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**3 (Sem-1/CBCS) CHE HC 1**

**2022**

**CHEMISTRY**

(Honours)

Paper : CHE-HC-1016

**(Inorganic Chemistry-I)**

Full Marks : 60

Time : Three hours

**The figures in the margin indicate full marks for the questions.**

1. Answer **any seven** questions from the following : 1×7=7
  - (a) Which series of spectral lines of hydrogen atom falls in visible range of sunlight?
  - (b) What is an eigenfunction?
  - (c) What is the value of shielding constant for the valence electron of *Li* atom?

- (d) Arrange the halogens in decreasing order of their electronegativities.
- (e) Calculate the formal charge of P in  $PH_4^+$  ion.
- (f) How does bond multiplicity affect bond length?
- (g) Can the molecule  $Be_2$  exist?
- (h) An element can show +1, +3 and +5 oxidation states. In which state does the element can act both as an oxidising agent as well as a reducing agent?
- (i) What is reduction potential?
- (j) In which group of the periodic table will the element having atomic number 119 lie?
- (k) What is an operator?
- (l) Which group of elements of the periodic table are collectively known as chalcogen?

2. Answer **any four** questions from the following : 2×4=8

- (a) If the value of Rydberg constant for H atom is  $1.1 \times 10^7 m^{-1}$ , what would be its value for  $He^+$  ion?
- (b) Define micro and macro particles in terms of 'action'.
- (c) Show that the probability of finding the electron in a hydrogen-like atom is independent of the angle  $\phi$ .
- (d) Discuss the trend in basic strength of the hydrides of group 15 elements.
- (e) Second electron affinity of the elements is positive. Why?
- (f) Ionic radii of  $O^{2-}$  ion is greater than  $O^-$  ion. Why?
- (g) With the help of a proper example explain that a non-polar molecule can have polar bonds.
- (h) With the help of a proper example explain disproportionation reaction.

3. Answer **any three** questions from the following :  $5 \times 3 = 15$

(a) What do you mean by orbital quantum numbers? How are their values interrelated?  $3 + 2 = 5$

(b) What are symmetric and antisymmetric wave functions? Explain Pauli's antisymmetry principle.  $2 + 3 = 5$

(c) How can the ionisation energy values of the elements be applied in determining reducing power and reactivity order of the elements.  $2\frac{1}{2} \times 2 = 5$

(d) How does electronegativity vary with bond order and hybridisation? With the help of electronegativity concept explain that  $\text{HClO}_3$  is a stronger acid than  $\text{HClO}$ .  $2 + 3 = 5$

(e) Give Kapustinskii expression for lattice energy and identify the terms involved. What are its utilities?  $3 + 2 = 5$

(f) With the help of VSEPR theory explain the shapes of  $\text{XeF}_2$  and  $\text{IF}_5$  molecules.  $2\frac{1}{2} \times 2 = 5$

(g) Discuss electrostatic theory of H-bonding. Give reason why ice floats over water.  $3 + 2 = 5$

(h) Derive Nernst equation for measuring EMF of cell.

4. Answer **any three** questions from the following :  $10 \times 3 = 30$

(a) (i) With the help of Bohr's theory, explain the line spectra of H-atom.

(ii) Explain Hund's rule of maximum multiplicity.

(iii) Show that an s orbital has spherical shape.

(b) What is effective nuclear charge? Explain the variation in effective nuclear charge of the elements along a period. Give Slater's rules for calculating screening constant.  $3 + 2 + 5 = 10$

(c) (i) Explain Allred and Rochow's approach of electronegativity. What are its limitations?  $3 + 2 = 5$

- (ii) What are radial nodes? Draw the radial probability distribution curve for 4p, 4d, 3s and 5f orbitals. 1+4=5
- (d) Give Hückel and London approach of bonding in  $H_2$  molecule.
- (e) What is polarisation in ionic compounds? Give Fajan's rules on polarisation. With the help of polarisation explain the solubility of silver halide in water. 3+4+3=10
- (f) (i) Discuss electron sea model of metallic bonding and explain the metallic properties arising out of it. 4
- (ii) Explain various types of hybridisation involving s and p orbitals with suitable examples. 6
- (g) (i) What is ionisation energy? Explain the factors on which it depends. 1+4=5
- (ii) Discuss the crystal structure of zinc blende. 5

