2017

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) Derive Schrodinger wave equation. Explain the significance of ψ and ψ^2. 5+2

   b) Explain normalised and orthogonal wave function. 4

   c) State and explain Pauli's exclusion principle. 4

OR

   d) Write the postulates of Bohr's theory of atomic orbitals. What are its limitations. 4+2

   e) What are quantum numbers ? Describe magnetic quantum number. 1+3

   f) Derive de-Broglie equation. 3

   g) Write the electronic configuration of Cu and N^{3-}. 2

L-339   [Turn Over

2. a) Define electronegativity. Discuss the factors affecting electronegativity. 1+4

   b) Explain the following :

      i) Electron affinity of Fe^{+3} is less than Mn^{+3}. 3

      ii) $O^-(g)$ ion is formed by release of energy but $O^{2-}(g)$ is formed by absorption of energy. 3

      iii) Ionisation energy decreases while descending down a group. 4

   OR

   c) Discuss effective nuclear charge and shielding effect. 3+3

   d) Discuss Mulliken's scale of electronegativity. 3

   e) Explain : 3+3

      i) Second I.E. is always greater than first I.E.

      ii) Sanderson's electron density ratio.

3. a) Write a note on Fajan's rule. 3

   b) Discuss the structure of ClF_3. 3

c) Draw the molecular orbital energy level diagram O_2 molecule. Find its bond order. Explain its magnetic character. 2+2+1

d) Discuss solvation energy. 4

OR

e) Draw M.O energy diagram for N_2 molecule. Find out its bond order. 2+2

f) Write a note on lattice energy. 5

g) Explain the law solubilitity of AgCl. 3

h) What is meant by dipole moment ? Write two application of dipole moment. 1+2

4. a) Explain Frenkel defects in ionic crystals. 4

b) Write a note on induced dipole interactions. 3

c) Explain : Why ice floats on water. 4

d) Explain P-type conductor with suitable example. 4

OR

e) Explain Schottky defect in ionic crystals.   4

f) Write a note on hydrogen bonding.   5

g) What do you mean by redox reaction ? Explain with an example.   3

h) Balance the folowing equations :   3

   i) $S_2O_3^= + I_2 \rightarrow S_4O_6^{2-} + I^-$

   ii) $MnO_4^- + H^+ + C_2O_4^{2-} \rightarrow Mn^{+2} + H_2O + CO_2.$

□□

2017

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions selecting either {(a),(b),(c)}
or {(d),(e),(f)} from each question

1. a) Explain the critical phenomenon and continuity of state in isotherms of CO_2, prove that

$$\frac{P_C V_C}{R T_C} = \frac{3}{8},$$

with thier usual notation.   2+3+4

   b) Justify Avogadro's law from Kinetic gas equation.   3

   c) Define average, rms and most probable velocity.   3

OR

   d) Explain Collision diameter, Collision fequency and mean free path. Establish the interrelationship in between them. What is the effect of temperature and pressure on mean free path.   3+3+3

    [Turn Over

e) Calculate the no. of translational rotational and vibrational degrees of freedom in H_2O, C_2H_2 and C_6H_6.   3

f) Explain the causes of deviation of ideal behaviour.   3

2. a) Discuss Vapour pressure, surface tension and co-efficient of Viscosity. Explain the factors influences on it. 3×3

b) Explain the cleansing action of detergents.   3

c) Mention physical properties of liquids.   3

OR

d) State and explain common ion effect. How this effect is used for analysing diff. basic radicals in qualitative analysis.   4+5

e) Explain all the factors affecting the degree of ionization.   3

f) Compare the structure of ice and $H_2O(l)$.   3

3. a) Explain with examples of all types of symmetry elements and operation in crystal system. What do you mean by law of constancy of angles ?   6+3

b) Explain the diffraction patterns in CsCl Crystal.

3

c) State and explain Bragg's law.

3

OR

d) Define defects in Crystal. Explain all types of defects with respect to excess and deficiency in different said system by taking examples. 2+7

e) Give a short note on liquid crystal.

3

f) State and explain the law of rational idices. 3

4. a) What do you mean by degree hydrolysis and hydrolysis constant ? Prove that for aqueous solution of $FeCl_3$, the pH is < 7. 2+2+5

b) Explain the buffer action of equimolar mixture of HCN and NaCN.

