(iii) There is no overall choice. However an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks each. You have to attempt only one of the choices in such questions.

(iv) Fifteen minutes time has been allotted to read this question paper. During this time, the students will read the question paper only and will not write any answer on the answer script.

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1.   What is the physical significance of Vander Waal's constant 'a' ?   (1)

2.   Write the atomic number of the element present in the third period and seventeenth group of the periodic table.   (1)

3.   Write the IUPAC name of

$$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_2 - CH_2 - \overset{\overset{\displaystyle O}{\|}}{C} - O - H$$ (1)
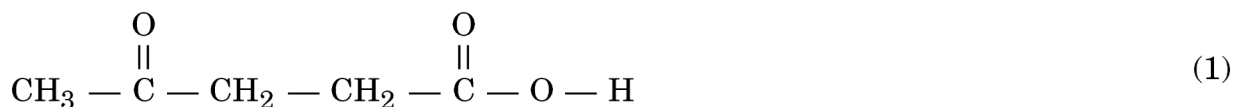
4.   The value of $\Delta_f H°$ for NH_3 is – 45.9, kj mol^{-1}. Calculate enthalpy change for the reaction :   (1)

$$2NH_3 \ (g) \ \xrightarrow{\quad} \ N_2 \ (g) + 3H_2 \ (g)$$
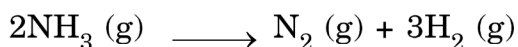
5.   What is the effect of temperature on viscosity of liquids and why ?   (1)

6.   In the reaction :

     $C(s) + 2S (s) \longrightarrow CS_2 (l)$ (2)

     4 g of carbon was heated with 8 g of sulphur. (Atomic mass : C = 12, S = 32)

     (a)   Which is the limiting reagent ?

     (b)   How much carbon disulphide (CS_2) will be formed when the reaction is complete.

7.   The following techniques are used to estimate quantitatively other elements (nitrogen, sulphur & halogens) in organic compounds. Identify the name of the method and the element which is estimated by the following methods :   (2)

     (a)   A known mass of an organic compound is heated with fuming nitric acid in presence of silver nitrate.

     (b)   A known mass of an organic compound is heated with copper oxide in the atmosphere of carbon dioxide.

8.   In the molecule $\overset{2}{C}H_3 - \overset{1}{C}N$

     (a)   How many sigma and pi bonds are present in this molecule ?

     (b)   What is the hybridised state of each carbon atom in it ?   (2)

                                    OR

     Give reasons for the following :

     (a)   The two O–O bond distance in ozone molecule are equal.

     (b)   Ethene molecule is trigonal planar.

9.   2.9 g of a gas at 95°C occupied the same volume as 0.184 g of di-hydrogen at 17°C at the same pressure. What is the molar mass of the gas ?   (2)

10. (a)   Why is boric acid considered a weak acid ?

     (b)   Write any two reactions to justify the amphoteric nature of aluminium ? (2)

11. (a) Name the isotope of hydrogen which is

   (i)   used in nuclear reactor

   (ii)   radioactive

(b) Why is hydrogen peroxide stored in wax lined bottles in dark ?

(c) Why does ice float on the surface of water ?   (3)

12. (a) What is a disproportionation reaction ? Give an example.

(b) Balance the following redox reaction in acidic medium :

$$Cl_2O_7\,(g) + H_2O_2\,(aq) \rightarrow ClO_2^-(aq) + O_2(g)$$ (3)

13. (a) How many electrons in an atom may have the following quantum numbers :

   $n = 4; l = 0$

(b) Calculate the number of photons emitted in 10 hours by a 60 W sodium lamp emitting radiations of wavelength 6000 Å.   (3)

14. (a) Write the conjugate acid and conjugate base of NH_3.

(b) Calculate the pH of the solution obtained when 1 ml of 13.6 M HCl is diluted with water to give 1 litre of the solution.   (3)

OR

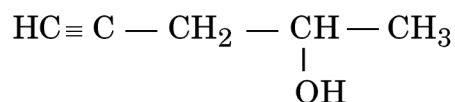Equal volumes of 0.002 M solution of sodium iodate ($NaIO_3$) and copper chromate ($CuCrO_4$) are mixed together. Will it lead to precipitation of copper iodate ? For copper iodate $K_{SP} = 7.4 \times 10^{-8}$

15. (a) Why atomic radius of gallium is smaller as compared to aluminium ?