- (h) (i) Draw the resonance structure of  $CO_3^{2-}$  and  $SO_4^{2-}$ . 2
- (ii) What do you mean by well-behaved function? 2
- (iii) Identify whether the following functions are eigenfunctions of  $d^2/dx^2$  :  
 (a)  $\cos kx$   
 (b)  $e^{ikx}$   
 Find the eigenvalue (if any). 3
- (iv) Draw the shapes of the orbitals for  $l=2$ . 3

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3 (Sem-1/CBCS) CHE HC 2

2022

**CHEMISTRY**

(Honours)

Paper : CHE-HC-1026

**(Physical Chemistry - I)**

Full Marks : 60

Time : Three hours

**The figures in the margin indicate full marks for the questions.**

**(Symbols used signify their usual meaning)**

1. Answer the following as directed :

**(any seven)**

1×7=7

- (a) Write the kinetic gas equation for an ideal gas.
- (b) Define Boyle temperature of a gas.
- (c) Higher the viscosity, slower is the rate of flow of a liquid at a given temperature. (State True or False)

(f) Explain why sodium hydroxide solution is not used to precipitate  $Al^{3+}$  as  $Al(OH)_3$  in Gr 3 of qualitative analysis of salt ?

(g) With the help of a suitable example explain what is impurity defect in crystal.

(h) What is rotating crystal method of observing diffraction in single crystal ?

3. Answer **any three** of the following questions :  $5 \times 3 = 15$

(a) Starting from the Van der Waals equation, find an expression for the Boyle temperature of a gas. Calculate Boyle temperature of  $CO_2$  gas. (Given for  $CO_2$  gas  $a = 0.3637 \text{ Nm}^4 \text{ mol}^{-2}$  and  $b = 42.8 \text{ m}^3 \text{ mol}^{-1}$ )  $3+2=5$

(b) Obtain relations to express critical constants in terms of Van der Waals constants 'a' and 'b'. Show that critical compressibility constant  $Z_c$  of one mole of a Van der Waals gas is 0.375.

$4+1=5$

(c) Define coefficient of viscosity. Give the SI unit of coefficient of viscosity. Give the theory of determination of coefficient of viscosity of a liquid by Ostwald viscometer method.  $1+1+3=5$

(d) What is meant by symmetry elements and symmetry operations? With the help of suitable examples, explain what are centre of symmetry and axis of symmetry.  $2+3=5$

(e) Give *one* example each of a strong acid and a weak acid. Explain the role of solvent in the ionization process of these acids.  $2+3=5$

(f) Using the expression for Maxwell distribution of speed, show that average kinetic energy of a gas molecule is given

by  $\frac{3}{2}kT$ .  $5$

(g) Explain the following :

(i) Surface tension of water increases on addition of  $NaCl$ .  $2$

(ii) Cleansing action of detergent.  $3$

(h) Discuss the theory of pH metric titration between acetic acid solution and sodium hydroxide solution. Show the graphical variation between pH change with volume of sodium hydroxide added for the titration.  $4+1=5$

4. Answer **any three** of the following questions :  $10 \times 3 = 30$

(a) Define collision frequency. Obtain an expression for bimolecular collision frequency of a pure gas. Explain how collision diameter of a gas can be calculated from the measurement of coefficient of viscosity of the gas.