3

c) Calculate the PH of $10^{-9}M$ HCl solution. 3

OR

d) Discuss two theories of acid-base indicator with role of the pH. $4\frac{1}{2}+4\frac{1}{2}$

e) What do you mean by multistage equilibrium in photoelectric system.   3

f) Establish the relationship between K_{SP} and S in $Al_2(SO_4)_3$ and $PbBr_2$.   3

L-364-14   ⬜⬜

2017

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer **all** questions selecting either {(a),(b),(c)}
or {(d),(e),(f)} from each question

1. a) Derive expressions for complete wave functions of 'd' orbitals. Explain how these expressions account for the various shapes of the 'd' orbitals.   9

   b) Derive Debroglie's relation.   3

   c) Write limitations of Bohr's theory.   3

   ### OR

   d) Explain hydrogen atom spectra.   9

   e) Write the possible values of 'e' and 'm' for an electron in 3p and 3d orbitals.   3

   f) Write the electron configuration of Ag.   3

2. a) Discuss the VSEPR theory. Illustrate the VSEPR theory has to be combined with concept of hybridisation to account for the geometry of covalent molecule.   9

L-400   [Turn Over

b) On the basis of hybridisation discuss the structure of the following :   3

    i) SF_6

    ii) XeF_4.

c) Expain why PCl_5 exists while NCl_5 not ?   3
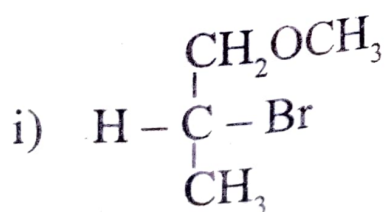
OR

d) Draw the MO diagram of CO molecule.   9

e) Compare the stability of O_2^-, O_2^+ and O_2 on the basis of MO concept.   3

f) On the basis of VSEPR theory explain the structure of CCl_4.   3
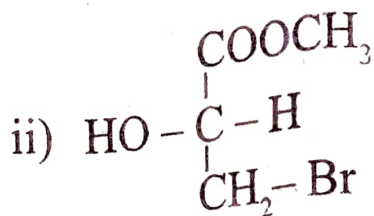
3. a) What do you mean by reactive intermediates ? Explain the effect of Inductive effect and hyperconjugation on the stability of carbocations.   9

b) Explain why Allyl Carbocation is more stable than n-propyl carbocation.   3

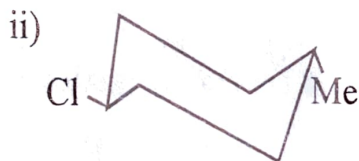c) Designate the structures as R and S.   3

$$
\begin{array}{c}
CH_2OCH_3 \\
| \\
i) \quad H-C-Br \\
| \\
CH_3
\end{array}
$$

ii) $HO - \overset{\displaystyle COOCH_3}{\underset{\displaystyle CH_2- Br}{C}} - H$

OR

d) What is free radicals ? Explain their structure and fate of their formation. 9

e) Explain why methyl carbocation is pyramidal but benzyl carbocations is planar ? 3

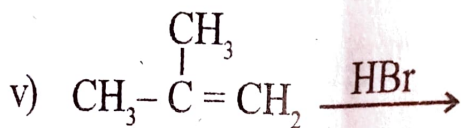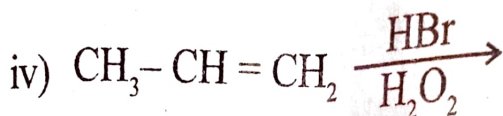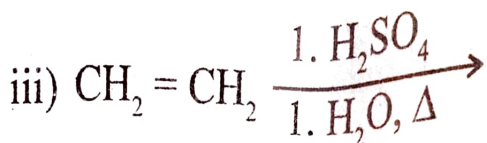f) Lable each of the following compound as cis or trans and comment on their chairality. 3
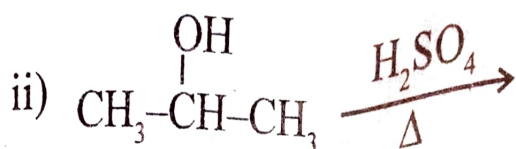
i)

ii)
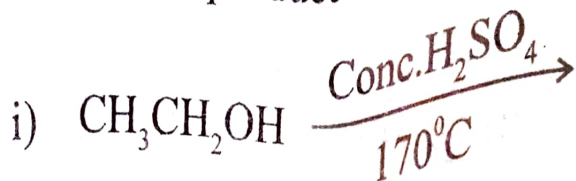
4. a) i) Discuss the conformations of n-butane. 5

   ii) Give evidence to show that chlorination of methane involves free radical mechanism. 4

b) Write a note on Ozonolysis of alkane. 3

c) Explain how will you synthesize 2,3-dimethyl butane from propane. 3

OR

[Turn Over

d) Predict the product :

2×5

i) $CH_3CH_2OH \xrightarrow[170°C]{Conc.H_2SO_4}$

ii) $CH_3-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_3 \xrightarrow{\underset{\Delta}{H_2SO_4}}$

iii) $CH_2 = CH_2 \xrightarrow[1.\ H_2O,\ \Delta]{1.\ H_2SO_4}$

iv) $CH_3- CH = CH_2 \xrightarrow[H_2O_2]{HBr}$

v) $CH_3-\overset{\overset{\displaystyle CH_3}{|}}{C} = CH_2 \xrightarrow{HBr}$

e) Explain why acetylene forms a silver acetylide but ethylene does not ?