(b) What are silicones ? Write its one use.

(c) CCl_4 does not hydrolyse whereas $SiCl_4$ undergoes hydrolysis. Why ?   (3)

16. Describe the following with the help of chemical equations :

(a) Wurtz Reaction

(b) Friedel–Crafts Reaction

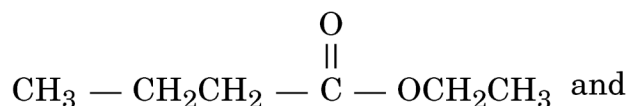(c) Dehydrohalogenation   (3)

C   3

17. (a) Identify the most stable cation in the following set of ions giving reason :

$CH_3 \overset{+}{C}H_2$, $(CH_3)_3 \overset{+}{C}$
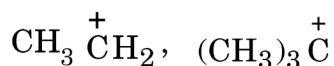
(b) Draw the bond line formula of

$HC \equiv C - CH_2 - \underset{\underset{OH}{|}}{CH} - CH_3$

(c) What type of isomerism is exhibited by

$CH_3 - CH_2CH_2 - \overset{\overset{O}{||}}{C} - OCH_2CH_3$ and

$CH_3CH_2 - \overset{\overset{O}{||}}{C} - OCH_2CH_2CH_3$ (3)

18. (a) Which series of hydrogen spectrum lies in
   (i) visible region
   (ii) ultraviolet region

(b) A table tennis ball has a mass of 10 g and a speed of 90 ms^{-1}. If the speed can be measured within accuracy of 4%, calculate the uncertainity in the position of the ball. (3)

19. Account for the following :
   (a) The first ionization enthalpy of magnesium is higher than that of aluminium.
   (b) Fifth period of the periodic table has 18 elements.
   (c) The first element of all the groups show anomalous behaviour. (3)

20. (a) What do you understand by common ion effect ?
   (b) The reaction quotient of a reversible reaction is Q_c and the equilibrium constant is K_c. In which direction equilibrium will shift if $Q_c < K_c$?
   (c) For the reaction :

   A_2 (g) + $3B_2$ (g) $\rightleftharpoons$ $2AB_3$ (g) + heat
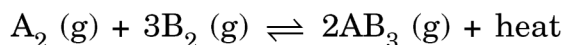
   On the basis of Le-Chatlier's principle explain the effect of temperature and pressure to yield maximum amount of AB_3. (3)

21. (a) Out of molarity and molality which is a better way of expressing the concentration of a solution and why ?

(b) Boron occurs in nature in the form of two isotopes whose atomic masses are 10.01 u and 11.01 u. The atomic mass of natural boron is 10.81 u. Calculate the percentage of each isotope in natural boron. (3)

22. Write molecular orbital configuration of N_2 and N_2^+. Calculate the bond order and predict their magnetic behaviour. (3)

23. On World Environment Day, ABC School invited eminent speakers to come and address the school children on the issue of environment conservation. Some of the students were so impressed by the program that they decided to spread awareness in their housing societies. They requested the residents to abstain from using polyethene bags and switch to cloth/jute bags. They also convinced people to observe 'NO ELECTRICITY HOUR' for one hour on every Saturday night.

(a) What values are shown by the students ?

(b) What do you mean by green chemistry ?

(c) How will green chemistry help in reducing environmental pollution ? (4)

24. (a) Give the reactions involved in the Solvay's process for the preparation of sodium carbonate.

(b) State as to why :

(i) Be and Mg do not impart any colour to the flame whereas other alkaline earth metals do so.

(ii) Alkali metals dissolve in liquid ammonia giving deep blue solution.

(iii) $BeSO_4$ is soluble in water but $BaSO_4$ is insoluble in water. (5)

OR

(a) Which alkali metal ion forms largest hydrated ion in aqueous solution and why ?

(b) Write chemical equation for the preparation of Plaster of Paris and give its one use.

(c) Write balanced equations for :

(i) $LiNO_3 \xrightarrow{\Delta}$

(ii) $BeCl_2 + LiAlH_4 \longrightarrow$

(iii) $CaO + P_4O_{10} \longrightarrow$
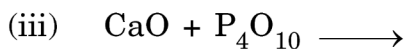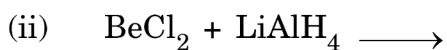
25. (a) What is the difference between extensive and intensive properties ?