$1+5+4=10$

(b) (i) What is the virial equation of state of a gas ? Express the Van der Waals equation of state in the virial form.  $2+4=6$

(ii) Explain the principle of continuity of states.  $4$

(c) (i) Show the graphical variations for distribution functions for speeds with speeds of a gas at temperatures

$T_1, T_2$  and  $T_3$  ( $T_1 < T_2 < T_3$ ).  $3$

(ii) Define vapour pressure of a liquid at a given temperature. Explain a method of experimental determination of vapour pressure of a liquid. How vapour pressure is related to the boiling point of a liquid ?  $1+4+2=7$

(d) Explain the powder X-ray diffraction method of determination of a crystal structure. Explain how the lattice planes in sodium chloride are indexed.

$5+5=10$

(e) (i) What is meant by ionic product of water ? Show that  $pH = \frac{1}{2} pK_w$  for

pure water. If  $K_w = 4.0 \times 10^{-14}$  for pure water at 317K, calculate  $pOH$ .

$1+2+2=5$

(ii) Define buffer capacity. Explain the role of buffer solution in qualitative analysis of salt.  $1+4=5$

(f) (i) A bulb of capacity  $1 \text{ dm}^3$  contains  $3.011 \times 10^{23}$  gaseous He atoms. Pressure exerted by these molecules is  $101.325 \text{ kPa}$ . Calculate the temperature and root mean square speed of the gas, assuming it to behave ideally under the given condition.  $4$

(ii) Derive an expression for coefficient of viscosity of a gas relating the mean free path of the gas. How the viscosity of a gas is influenced by the change of pressure ?  $5+1=6$

(d) State the total number of planes of symmetry in a cubic system.

(e) The planes which are absent in simple cubic crystal system is

(i) (100)

(ii) (200)

(iii) (110)

(iv) (111)

*(Choose the correct option)*

(f) Explain why  $Zn^{2+}$  ion is not precipitated as  $ZnS$ , when  $H_2S$  gas is passed through a  $ZnSO_4$  solution in presence of  $HCl$ .

(g) Identify the odd pairs, that will not act as buffer solution, from the following :

(i)  $NH_4Cl$  and  $NH_4OH$  solution

(ii)  $NaCl$  and  $NaOH$  solution

(iii)  $CH_3COONa$  and  $CH_3COOH$  solution

(iv)  $NaH_2PO_4$  and  $Na_2HPO_4$  solution.

*(Choose the correct option)*

(h) The compression factor for hydrogen gas is always greater than 1. Explain.

(i) How vapour pressure of a liquid is related to its boiling point ?

(j) What is a thermotropic liquid crystal ?

(k) State the law of rational indices in a crystal system.

(l) What is universal indicator in acid-base titration ?

2. Answer the following questions : **(any four)-**  
 $2 \times 4 = 8$

(a) The mean free path of gas molecules increases and number of collisions per unit time decreases with the decreasing temperature. Explain.

(b) Explain qualitatively the structure of liquid water.

(c) Determine the interplanar spacing between the (221) planes of a cubic lattice of edge length 450 pm.

(d) The degree of hydrolysis of  $NH_4Cl$  in 0.02 M aqueous solution at 298 K is  $5 \times 10^{-3}$ . If  $pK_b$  for  $NH_4OH$  at 298 K is 4.73, calculate  $pH$  of the solution.

(e) Value of Van der Waals radius for gaseous  $A_2$  molecule is  $2.0 \text{ \AA}$ . Calculate Van der Waals constant  $b$  for the gas.

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3 (Sem-1/CBCS) CHE HG/RC

2022

## CHEMISTRY

(Honours Generic/Regular Elective)

Paper : CHE-HG/RC-1016

**(Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons)**

Full Marks : 60

Time : Three hours

**The figures in the margin indicate full marks for the questions.**

Answer **either** in English **or** in Assamese.

1. Answer **any seven** from the following questions : 1×7=7

তলত দিয়া প্রশ্নবোৰৰ যিকোনো সাতোটাৰ উত্তৰ কৰা :

- (a) What is meant by orthogonal wave function ?

অর্থগনেল তৰংগ ফলন মানে কি বুজা ?

- (b) Express 1D in coulomb meter.

1D ক কুলম্ব মিটাৰ এককত প্রকাশ কৰা।

Contd.

