(18)

[This question paper contains 6 printed pages.]

4/12/17

Your Roll No...............

**Sr. No. of Question Paper : 6481** **HC**

Unique Paper Code : 32171101

Name of the Paper : Inorganic Chemistry

Name of the Course : **B.Sc. (H) Chemistry**

Semester : I

Duration : 3 Hours Maximum Marks : 75

## Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions in all.
3. Question No. **1** is compulsory.
4. The questions should be numbered in accordance with the number in the question paper.
5. Calculators and log tables may be used.

1. Explain any **five** of the following :

   (i) The first ionization enthalpy of Al is less than that of Mg but reverse is true for the second ionization enthalpy of Al. Explain.

(ii) Half-filled and fully - filled orbitals are associated wit extra stability.

(iii) 's' orbitals are spherically symmetrical.

(iv) Water has maximum density at 4°C.

(v) Bond length in $N_2^+$ is greater than in $N_2$, while the bond length in $NO^+$ is less than NO.

(vi) $NO_2$ is bent whereas $CO_2$ is linear. (3×5)

2. (i) Write the Schrodinger wave equation for an electron in H atom and give the significance of the various terms involved.

(ii) Draw neatly labelled diagrams for radial probability distribution curves for 2s and 2p orbitals.

(iii) Calculate the ionic radii of $K^+$ and $Cl^-$ using Pauling's method if the inter-nuclear distance between these ions is 314 pm. (4×3)

3. (i) State the Heisenberg's Uncertainty Principle. Give its importance on micro and macro scales.



(ii) What are degenerate orbitals? Comment upon the degeneracy of the 3s, 3p and 3d orbitals for the hydrogen atom and multi electron systems.

(iii) What do you understand by resonance? Write resonating structures for $N_2O$ and $N_3^-$. (4×3)

4. (i) State the Pauli Exclusion Principle. How can this principle be used to fix the maximum capacity of the various energy levels in an atom?

(ii) If an electron shifts from n=6 to n=1 and n=5 to n=2 levels, in which portion of the electromagnetic spectrum would these lines lie? Name the corresponding spectral series.

(iii) On which law is the Born-Haber Cycle based? Set up a Born-Haber Cycle for the formation of MgO from Magnesium metal and Oxygen, i.e. Mg(s) + 1/2 $O_2$ (g) $\rightarrow$MgO(s). (4×3)

5. (i) Draw neatly labelled molecular orbital diagrams of $N_2$ (with s-p mixing) and $F_2$. Predict the bond order in each case.

(ii) What are the basic principles of VSEPR theory? Using this theory, predict the shape of the following : $I_3^-$ and $SF_6$.

(iii) What are Slater rules? Calculate the screening constant and the effective nuclear charge for the Valence electrons in gallium (Z = 31). (4×3)

6. (i) Select from each group of species the one having the smallest size. Justify your answer.

(a) O, $O^-$, $O^{2-}$. (b) $K^+$, $Sr^{2+}$, $Al^{3+}$. And

(ii) Which of the elements Na, Mg, Si & P will have the greatest difference between the first and second ionisation enthalpy? Explain.

(iii) Calculate the per cent ionic character in the Cs-F bond in CsF. The electronegativity values for Cs and F are 0.7 and 4.0 respectively. Predict the nature of the bonding in CsF. $16(4-0.7) + 3.5(4-0.7)^2$ (4×3)

=

7. (i) Identify the example, which best suits the property mentioned. Giving reasons for your choice :

(a) Higher dipole moment: $NH_3$ or $NF_3$



(b) Higher boiling point: ortho- nitrophenol or para-nitrophenol.

(ii) The bond angles in $CH_2F_2$ are HCH = 112.3° and FCF = 108.3°. Calculate the *s* character used by the carbon atom in the orbital directed to the hydrogen and fluorine atoms. Discuss the result in terms of Bent's rule.

(iii) Calculate the limiting radius ratio of cation to that of anion when co-ordination number is four (tetrahedral geometry). What is the co-ordination number of cation in the crystal, when $r_{M^+}$ = 97 pm and $r_{X^-}$ = 221 pm? (4×3)

8. (i) Using Band theory explain how Na and Be metals act as conductors.

(ii) How is percent ionic character related to electronegativity difference and dipole moment? The dipole moment of HI is 0.384 D and bond distance is 1.60 pm. What will be the % of ionic character of HI?

(iii) What do you understand by equivalent and non-equivalent hybrid orbitals? Give one example each. (4×3)

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[This question paper contains 4 printed pages.]

15/12/17

Your Roll No..............