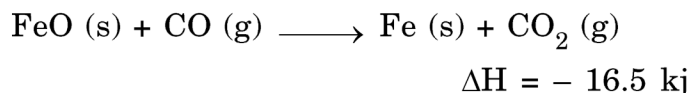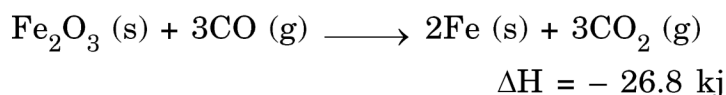(b) (i) For the reaction

$$2Cl\ (g) \longrightarrow Cl_2\ (g)$$

What are the signs of ΔH and ΔS ?
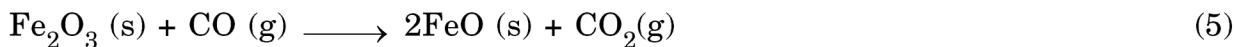
(ii) When $\Delta H > 0$ and $\Delta S < 0$, a reaction is never spontaneous. Why ?

(c) Consider the following two reactions :

$$Fe_2O_3\ (s) + 3CO\ (g) \longrightarrow 2Fe\ (s) + 3CO_2\ (g)$$
$$\Delta H = -\ 26.8\ kj$$

$$FeO\ (s) + CO\ (g) \longrightarrow Fe\ (s) + CO_2\ (g)$$
$$\Delta H = -\ 16.5\ kj$$

What is the value of ΔH for the reaction ?

$$Fe_2O_3\ (s) + CO\ (g) \longrightarrow 2FeO\ (s) + CO_2(g) \hspace{2cm} (5)$$

OR

(a) State Hess's Law of Constant Heat Summation.

(b) The equilibrium constant for a reaction is 10 at 27°C. Calculate the value of $\Delta G°$ at 27°C.

(c) Calculate the standard enthalpy change and standard internal energy change for the following reaction at 300 K :

$$OF_2\ (g) + H_2O\ (g) \longrightarrow O_2\ (g) + 2HF\ (g)$$

Given that the standard enthalpy of formation of OF_2, H_2O and HF are 23 kj mol^{-1}, $-\ 241.8$ kj mol^{-1} and $-\ 268.6$ kj mol^{-1} respectively.

26. (a) Giving reasons arrange the following in order of property mentioned against each :

    (i)   n-Pentane, isopentane, neopentane (increasing boiling point)

    (ii) Ethene, ethane, ethyne (increasing acidic character)

  (b) Convert

    (i)   But-2-ene to Ethanal

    (ii) Acetylene to Chlorobenzene

    (iii) Benzene to p-Nitrobromobenzene   (5)

OR

  (a) Give the mechanism of addition of HBr to propene in presence of peroxide.

  (b) What happens when (write only chemical equations) :

    (i)   Sodium salt of benzoic acid is heated with sodalime.

    (ii) 2-Methylpropene is treated with acidic potassium permanganate.

    (iii) Propyne is treated with water at 333 K in the presence of mercuric sulphate and dilute sulphuric acid.

□□□

Roll No. _____   Code : 112015-043-A

> Please check that this question paper contains **26** questions and **7** printed pages.

CLASS-XI
CHEMISTRY (THEORY)

Time Allowed : 3 Hrs.   **Maximum Marks : 70**

General Instructions :

(i)   All questions are compulsory.

(ii) There are 26 questions in all. Questions 1 to 5 carry one mark each, Questions 6 to 10 carry two marks each, questions 11 to 22 carry three marks each, question 23 carries four marks and questions 24 to 26 carry five marks each.

(iii) There is no overall choice. However an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks each. You have to attempt only one of the choices in such questions.

(iv) Fifteen minutes time has been allotted to read this question paper. During this time, the students will read the question paper only and will not write any answer on the answer script.

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1. Write the IUPAC name and symbol for the element with atomic number 114. (1)

2. Why is nitric acid added to sodium extract before adding silver nitrate solution for testing halogens ?   (1)

3. Why gas fizzes out when soda water bottle is opened ?   (1)

4. Why are the atomic masses the average values ?   (1)

5. The empirical formula and molecular mass of a compound are CH_2O and 180 g per mole respectively. What will be the molecular formula of the compound ?   (1)

6. Explain :

    (a) The boiling point of a liquid rises on increasing pressure.   (2)

    (b) Drops of liquid assume spherical shape.