(c) Using VSEPR rule predict the shape of  $SF_4$ .

VSEPR তত্ত্ব প্ৰয়োগ কৰি  $SF_4$  যৌগটোৰ আকৃতি নিৰ্ণয় কৰা।

(d) Arrange the following compounds in increasing polarity :

তলত দিয়া যৌগসমূহক প্ৰবৃত্ততাৰ উৰ্দ্ধক্ৰমত সজোৱা—

(i) 1,2-dichlorobenzene

1,2-ডাইক্ল'ৰ'ব'ব'নজিন

(ii) 1,3-dichlorobenzene

1,3-ডাইক্ল'ৰ'ব'ব'নজিন

(iii) 1,4-dichlorobenzene

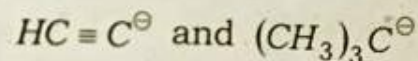
1,4-ডাইক্ল'ৰ'ব'ব'নজিন

(e) How many spectral lines will be produced in the spectrum of H-atom when an electron jumps from 5th energy level ?

হাইড্ৰ'জেন পৰমাণুৰ ইলেকট্ৰনটো পঞ্চম শক্তিকক্ষৰ পৰা ভূমিস্তৰ অৱস্থালৈ সংক্ৰমিত হ'লে কিমান সংখ্যক বৰ্ণালী ৰেখা পোৱা যায় ?

(f) Out of the following anions, which is more stable and why ?

তলত দিয়া আয়নবোৰৰ কোনটো বেছি স্থিৰ আৰু কিয় ?



(g) Why is  $AlCl_3$  covalent, while  $AlF_3$  is ionic ?

$AlCl_3$  যৌগটো সহযোজী, কিন্তু  $AlF_3$  যৌগটো আয়নীয়। ব্যাখ্যা কৰা।

(h) Out of  $NH_3$  and  $NF_3$  which molecule has higher dipole moment ?

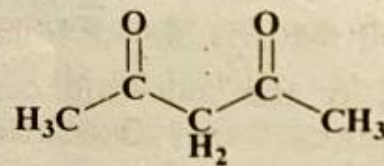
$NH_3$  আৰু  $NF_3$  অনুদুটাৰ ভিতৰত কোনটো অনুৰ দ্বিমোৰু ভ্ৰামক বেছি হ'ব ?

(i) Define Madelung constant.

মেডেলাং ধ্ৰুবকৰ সংজ্ঞা দিয়া।

(j) Write down the tautomeric form of the following compound :

তলত দিয়া যৌগটোৰ ট'ট'মেৰিক ৰূপটো লিখা :



(k) Write down the energy expression of an electron in the 3rd shell of an H-atom ?

হাইড্ৰ'জেন মৌলৰ তৃতীয় কক্ষত থকা ইলেকট্ৰনটোৰ শক্তিৰ প্ৰকাশ ৰাশিটো লিখা।

- (l) Draw the chair and boat conformations of cyclohexane.

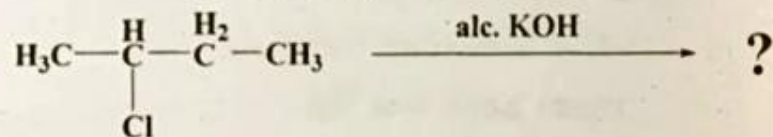
চাইক্লোহেক্সেনৰ চকী আৰু নাওঁ অনুৰূপতা অংকন কৰা।

2. Answer the following: **(any four)**  $2 \times 4 = 8$

তলত দিয়াবোৰৰ যিকোনো চাৰিটাৰ উত্তৰ কৰা :

- (a) Write down the major product of the following reaction :

তলত দিয়া বিক্ৰিয়াটোৰ মুখ্য বিক্ৰিয়াজাত যৌগটো লিখা আৰু তাৰ নামটো উল্লেখ কৰা।

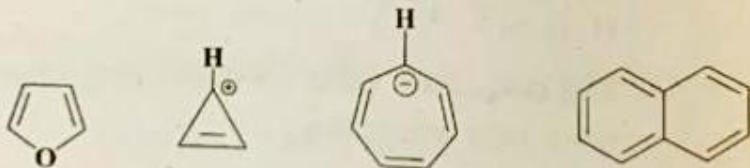


- (b) Calculate de Broglie wavelength of an electron accelerated through a potential difference of  $10^6 \text{ V}$ .