2

f) Discuss the mechanism for the reaction of 2-butyne with sodium in presence of liquid NH_3.

3

2018

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) Explain the quantum concepts of Bohr's theory. Write its limitations.   9

   b) Explain how one matter waves different from electromagnetic waves ?   3

   c) State and explain Heisenberg uncertainty principle.   3

OR

   d) Derive Schrodinger wave equation. Write the significance of ψ and ψ^2.   9

   e) Show from the wave function for an S orbital that the distribution of electronic charge in an S orbitals is spherically symmetrical.   3

   f) Explain Hund's maximum multiplicity rule. Apply this rule to show the electronic configurations of oxygen and Nitrogen atom.   3

[Turn Over

2. a) Write the salient features of the concept of hybridisation. On the basis of this explain the structure of followings :

BF_3, CH_4.   9

b) Berilium ($z = 4$) has no unpaired electron in its ground state. However, in all its compounds berillium shows divalence. Explain.   3

c) Explain the geometry of the following molecules.

ClO_4^-, ClO_3^- 3

OR

d) Construct the wave functions for SP and SP² hybride orbitals.   9

e) Draw and discuss the Mo diagram for No molecule.   3
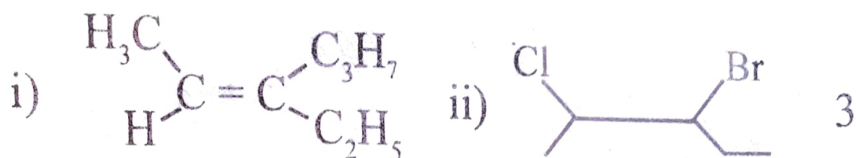
f) Explain on the Mo Theory why hydrogen forms diatomic molecule while Helium and Berillium remains monoatomic.   3

3. a) What is Carbanion ion ? Explain their structure and stability.   9

b) Explain why tertiary carbocation is more stable then Isopropyl carbocation.   3

c) Assign E or Z configuration to the following :

i) H_3C and H on left carbon, C_3H_7 and C_2H_5 on right carbon of $C=C$

ii) structure with Cl and Br

3

OR

d) What is Isomerism ? Explain geometrical Isomerism. Note the necessary conditions for geometrical isomerism.
9

e) Write short notes on Hyperconjugation.
3

f) Which of the following is/are optically active and why ?
3

   (i) n-Butanol (ii) 3-chloro hexane

4. a) Explain any three methods of preparation of Alkane.
9

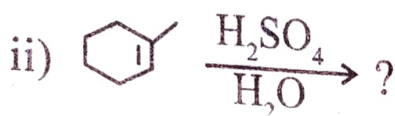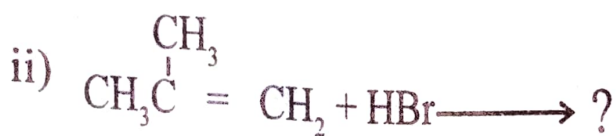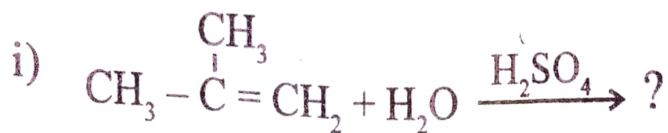   b) Explain why alkenes are more reactive than alkane.
3

   c) Explain Markownikoff's rule with suitable example.
3

OR

d) Predict the product 3×3

i) $$CH_3 - \underset{\underset{CH_3}{|}}{C} = CH_2 + H_2O \xrightarrow{H_2SO_4} ?$$

ii) $$CH_3\underset{\underset{CH_3}{|}}{C} = CH_2 + HBr \longrightarrow ?$$

ii) $\xrightarrow[H_2O]{H_2SO_4}$?

e) Which compound would you expect to be hydrated more rapidly and why ?   3

$$H_3C\underset{\underset{CH_3}{|}}{C} = CH_2 \quad\quad OR \quad\quad ClCH_2\overset{\overset{CH_3}{|}}{C} = CH_2$$

f) Predict A and B of the following reactions :   3
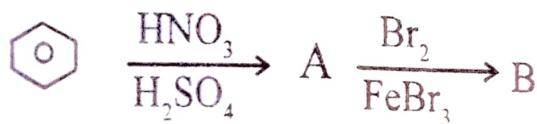
 $\xrightarrow[H_2SO_4]{HNO_3}$ A $\xrightarrow[FeBr_3]{Br_2}$ B