7. Write balanced equations for : (2)

   (a) $Ca(OH)_2 + CO_2 \longrightarrow$

   (b) $LiNO_3 \xrightarrow{\Delta}$

8. A sample of nitrogen gas occupies a volume of $1\ l$ at a pressure of 0.2 bar at 60°C. Calculate the pressure if the gas is compressed to $0.225\ l$ at -3°C ? (2)

9. (a) $[SiF_6]^{2-}$ exists where as $[SiCl_6]^{2-}$ does not exist. Why ?

   (b) Why the atomic radius of Gallium is smaller as compared to Aluminium ?

   OR

   Write equations for the chemical reactions when : (2)

   (i) Silicon is heated with methyl chloride at high temperature in the presence of copper.

   (ii) Boric acid is added to water.

10. Convert : (2)

    (a) Acetylene to Toluene

    (b) Sodium acetate to methane

11. The molarity of sulphuric acid (H_2SO_4) is 0.8 M and its density is 1.06 g cm^{-3}. What will be the concentration of solution in terms of molality and mole fraction ? (3)

12. An element having atomic number 29. Write (3)

    (i) electronic configuration of this element

    (ii) all the quantum numbers for an unpaired electron of this element.

13. For the reaction (3)

    $2A\ (g) + B\ (g) \longrightarrow 2D\ (g)$
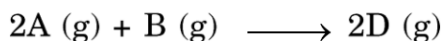
    $\Delta\mu^0 = -\ 10.5$ kj and $\Delta S^0 = -\ 44.10$ J K^{-1}

    Calculate ΔG^0 for the reaction and predict whether the reaction may occur spontaneously.
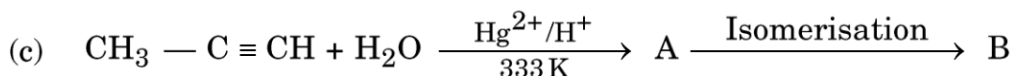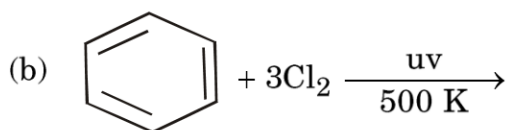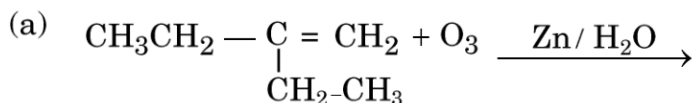
14. State as to why : (3)

    (a) Among alkali metal ions in aqueous solution, Li$^+$ has the lowest mobility.

    (b) Caesium rather than lithium is used in photoelectric cells.

    (c) Gypsum is added in the final stages of manufacture of cement.

15. Describe the following with the help of chemical equations : (3)

    (a) Wurtz Reaction

    (b) Markovnikov Rule

    (c) Dehydrohalogenation

                            OR

    Complete the following reactions :

    (a) $CH_3CH_2 \underset{\underset{\textstyle CH_2\text{-}CH_3}{|}}{-C} = CH_2 + O_3 \xrightarrow{\ Zn/\ H_2O\ }$

    (b) $+\ 3Cl_2 \xrightarrow[500\ K]{uv}$

    (c) $CH_3 - C \equiv CH + H_2O \xrightarrow[333\,K]{Hg^{2+}/H^+} A \xrightarrow{\ Isomerisation\ } B$
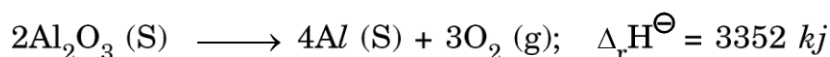
16. (a) Why hard water is softened before using in boilers ? (3)

    (b) Write chemical reactions to show the amphoteric nature of water.

    (c) Write two uses of interstitial hydrides ?

17. Balance the following redox reaction in acidic medium ?

$$MnO_4^- + SO_2 \longrightarrow Mn^{+2} + HSO_4^-$$ (3)

Also name the substance which is oxidised and reduced in the above reaction.

18. (a) Given :

$$2Al_2O_3\ (S) \longrightarrow 4Al\ (S) + 3O_2\ (g);\quad \Delta_r H^\ominus = 3352\ kj$$

What is the standard enthalpy of formation for Al_2O_3 (S) ?

(b) Why entropy of ice is less than that of water ?