$10^6 \text{ V}$  বিভব পাৰ্থক্যত গতি কৰি থকা ইলেক্ট্ৰন এটাৰ দ্য-ব্ৰয়লি তৰংগদৈৰ্ঘ্য কিমান হ'ব গণনা কৰা।

- (c) Identify the following compounds as aromatic, anti-aromatic and non-aromatic.

তলত দিয়া যৌগবোৰক এৰ'মেটিক, এন্টি-এৰ'মেটিক আৰু ন'ন-এৰ'মেটিক হিচাপে চিহ্নিত কৰা :

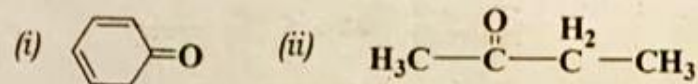


- (d) A particle having a wavelength  $4 \times 10^{-4} \text{ cm}$  is moving with a velocity of  $100 \text{ cm/sec}$ . Calculate the mass of the particle.

এটা পদাৰ্থৰ তৰংগদৈৰ্ঘ্য  $4 \times 10^{-4} \text{ cm}$  আৰু গতিবেগ  $100 \text{ cm/sec}$  হ'লে, তাৰ ভৰ নিৰ্ণয় কৰা।

- (e) Write the enolic forms of the following :

তলত দিয়া যৌগবোৰৰ ইন'লিক গঠন সংকেতবিলাক লিখা :



- (f) What is specific rotation? Give the mathematical equation for calculating specific rotation.

নিৰ্দিষ্ট ঘূৰ্ণন মানে কি বুজা ? নিৰ্দিষ্ট ঘূৰ্ণন নিৰ্ণয় কৰাৰ বাবে গাণিতিক সূত্ৰটো লিখা।

- (g) Write *two* differences between atomic orbitals and molecular orbitals.

পাৰমাণৱিক অৱবিটেল আৰু আণৱিক অৱবিটেলৰ মাজত দুটা পাৰ্থক্য লিখা।

- (h) Though B-F bond is polar,  $\text{BF}_3$  is non polar. Explain.

যদিও B-F বান্ধনি ধ্ৰুবীয় হয়,  $\text{BF}_3$  অণুৰ অধ্ৰুবীয়। ব্যাখ্যা কৰা।

3. Answer **any three** of the following:

5×3=15

তলত দিয়াবোৰৰ যিকোনো তিনিটাৰ উত্তৰ কৰা :

(a) Find the

(i) frequency, and

(ii) wavenumber of the 2nd line in the Balmer series in CGS unit.

2.5+2.5=5

Balmer শ্ৰেণীৰ দ্বিতীয় ৰেখাৰ

(i) কম্পনাংক, আৰু

(ii) তৰংগসংখ্যা CGS এককত নিৰূপণ কৰা।

(b) Distinguish between bond moments and dipole moment of a molecule. The dipole moment of HF molecule is 1.91D and the bond distance is 0.92Å. Calculate the percentage ionic character of HF.

1+4=5

এটা অণুৰ বান্ধনি ভ্ৰামক আৰু দ্বিমৰু ভ্ৰামকৰ মাজত পাৰ্থক্য লিখা। HF অণুৰ দ্বিমৰু ভ্ৰামক 1.91D আৰু বান্ধনি দৈৰ্ঘ্য 0.92Å. HF অণুৰ শতকৰা আয়নীয় গুণ নিৰ্ণয় কৰা।