2018

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) What is radial wave function ? Draw the radial probability distribution curves for electrons in s,p and d orbitals. Write the complete wave functions for s orbital.   9

   b) State and explain Heisenberg uncertainty principle.   3

   c) Determine the de-Broglie wavelength of an electron moving at one-tenth the speed of light.   3

OR

   d) What are normalised and orthogonal wave functions ? Prove that the wave functions

$$\psi_n(x) = (2/a)^{1/2} \sin(n\pi x/a)$$

   are orthogonal in the interval $0 \le x \le a$.   9

[Turn Over

e) Find the possible values for all four quantum numbers of a 3d electron. 3

f) Illustrate the difference between electronic configuration and electronic arrangement with suitable example. 3

2. a) What is electronegativity ? Explain the Pauling, Rochoo and Mullikan's approach to measure electronegativity of atoms. Illustrate examples if required. 9

b) What is effective nuclear charge ? Calculate the effective nuclear charge felt by a 3d electron of Chromium atom. 3

c) What is ionisation energy ? Explain why are second ionisation energies so much higher than first ionisation energy? 3

OR

d) The size of the transition metal atoms decrease slightly from left to right in the periodic table. What factors must be considered in explaining this decrease ? In particular, why does the size decrease at all, and why is decrease so gradual ? 9

e) Which of these has higher ionic radius and why ? Al, Al^+, Al^{3+}.

3

f) Explain the term electron affinity. Why are electron affinities of the halogenes so high ? 3

3. a) Write the postulates of VSEPR theory. Explain the structure of IF_5 on the basis of this theory. 9

b) Explain with suitable examples why ions with three positive or three negative charges are rare ?

3

c) Differentiate between sigma bond and pi bond. Explain why a sigma bond is stronger than a pi bond ?

3

OR

d) Draw and explain the molecular orbital energy diagram of CO molecule.

9

e) Of the following species which has the shortest bond length and why ? Which among them are paramagnetic in nature ?

NO, NO^+, NO^-, NO^{2-}.

3

f) What is resonance ? Discuss by taking example of CO_3^{2-} ion. 3

4. a) What is metallic bond ? Explain the band model to account for the nature of bonding in metals. 9

b) Explain the dipole moment and hence the structure for H_2O and CO_2 molecule. 3

c) If $M \rightarrow M^{2+} + 2e$, $E^0 = 0.44$ V

$M^{2+} \rightarrow M^{3+} + 1e$, $E^0 = -0.77$ V

Calculate standard electrode potential (E^0) for the process $M \rightarrow M^{3+} + 3e$. 3

OR

d) What are semiconductors ? Explain extrinsic semiconductors with reference to doping. 9

e) Which is more polar H_2S or H_2O and why ? 3

f) Explain the importance of hydrogen bonding in sustaining life. 3

□□

2018

Full Marks - 60

Time - 3 hours

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Answer *all* questions

1. a) Prove from the kinetic theory of gases that the average kinetic energy of a gram molecule of a perfect gas at temperature T (absolute) is given by 3/2RT where R is the gas constant. Calculate from this result the ratio of the specific heats at constant pressure and constant volume of a gas.   9

    b) i) What is inversion temperature ? How is it related to van der Waals constants ?   3

        ii) What are the units of van der Waals constants a and b ? Do they have same value for all gases ?   3

OR

    c) Discuss Maxwell's distribution of molecular velocities with the help of a diagram. Illustrate the effect of temperature on the distribution.   9

[Turn Over

d) i) Discuss the three types of velocities and derive an expression for root mean square velocity. 3

ii) Under what conditions, a sample of ideal gas not only exhibits a pressure of 1 atm, but also a concentration of 1 mol dm^{-3}. 3

2. a) Explain the term surface tension. How is it measured experimentally ? Discuss the effect of temperature on the surface tension of a liquid ? 9

b) i) Define boiling point of liquid. 3

ii) Explain the term viscosity. Discuss the effect of temperature on the viscosity of a liquid. 3

OR

c) Explain what you understand by dissociation constant of an acid. Describe how will you determine the dissociation constant of acetic acid. 9

d) i) pH of 1N HCl is zero. What is the physical significance of this statement ? 3

ii) What do you mean by common ion effect ? Explain any two of its applications. 3