Sr. No. of Question Paper : 6482 HC

Unique Paper Code : 32171102

Name of the Paper : Physical Chemistry I

Name of the Course : B.Sc. (Honours) Chemistry

Semester : I

Duration : 3 Hours Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **six** questions.
3. First question is compulsory.
4. Use of scientific calculators and log tables is allowed.

1. Explain any **five** :

(a) pH of neutral water at 110°C is less than 7 but it is not acidic in nature.

(b) Solubility of AgCl will decrease if some $AgNO_3$ is added to its saturated solution.

(c) Addition of acetic acid to water decreases its surface tension, whereas addition of sodium chloride increases it.

(d) At room temperature the distribution of molecular velocities of hydrogen and helium is same.

(e) Heat capacity of a polyatomic gas is greater than that of a monoatomic gas.

(f) $K^+$ and $Cl^-$ are indistinguishable by X ray diffraction method. (3×5=15)

2. (a) Derive the van der Waals equation of state for gases. How does it take into account the deviation from ideality?

(b) Draw, label and explain the Andrews isotherms for a real gas.

(c) Find the temperature at which 3 moles of $SO_2$ will occupy a volume of 20 $dm^3$ at a pressure of 1.5 MPa a) using ideal gas equation b) using the van der Waals equation ($a = 678.88\ dm^6$ KPa $mole^{-2}$ and $b = 5.6\times10^{-2}$ $dm^3\ mol^{-1}$, $R = 8.314$ K Pa $dm^3$). (4,4,4)

3. (a) Derive the expressions for the pH of the solutions for the titration of strong acid with strong base – (i) before the equivalent point (ii) at the equivalent point (iii) after the equivalent point.

(b) Define buffer Index. Derive an expression for it.

(c) Calculate the solubility product of $Ag_2CrO_4$ if its solubility is $8\times10^{-5}$ mol per liter. What is the solubility of $Ag_2CrO_4$ in a solution containing 0.01 mol per liter of $K_2CrO_4$? (4,4,4)



4. (a) What is the coefficient of viscosity of a liquid? What are its SI units? Describe a method for determining the coefficient of viscosity in the lab.

(b) How do the detergents help in cleaning?

(c) Describe phenomenon of capillary action?

(d) What is the radius of the drop of liquid falling from a capillary tube 1mm in diameter at 300 K. (Surface tension of liquid = $65 \times 10^{-3}\ Nm^{-1}$, density =1.3 $gcm^{-3}$). (4,2,2,4)

5. (a) Describe all the symmetry elements of a cube.

(b) Write the Millar indices for the planes with the following intercepts (i) a, 1/3b/, 1/4c (ii) 0a, 1b, 2c (iii) 3a, 2b, 4c (iv) l/2a, 1/4b, ∞c

(c) X ray powder for molybdenum has reflections at

θ values 20.25° 29.30° 36.82° 43.81° 50.69° 58.80° 66.30° and other larger angles, when $K_\alpha$X rays from Cu are used ($\lambda = 154$ pm)

(i) What is the type of crystal of molybdenum lattice?

(ii) What is the length of side of the unit cell? (4,4,4)

6. (a) Derive Bragg's law. How is it used to determine the crystal structure?

(b) Derive an expression for the viscosity of a gas.

(c) Calculate the pH of the following solutions

(i) 0.11 N Sodium acetate (ii) a solution formed by mixing 20 ml, 0.1 M Acetic acid and 10 ml 0.1 M Sodium acetate. ($K_a$ of Acetic Acid is $1.74 \times 10^{-5}$) (4,4,4)

7. (a) Derive expression for hydrolysis constant and pH of the solution of salt of a strong acid and a weak base.

(b) Derive the expressions for the heat capacities of linear and non linear polyatomic molecules on the basis of equipartition of energy.

(c) (i) Define mean free path in a gas assembly.

(ii) Calculate the number of bimolecular collisions per sec $cm^{-3}$ in Argon at a pressure of 101.325 KPa at a tem[illegible]0°C if the collision diameter is 350 pm. ($k=1.38 \times 10^{-23}$ J $K^{-1}$). (4,4,4)

8. Write short note on any **three** of the following :

(a) Experimental determination of critical constants of a gas

(b) Buffer Action

(c) Theory of acid-base indicators

(d) Laws of crystallography (4,4,4)

Sl-No-of Q.P. : 5601 Roll No. 5/17/17

B.Sc (H) Chemistry/Sem- I
Paper – CHHT -101
Inorganic Chemistry -1
(Atomic Structure and Periodicity of Elements)
~~Subject~~ Code: 217101
UP

H

Time : 3 hrs

Max marks : 75

Instructions for candidates

- Write your Roll No on the top immediately on receipt of the question paper.
- Attempt six questions in all
- Question no. 1 is compulsory and carries 15 marks
- All other questions carry 12 marks each.