(c) Draw the Born-Haber cycle for NaCl using the following data and calculate

$$\Delta H_f^{\circ}(\text{NaCl}) :$$

3+2=5

$$U_0 = -75 \text{ kJmol}^{-1},$$

$$\Delta H_{1E}(\text{Na}) = 496 \text{ kJmol}^{-1},$$

$$\Delta H_{EA}^{\circ}(\text{Cl}) = -349 \text{ kJmol}^{-1}$$

$$\Delta H_A^{\circ}(\text{Cl}) = 242 \text{ kJmol}^{-1},$$

$$\Delta H_A^{\circ}(\text{Na}) = 108 \text{ kJmol}^{-1}$$

NaCl অণুৰ বাবে ব'ৰ্ন-হেৰাৰ চক্ৰটো অংকন কৰা আৰু

তলত দিয়া মানবিলাকৰ পৰা  $\Delta H_f^{\circ}(\text{NaCl})$  নিৰ্ণয় কৰা :

$$U_0 = -75 \text{ kJmol}^{-1},$$

$$\Delta H_{1E}(\text{Na}) = 496 \text{ kJmol}^{-1},$$

$$\Delta H_{EA}^{\circ}(\text{Cl}) = -349 \text{ kJmol}^{-1}$$

$$\Delta H_A^{\circ}(\text{Cl}) = 242 \text{ kJmol}^{-1},$$

$$\Delta H_A^{\circ}(\text{Na}) = 108 \text{ kJmol}^{-1}$$

- (d) (i) How many radial nodes are present in the following wave function?  $1+1=2$

তলত দিয়া তৰংগফলন বিলাকৰ বেডিয়েল নোডছ কিমানটো থাকিব ?

(a)  $n=4, l=2$

(b)  $n=3, l=1$

- (ii) Sketch the orbitals for  $n=3, l=2$ .  
3

$n=3, l=2$  হ'লে অৰবিটেল বিলাক অংকন কৰা।

- (e) Draw Newman projection formula of conformers of *n*-butane. Arrange them in increasing order of energy.  $4+1=5$

বিউটেনৰ অনুৰূপীবোৰৰ বাবে নিউমেন অভিক্ষেপন অংকন কৰা আৰু সিহঁতক শক্তিৰ উৰ্ব্বক্রমত সজোৱা।

- (f) What is oxymercuration-demercuration reaction? Draw the mechanism of the reaction by considering a suitable example.  $1+4=5$

অক্সিমাৰকিউৰেচন-ডিমাৰকিউৰেচন বিক্ৰিয়া কি হয় ? এটা উদাহৰণ উল্লেখ কৰি উক্ত বিক্ৰিয়াটোৰ ক্ৰিয়াবিধি বৰ্ণনা কৰা।

- (g) Write notes on:  $2.5+2.5=5$   
টোকা লিখা :

(i) Saytzeff's rule  
চেইটজেফ নীতি

(ii) Huckel rule of aromaticity  
এৰ'মেটিছিটিৰ হুকেলৰ নীতি

- (h) Show the product of ozonolysis reaction by considering pent-2-yne as an example. Mention the steps involved in the process.  $2+3=5$

pent-2-yne ৰ অ'জনলাইছিছ বিক্ৰিয়াটোৰ বিক্ৰিয়াজাত যৌগটো লিখা। উক্ত বিক্ৰিয়াটোৰ ক্ৰিয়াবিধি উল্লেখ কৰা।

4. Answer the following: (**any three**)

$10 \times 3 = 30$

- (a) Give the detailed account of Fajan's theory to explain the partial covalent character in ionic compounds. Using Fajan's rule explains the trend in solubility of silver halides. Also explain the trends in bond lengths of the following silver halides:

$AgCl$  (277 pm),  $AgBr$  (289 pm) and  $AgI$  (281 pm)  
 $5+2.5+2.5=10$

(b) Inductive effect

আবেশী প্ৰভাৱ

(c) Hyperconjugative effect

অতিসংযুক্তিতা প্ৰভাৱ

(ii) Write the limitation of Bohr's atomic theory. What is the difference between radial wave function and angular wave function? 3+2=5