3. a) What do you understand by the term space lattice and unit cell ? Represent diagramatically (i) a simple cubic lattice, (ii) face centered cubic lattice and (iii) body centered cubic lattice. 9

   b) i) Why is glass considered as a super cooled liquid ? 3

   ii) NaCl has FCC structure. How many Na^+ and Cl ions are there in the unit cell ? 3

OR

   c) Draw a schematic diagram of X-Ray spectrometer. Explain how you would proceed to determine the structure of a crystal with its help. 9

   d) i) Name the Bravis lattices for orthorhombic crystal. 3

   ii) Explain the structure of graphite. 3

[Turn Over

4. a) Discuss in details the phenomenon of hydrolysis of salts. Illustrate your answer taking examples of
   i) the salt of a weak acid and a strong base
   ii) strong acid and weak base
   iii) weak acid and weak base. 9

   b) i) What do you mean by buffer solution ? Explain buffer action taking suitable examples. 3

   ii) How would you test two solutions of pH 9.0, one a buffer solution and the other a solution of KOH. 3

   OR

   c) Write all you know about the theory of indicators, with methyl orange and phenolphthalein as examples. 9

   d) i) The solubility product of silver chloride is 1.56×10^{-10} at 25^0C. Calculate the solubility of AgCl in gram per litre. 3

   ii) Explain the use of solubility product principle in qualitative analysis. 3

2019

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Answer the following :   8 × 1

    a) The designation of an orbital with $n = 4$ and $l = 3$ is _____.

    b) The maximum number of electrons in a subshell is given by the relation by _____.

    c) Among Li+, Na^+, Cs^+ and Rb^+, _____ has maximum ionic radius.

    d) Among C_2, O_2, M_2 and F_2 the paramagnetic molecule is _____.

    e) For octahedral coordination, the radius ratio (r^+/r^-) is _____.

    f) The appearance of colour in solid alkali metal halides is generally due to_____.

[Turn Over

g) In the reaction : $SnCl_2 + 2\ Hg\ Cl_2 \rightarrow SnCl_4 + Hg_2Cl_2$, the reducing agent is ____.

h) According to VSPER theory the geometry of IF_7 is ____.

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

a) Write Schrodinger wave equation and mention the significance of terms associated in the equation.

b) State Pauli's exclusion principle.

c) Define ionisation potential.

d) What is screening effect ?

e) Define lattice energy.

f) Why PCl_5 is stable but not NCl_5.

g) Define London forces.

h) How can we calculate bond order ?

i) What is the difference between valency and oxidation number ?

j) Represent a standard hodrogen electrode.

Part-III

3. Answer any *eight* of the following : 2×8

   a) Why a 4s orbital is filled earlier than a 3d orbital.

   b) Sketch d orbitals.

   c) Why are the electron affinities of halogens so high ?

   d) How can electronegativity be used to distinguish between an ionic bond and a covalent bond ?

   e) Why does He_2^+ exist whereas He_2 does not ?

   f) Assuming that ionic character in H-Br bond is 11%, Calculate the fraction of the contribution of ionic character to the valence bond wave function.

   g) Mention the bond orders for N_2, C_2, B_2 and O_2.

   h) What do you mean by Schottky defect ?

   i) Among H_2O and HCl which has higher boiling point and why ?

   j) Represent digrammatrically the unit cell for a face centred cubic lattice. How many atoms are present per unit cell in this arrangement ?

[Turn Over

Part-IV

4. a) What are radical and angular wave functions ? What information about the shpae of the orbitals can we get from these wave functions ? 6

OR

b) Discuss important postulates of Bohr's theory.

5. a) Discuss in details the Born-Haber cycle for experimental determination of lattice energy. 6

OR

b) On the basis of hybridisation discuss the geometry of (i) NH_3, (ii) XeF_4 molecule.

6. a) Briefly explain different Vander Waals forces. 6

OR

b) What is acid base titration ? Discuss the use of indicators in acid-base titrations.

7. a) Define electron affinity. How do the electron affinity of elements vary along a period ? Give reason . 6

OR

b) Define atomic radii and ionic radii. How do atomic and ionic radii vary in groups and periods.

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2019

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Fill in the blanks :   1 × 8

   a) 3.5gm of CO gas at 0°C and 1atm pressure contain_____ molecules.

   b) The unit of Vander Waal's constant "a" is _____ and "b" is _____.

   c) As the temperatures increases the surface tension of solution _____.

   d) A relation between Vapour pressure and temperature is known as _____.

   e) If a plane makes intercepts a, b and ∞, then Miller indices will be _____.

   f) Sodium Chloride crystal has a _____ lattice.

   g) A mixture of NH_4Cl and NH_4OH show _____ effect.