1. Attempt any five questions from the following:
   a) Write the electronic configuration of the following elements:
      i. Cu-29
      ii. La -57
      iii. Cr-24
   b) Arrange the following species in order of increasing size giving reasons
   c) Distinguish between Electron gain enthalpy and Electronegativity.
   d) Draw the radial probability distribution curves for 2s, 2p, and 3d orbitals
   e) Which of the following is more covalent and why?
      i. CuCl and KCl
      ii. AgF or AgI
      iii. $SnCl_2$ or $SnCl_4$
   f) Explain which is greater and why? HNH angle in $NH_3$ or HPH angle in $PH_3$.

   (3*5)

2. a) Write the time dependent Schrodinger wave equation for hydrogen atom and define each term in it.
   b) Explain the significance of $\psi$ and $\psi^2$.
   c) Write the conditions and importance for normal and orthogonal wave functions.

   (4*3)

3. a) Explain why HF is a liquid whereas HCl is a gas.
   b) Explain Slaters rule for determining Z* for 4S electron of copper and 19$^{th}$ electron of K.
   c) State Hund's rule of maximum multiplicity and its consequences.

   (4*3)

4. a) Explain why F is more electronegative than Cl whereas F has lower electron gain enthalpy than Cl.
   b) Explain Heisenberg's uncertainty principal and its significance.
   c) Describe Mulliken Jaffe scale of electronegativity.

   (4*3)

5. Write short notes on any three of the following.
   a) Fazan's rules
   b) Hydrogen bonding
   c) Pauling's scale of electronegativity
   d) Factors affecting ionisation enthalpy.

(4*3)

6. a) How many types of quantum numbers are there and what information do they give about the orbitals.
   b) Give all possible orbitals for n=4 and also determine the maximum number of electrons which can exist in a completely filled n=4 level.
   c) State de Broglie's wave equation, its importance and its relationship with Bohr's orbital.

(4*3)

7. a) Explain why?
   i. Meta and para-nitrophenols have higher boiling points than the ortho isomer.
   ii. There is a substantial decrease in first ionisation energy observed between Mg and Ca and not between Al and Ga.

   b) List four characteristic properties of a well-behaved wave function.
   c) Write a short note on ionic radii and explain one method of determining ionic radii.

(4*3)

Sl. No. 07) Q.P. : 5602 8/12/17 102

H

Unique Paper Code : 217103
Name of the Paper : CHHT Organic Chemistry-I (Basics of Organic...............)
Name of the Course : B.Sc.(Hons.) CHHT-102
Semester : I
Duration : 3 Hours Maximum Marks : 75



**Instructions for Candidates**

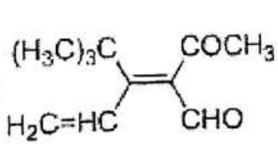
1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Answer five questions in all.**

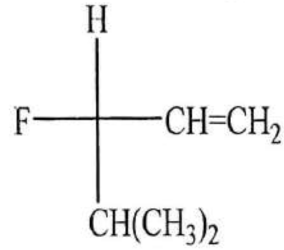
1. Account for the following statements:

(a) Boat conformation of cyclohexane is less stable than the chair conformation.
(b) Both Racemic and Meso compounds are optically inactive.
(c ) Straight Chain isomeric alkanes have higher boiling points than branched chain alkanes.
(d) Methyl group in Toluene is ortho-para directing towards electrophilic aromatic substitution.
(e) Anti Markovnikov addition in alkenes is not observed in case of HI and HCl
(f) Methoxy methyl carbocation is more stable than propyl carbocation even though both are primary carbocations.
(g) Cyclopentadiene is not aromatic unlike cyclopentadienyl anion.
(h) $pK_a$ values for p-Nitrophenol and phenol are 7.14 and 9.95 respectively.
(i) o-Hydroxybenzaldehyde has a lower boiling point as compared to its m and p isomers.
(j) Alkenes are more reactive than alkynes towards electrophilic addition reaction. (1.5 x 10)

2. a) How many optical isomers are possible for 2,3-Dicholoropentane? Draw their fischer projections and give the relationship between them. Also assign absolute configuration (R/S) at each chiral center. ( 9)

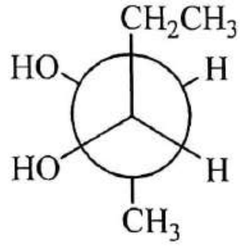
b) Explaining the priority order, assign E/Z or R/S configuration to the following

i) 


(ii) 


(3)

c) Convert the following into Fischer projection and designate as erthyro or threo. (3)



3. a) Calculate the percentage of isomers formed during the monobromination of 2,3-Dimethylbutane. The relative reactivity of primary, secondary and tertiary hydrogen are 1,82,1600 respectively.