বৰ'ৰ পৰমাণু আৰ্হিৰ আসোৱাহসমূহ লিখা।  
ব্যাসাৰ্থিক তৰংগ ফলন আৰু কৌণিক তৰংগ  
ফলনৰ মাজৰ পাৰ্থক্য লিখা।

(g) (i) The ionization energy of rubidium and silver are respectively  $4.18 eV$  and  $7.57 eV$ . Calculate the ionisation energies of an H-atom with its electron in the same orbitals as in these two atoms and account for the difference in values. 5

ৰ'বিডিয়াম আৰু ছিলভাৰ মৌল দুটাৰ আয়নীকৰণ  
এনথালপি ক্ৰমে  $4.18 eV$  আৰু  $7.57 eV$ ।  
উপৰোক্ত মৌল দুটাৰ দৰে একে অৰবিটেলত  
যদি হাইড্ৰ'জেন মৌলৰ এটা ইলেকট্ৰন থাকে,  
তেতিয়া হ'লে হাইড্ৰ'জেন মৌলটোৰ আয়নীকৰণ  
এনথালপি উলিওৱা আৰু মান দুটাৰ পাৰ্থক্য  
নিকপণ কৰা।

(ii) State and explain Hund's rule of maximum multiplicity. 3

হুণ্ডৰ সৰ্বোচ্চ গুণিতক নীতিটো উল্লেখ কৰা আৰু  
ব্যাখ্যা কৰা।

(iii) Calculate the velocity of a moving electron in the 2nd orbit of  $He^+$  ion. 2

$He^+$  আধানৰ দ্বিতীয় অৰবিটত থকা ইলেক্ট্ৰন  
এটাৰ গতিবেগ নিৰ্ণয় কৰা।

(h) (i) Write the differences between diastereomers and enantiomers. 4

ডাইঅ'ষ্টেৰিঅ'মাৰ আৰু ইনানছিঅ'মাৰৰ পাৰ্থক্য  
লিখা।

(ii) Write short notes on: 3+3=6

চমু টোকা লিখা :

(a) Meso compound

মেছ' যৌগ

(b) Chirality in alkenes

এলকিনৰ কিৰেলিটি

আয়নিক বান্ধনিৰ আংশিক সহযোজী ধৰ্ম কেনেকৈ ফাজানছ নীতিসমূহে ব্যাখ্যা কৰে, উল্লেখ কৰা। ফাজানছ নীতিসমূহ প্ৰয়োগ কৰি ছিলভাৰ হেলাইডৰ দ্ৰৱনীয়তা ব্যাখ্যা কৰা। তলত দিয়া ছিলভাৰ হেলাইড বিলাকৰ বান্ধনি দৈৰ্ঘ ব্যাখ্যা কৰা।

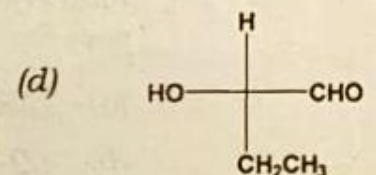
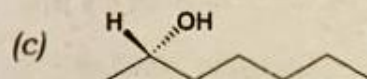
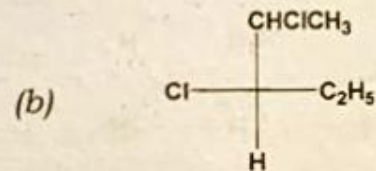
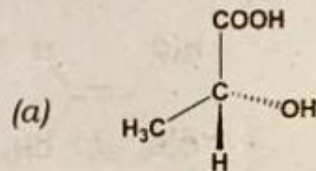
$AgCl$  (277pm),  $AgBr$  (289pm) and  $AgI$  (281pm)

- (b) Using LCAO show how two 1s atomic orbitals may be combined to obtain different molecular orbitals. Draw the probability function for the bonding and antibonding molecular orbitals. Mention the differences between bonding molecular orbitals and antibonding molecular orbitals.  $2+3+5=10$