[Turn Over

h) Solubility product for the sparingly soluble salt A_2B_3 (in terms of solubility S mol L^{-1}) is _____

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

   a) Define mean free path of gas molecules.

   b) Write the law of equipartition of energies.

   c) Write Vander Waal's gas equation for n moles of a gas.

   d) Define surface tension.

   e) What are surfactants ?

   f) Define unit cell.

   g) What do n, λ, d, θ signifies in the Bragg's law $n\lambda = 2d \sin \theta$?

   h) What is common ion effect ?

   i) Calculate pH of 0.001M H_2SO_4 solution ?

   j) Define buffer action.

Part-III

3. Answer any *eight* of the following : 2×8

   a) What is the average kinetic energy of one mole of nitrogen at 300 K ?

b) Comment on the statement "mean free path depends on Collision frequency and molecular size".

c) Write the difference between ideal gas and real gas.

d) Discuss cleaning action of soap.

e) What are Miller indices ?

f) Explain the term isotropy and anisotropy.

g) Name the different intermolecular forces present in the liquid.

h) Explain why an aqueous solution of ferric chloride is acidic in nature.

i) How much sodium acetate need to be added to 1 litre of 0.01M acetic acid solution to prepare a buffer of pH 4.1 ? Ka for $CH_3COOH = 1.8 \times 10^{-5}$.

j) Write the characteristics of buffer solution.

Part-IV

4. a) Starting from the postulates of kinetic theory of gases, derive $PV = \dfrac{1}{3} mn\bar{u}^{-2}$.   6

OR

L-530   [Turn Over

b) Deduce Boyle's law and Graham's law of diffusion from kenetic gas equation. 6

5. a) Discuss briefly the sturcture of water molecule. 6

OR

b) Write short notes on the following : 6

i) London forces

ii) Dipole-dipole interactions.

6. a) What do you mean by liquid crystals ? Calssify thermotropic liquid crystals along with their characteristics. 6

OR

b) Discuss the laws of crystallography.

7. a) Derive the Henderson equation and discuss its applications. 6

OR

b) What are indicators ? Discuss the selection of indicators and their limitations.

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2019

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Fill in the blanks. 1 × 8

a) The outermost electronic configuration of Cr is _____ .

b) According to _____ principle, no two electrons in an atom will have all the four quantum numbers.

c) The stability of an ionic solid is measured in terms of its _____ .

d) The d orbital involved in dsp^2 hybridization is _____ .

e) Loctic acid exhibits _____ isomerism.

[Turn Over

f) Separation of racemic modification into its enantiomorphs is called _____ .

g) Complete the reaction $+ \dfrac{CH_2 \quad 200°C}{CH_2 \quad \Delta}$

h) Boiling point of alkanes _____ on branching.

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

a) An electron is in 4d orbital. What possible values for the quantum numbers n, *l* and m can it have ?

b) What do you mean by the term $4\pi r^2 \, dr\psi^2$?

c) How many nodal planes are present in $3dx^2 - y^2$ and $3P_z$ orbital ?

d) On the basis of hybridisation predict the structure of (i) ClF_3 (ii) SF_6.

e) Define Lattice energy.

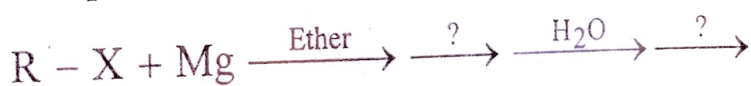f) Arrange the following carbocation in the order of increasing stability

$(CH_3)_2 \overset{\oplus}{C}H$, $(CH_3)_3 \overset{\oplus}{C}$ $(C_6H_5)_2 \overset{\oplus}{C}H$, $C_6H_5CH_2^{\oplus}$
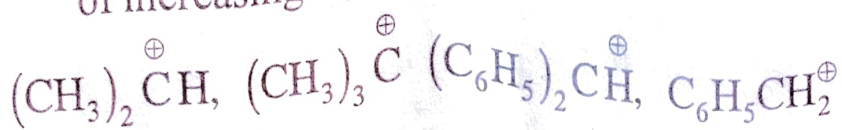
g) Assign R and S configuration to the following molecule.

$$OH-\underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}}-C_2H_5$$
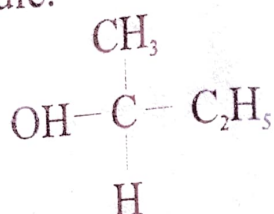
h) Comment on the aromatic character of 1, 3 cyclopentadietric.

i) Complete the reaction

$$R - X + Mg \xrightarrow{\text{Ether}} \xrightarrow{?} \xrightarrow{H_2O} \xrightarrow{?}$$

j) Draw geometrical isomers of Pentene -2.

Part-III

2 × 8

3. Answer any *eight* of the following :

a) Draw the distribution curve for the radial wave function of 2S orbital. Point out the node in the curve.