(c) What is the difference between extensive property and intensive property ? (3)

19. (a) In how many elements does the last electron have the quantum numbers n = 4 and l = 1 ?

(b) Calculate the energy associated with the first orbit of He^+. What is the radius of this orbit ? (3)

20. What happens when (write chemical equations only) :

(a) Aluminium is treated with dilute NaOH.

(b) Sodium borohydride is reacted with iodine.

(c) Silicon dioxide is treated with hydrogen fluoride. (3)

21. Arrange the following in order of property indicated against each :

(a) Na^+, F^-, Mg^{+2}, Al^{+3} (increasing ionic size)

(b) B, C, N, O (increasing first ionization enthalpy)

(c) I, Br, F, Cl (increasing negative electron gain enthalpy) (3)

22. Give reasons : (3)

    (a) Alkynes are acidic in nature.

    (b) ⌂ is not aromatic.

    (c) n-pentane has greater boiling point than isopentane.

23. Rahul visited his grandmother's house in vacations. He observed that families from nearby localities bring loads of laundry to wash in the river. Also they make their animals bathe in the river and dump garbage around it. Rahul advised them to keep the environment clean, maintain healthy and hygenic surroundings and prevent water pollution. (4)

    (a) What is the effect of water pollution ?

    (b) What do you mean by Biochemical Oxygen Demand (BOD) ?

    (c) What is the threat to aquatic animals due to water pollution ?

    (d) What values are possessed by Rahul ?

24. (a) Account for the following : (5)

        (i)   Although ammonia and water both have distorted tetrahedral geometries, bond angle in water is less than that of ammonia.

        (ii)   All carbon to oxygen bonds in CO_3^{2-} are equivalent.

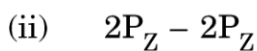   (iii) BF_3 has a zero dipole moment although B–F bonds are polar.

    (b) Write the molecular orbital configuration of O_2^+. Also calculate its bond order and magnetic nature.

<div align="center">**OR**</div>

    (a) On the basis of VSEPR theory, predict the shape of BrF_5.

    (b) Name the molecular orbital formed by the combination of following atomic orbitals (assume Z-axis as the internuclear axis)

        (i) $2P_X + 2P_X$

(ii) $2P_Z - 2P_Z$

(c) In the molecule of ethene (C_2H_4)

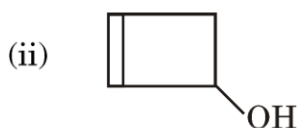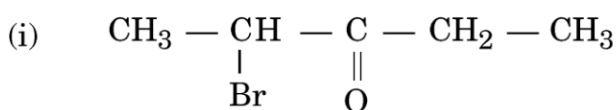   (i)   How many sigma and pi bonds are present ?

   (ii)   Draw the orbital overlap diagram showing the double bond formation in ethene.

25. (a) Why $(CH_3)_3 \overset{\oplus}{C}$ is more stable than $(CH_3)_2 \overset{\oplus}{C} H$?   (5)

   (b) What type of liquids can be purified by the technique of distillation under reduced pressure ?

   (c) Draw the resonance structures for $C_6H_5 — CHO$?

   (d) Write IUPAC names of :

      (i) $CH_3 — \underset{\underset{Br}{|}}{CH} — \underset{\underset{O}{\|}}{C} — CH_2 — CH_3$

      (ii)
             OH

OR

(a) Giving justification categorise BF_3 as electrophile or nucleophile.

(b) What type of structural isomerism is exhibited by $CH_3O\ CH_2\ CH_2\ CH_3$ and $CH_3\ CH_2\ OCH_2\ CH_3$?

(c) Give examples of two substances which can be used as adsorbents in Thin Layer Chromatography ?

(d) Write the structural formula of :

   (i) $4-O \times O$ pentanal

   (ii)   1-Pheny*l* but-1-ene

26. (a) Calculate the value of K_C for the following equilibrium :

$CaCO_3$ (S) $\rightleftharpoons$ CaO (S) + CO_2 (g), k_P = 167 at 1000 K

(b) The solubility product of $Al(OH)_3$ is 2.7×10^{-11}. Calculate its solubility and also find the pH of this solution. (5)

OR

(a) Explain the following :

(i) Common Ion Effect

(ii) Bronsted Lowry Concept of acid and base.

(b) Calculate the pH of a solution obtained by mixing 10 ml of 0.2 M $Ca(OH)_2$ with 25 ml of 0.1 M HCl.

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