পাৰমাণৱিক অৰবিটেলৰ বৈখিক মিলন নীতি প্ৰয়োগ কৰি কেনেকৈ দুটা 1s পাৰমাণৱিক অৰবিটেল লগ হৈ বিভিন্ন আণৱিক অৰবিটেল গঠন হয়, বুজাই লিখা। বন্ধন আৰু প্ৰতিবন্ধন আণৱিক অৰবিটেলৰ সম্ভাৱনা ফলন অংকন কৰা। বন্ধন আৰু প্ৰতিবন্ধন আণৱিক অৰবিটেলৰ পাৰ্থক্যবোৰ লিখা।

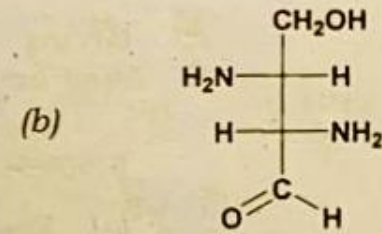
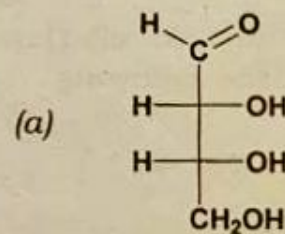
(c) (i) Assign R/S designation of the following compounds: 4

তলত দিয়া যৌগবোৰৰ R/S চিহ্ন নিৰূপণ কৰা।



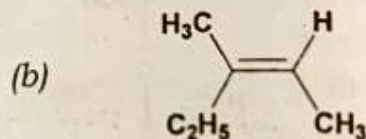
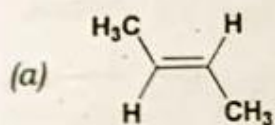
(ii) Assign D, L designation for the following compounds: 2

তলত দিয়া যৌগবোৰৰ D, L চিহ্ন নিৰূপণ কৰা :



(iii) Assign *cis-trans* and E/Z notation for the following: 2

তলত দিয়াবোৰৰ *cis-trans* E/Z চিহ্ন নিৰূপণ কৰা :



(iv) Draw the structures of the following: 2

তলত দিয়া নাম দুটাৰ পৰা গাঠনিক সংকেত লিখা।

(a) (2R,3S) - tartaric acid

(b) (Z)-Pent-2-ene.

(d) (i) Using the idea of hybridization draw the shapes of  $BeF_2$  and  $BCl_3$ . 5

সংকৰণ নীতি প্ৰয়োগ কৰি  $BeF_2$  আৰু  $BCl_3$  অণুৰ আকাৰ অংকন কৰা।

(ii) Giving suitable orbital overlap diagram, explain the following: 5

অভিলেপন চিত্ৰৰ সহায়ত বৰ্ণনা কৰা :

(a) Positive overlap

ধনাত্মক অভিলেপন

(b) Negative overlap

ঋণাত্মক অভিলেপন

(c) Zero overlap

শূন্য অভিলেপন

(e) (i) Explain Kolbe and Wurtz reaction for the synthesis of alkanes taking suitable example. 2.5+2.5=5

উদাহৰণসহ কল্বেৰ বিদ্যুত-বিশ্লেষণ পদ্ধতি আৰু উটছ বিক্ৰিয়াৰ দ্বাৰা কেনেকৈ এলকেন প্ৰস্তুত কৰা হয়, বুজাই লিখা।

(ii) Discuss the Markownikoff's and anti-Markownikoff's addition of  $HBr$  to propene. Justify the observed behaviour. 5

প্ৰ'পিনৰ লগত  $HBr$  অণুৰ যোজন বিক্ৰিয়াটো মাৰ্ক'নিকভ আৰু প্ৰতি-মাৰ্ক'নিকভ যোজন বিক্ৰিয়াৰ দ্বাৰা বুজাই লিখা।

(f) (i) Write short notes on: (**any two**) 2.5×2=5

চমু টোকা লিখা : (যিকোনো দুটা)

(a) Mesomeric effect

মেছ'মেৰিক প্ৰভাৱ