[Turn Over

b) Explain the physical significance of ψ.

c) Write the expressions for total angular part of wave functions of 2P orbitals.

d) Why Oxygen molecule is paramagnetic ?

e) Under what conditions a salt dissolves in a solvent ?

f) Write the Huckel rule for aromaticity ?

g) What is functional isomerism ? Illustrate with an example.

h) Complete the following reaction

$$CH_3CH=CH-CH_3 +O_3 \longrightarrow ? \xrightarrow{Zn/H_2O} ?$$
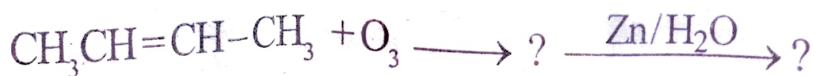
i) How will you convert $CH_3C \equiv CH$ into $CH_3C \equiv CCH_3$?

j) Sketch d orbitals.

[5]

Part-IV

4. a) What are the radial and angular wave function ? What information about the shape of the orbitals can we get from these wave functions ? 6

OR

b) The basic equation which describes the standing motion of a stretched string is $\psi = A \sin \dfrac{2\pi x}{\lambda}$ in one of the drs (X axis). Formulate Schrodinger wave equation from this.

5. a) Discuss Born equation for calculation of lattice energies. What conclusion can be drawn from this equation ? 6

OR

b) Explain how the atomic orbitals combine to form bonding and anti bonding molecular orbitals. What are the limitations to such combinations.

6. a) Differentiate between conformations and configurations. Why is chair conformation of cyclohexane more stable than the boat conformation ?
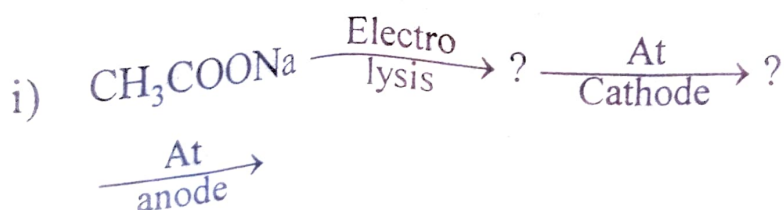
6

OR

b) Write short notes on inductive effect. How does this effect help in explaining relative acid strengths of acetic acid and formic acid.

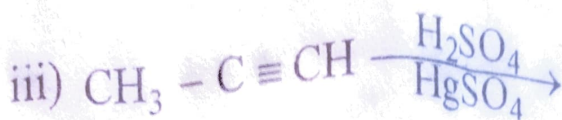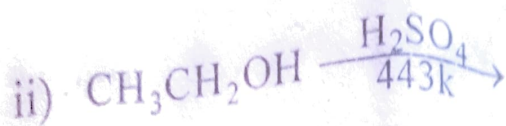7. a) i) Give mechanism of antiMarkonikoff's addition in alkenes.

3

ii) Discuss briefly Wurtz reaction.

3

OR

b) Complete the following reaction :

2 × 3

i) $CH_3COONa \xrightarrow[\text{lysis}]{\text{Electro}} ? \xrightarrow[\text{Cathode}]{\text{At}} ?$

$\xrightarrow[\text{anode}]{\text{At}}$

ii) $CH_3CH_2OH \xrightarrow[443k]{H_2SO_4}$

iii) $CH_3 - C \equiv CH \xrightarrow[HgSO_4]{H_2SO_4}$

□□

2021

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer **all** questions

Part-I

1. Answer the following by fill in the blanks :   1 × 8

   a) The solubility of sodium sulphate ____ on increasing on temperature.

   b) The particle possess ____ motion in a solid.

   c) Surface tension of a liquid ____ with increase in temperature.

   d) The conjugate acid of NH_2^- is ____.

   e) The average distance through which a molecule moves before colliding with another mobule is known as its ____.

   f) In a reversible reaction the concentration of the reactant are halved, the equilibrium constant will be ____.

   g) ____ is used as indication, if weak acid is titrated against strong base.

   h) A blade floats on the surface of water due to ____.

L-788   [Turn Over

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

    a) Write down the Vander Waal's reduced equation of state for one mole of gas.

    b) Give the relation between P^H and P^{OH}.

    c) Why liquid Ammonia bottles are cooled before opening the seal ?

    d) Explain why the boiling point of a solution is always more that that of its pure solvent.

    e) Explain the term Viscosity.

    f) P^H of 1N HCl is zero. What is the physical significance of this statement ?

    g) In NaCl crystal, how many Na^+ and Cl^- ions are present in the unit cell ?

    h) What is iversion temperature ?

    i) Give one example of Bravais Lattice crystal.

    j) Write down the value of R litre-atomospere.

Part-III

3. Answer any *eight* of the following : 2×8

    a) Explain Hydrolysis of salt.

    b) Define Ionic product of water.

c) Define Viscosity.

d) Calculate the pH of 0.01M NaOH.

e) Write down Henderson's equation for acidic buffer solution.

f) Explain why the types of an automobile is inflated to lesser pressure in summer than in winter.

g) Define plane of Symmetry.

h) Explain the term common ion effect with suitable example.

i) Determine the dissociation constant of acetic acid.

j) Explain the collision-diameter.

Part-IV

4. a) Prove from the Kinetic theory of gases that the average Kinetic energy of a grame molecule of a perfect gas at temperature T (absolute) is given by 3/2RT. 6

OR

b) What do you mean by viscosity of Gases and Mean Free Path ? Prove that the coefficient of viscosity η is independent of pressure.

[Turn Over

5. a) Define surface tension and give the relation between surface tension and the vapour pressure.   6

OR

   b) Discuss viscosity of liquid and discuss how it varies with temperature.

6. a) What is meant by space lattice of a crystal ? Draw a unit cell for space lattices of Face-centred cubic crystal.   6

OR

   b) Derive Bragg's equation for the diffraction of X-rays by crystal lattice.

7. a) Define the term solubility product. Give the relation between solubility and solubility product of a substance.   6

OR

   b) What is buffer solution ? Discuss the types of buffer solutions with examples.

□□

2021

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer **all** questions

Part-I

1. Answer the following :   1 × 8

   a) An orbital represent _____ motion of electron around the nucleus.

   b) Give the name of the alkaline earth metal from the following

      Na, Fe, Cu, Mg, Br, B.

   c) The bond order of H_2^+ is _____

   d) _____ is the smallest size of ion among the following :

      Na^+, Si^{+4}, Mg^{+2}, Al^{+3}

   e) _____ molecule has the strongest bond among the following :

      i) F – F, (ii) Cl – Cl, (iii) Bn – Bn, (iv) I – I

   f) The shape of the SO_4^{-2} ion is _____ .

[Turn Over

g) An a queous solution of silver nitrate ____ be stored in a copper vessel.

h) The oxidation number of S in $Na_2S_2O_7$ is ____.

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

a) Define de Broglie equation.

b) Give the name of the elements of a Group which has highest electronegativities value in the periodic table.

c) An electron is present in 3d-sub-shell. Give the possible values of its four quantum numbers.

d) Explain polarity of a Covalent bond.

e) Among Cu^+ and Cu^{++} ion which requires more energy to be formed.

f) Define the term Dipolemoment.

g) Whether SO_2 is a Lewis base or acid ?

h) Why is the electron affinity of Si^{14} greater than that of P^{15} ?

i) Nitrogen and Chlorine have same electro-negativity value, but ammonia forms hydrogen bond while hydrogen chloride does not. Explain it.

j) Iodine is a solid, where as other halogens are gases, Give reasons.

Part-III

3. Answer *eight* of the following : 2 × 8

 a) Explain Hund's rule with example.

 b) What do you mean by Normalized wave function ?

 c) H_2O has higher boiling point than HF, why ?

 d) Bond angle in H_2O is less than that in NH_3. Explain it.

 e) Explain NF_3 is pyramidal where as BF_3 is planar.

 f) Compare the size among Ca^{+2} and S^{-2} ion, those are isoelectronic.

 g) Compare the ionisation energy between Nitrogen and Oxygen.

 h) Discuss the geometry of CCl_4 molecule.

 i) Draw the Lewis dot structures of the following molecules and ions : $CO_3^=$, HCOOH, PH_3, H_3O^+.

 j) Balance the equation by ion-electron method
 $$MnO_4^- + H^+ + C_2O_4^= \rightarrow Mn^{+2} + CO_2 + H_2O$$

Part-IV

4. a) What are quantum numbers ? Describe the significance of these quantum numbers. 6

OR

b) Give an account of Rutherford's nuclear atom. How did Bohr improve upon Rutherford's model of the atom ?

5. a) What are transition element ? Give its position in the periodic table and discuss its general characteristics. 6

OR

b) Define the term Ionization enthalpy. How do the Ionization enthalpy of the elements vary along a group and period ?

6. a) Explain with examples the term electrovalency covalency and co-ordinate valency. 6

OR

b) Draw the molecular orbital energy level diagram for O_2 molecule and discuss its stability bond order and magnetic character.

7. a) How interactions of dipoles cause orientation of molecules and how does it determine the boiling points of substances. 6

OR

b) Explain the term hydrogen bonding. Illustrate taking example of H_2O.