b) Identify the major product obtained when 1,3-Butadiene reacts with one mole of $Br_2$ at low temperature and high temperature respectively. Give mechanistic details.

c) Account for the formation of products (with stereochemistry) when cis-But-2-ene is treated with Bromine in $CCl_4$ and alkaline $KMnO_4$. (5x3)

4. a) Explain the mechanism involved in the sulphonation of benzene. Give the characteristic features of the reaction.

b) What happens when 3,3-Dimethylbutene undergoes acid catalysed hydration. Giving mechanism, account for the formation of product(s).

c) What are the limitations of Friedal's Crafts Alkylation? How are they overcome in Friedal's Crafts acylation? (5x3)

5. a) What happens when propene is treated with NBS in presence of $CCl_4$? Account for the formation of products?

b) Why nitration of nitrobenzene is slow as compared to nitration of toluene?

c) What is the difference between inductive and electromeric effect?

d) How will you distinguish pent-1-yne and pent-2-yne chemically? Give the chemical reactions involved?

e) Why dipole moment of $CH_2Cl_2$ is greater than of $CHCl_3$? (3x5)

6 a) Carry out the following conversions:

i) Benzene to p-NitroToluene

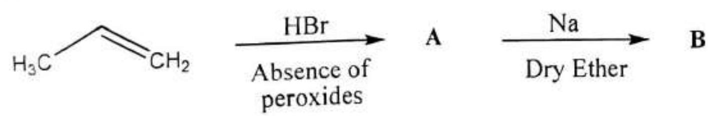
ii) Benzene to benzoic acid

iii) But-2-ene to trans-2-Butene

iv) Propyne to Acetone

b) Predict the products of the following reactions:

(i)

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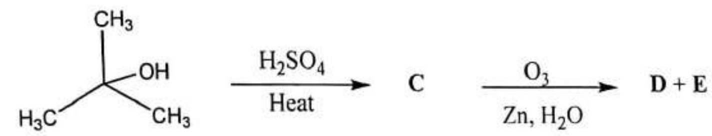
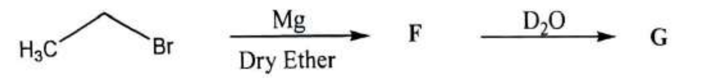



(iii)




(15)

Q.7 Write short notes on any **five** of the following:

a) Baeyer's Strain Theory
b) Acidity of Alkynes
c) Mechanism of Halogenation of Alkanes
d) Absolute and Relative Configuration
e) Diels Alder Reaction
f) Resolution of Racemic Mixture

(5x3)

13/12/17

[This question paper contains 4 printed pages]

**Your Roll No.** : ......................

**Sl. No. of Q. Paper** : **5603** **H**

Unique Paper Code : 235164

Name of the Course : **B.Sc.(Honours) Chemistry**

Name of the Paper : Mathematics I (MACT 101)

Semester : I

***Time : 3 Hours*** ***Maximum Marks : 75***

**Instructions for Candidates :**

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) **All** questions are compulsory .

(c) Attempt any **two** parts from each question.

(d) Marks are indicated against each question.

**1.** (a) (i) An actual volume of 35.00 $cm^3$ is measured as 35.15$cm^3$. Calculate

(1) Absolute uncertainity.

(2) Fractional uncertainity.

(3) Percentage uncertainity. 3

P.T.O.

(ii) Draw the graph of the function $y=2x-x^2$ 4.5

(b) For acetic acid $K_a=1.754\times10^{-5}$ at $25^0C$, find $[H^+]$ if 0.1000 mol of acetic acid is dissolved in enough water to make 1.0001. The stoichiometric concentration is equal to $0.100\text{mol } I^{-1}$. 7.5

(c) Find the Taylor series for log(x) expanding about =1. Space Also find its interval of convergence. 7.5

**2.** (a) Find the root of the equation space $x^3-5x+3=0$, between 0.5 and 0.75 up to 3 decimal places by Newton-Raphson method. 7.5

(b) (i) Find the curvature of the function $y=(4ax)^{1/2}$ at x=0. 4.5

(ii) Two lenghts have been measured as 56.57s ±0.13s and 75.12s ±0.17s. Find the probable value of their sum and its probable error. 3

(c) Find the maximum and minimum value of the function :

$$f(x) = x^4+4x^3-2x^3-12x+7$$ 7.5

**3.** (a) For an ideal gas equation

PV=nRT,

Where P is the pressure, V is the volume, R is an ideal gas constant, n is the number of moles and T is the temperature. Find an





expression for dp and calculate the approximate change in pressure of an ideal gas, if the volume is changed from 20.0001 to 19.8001 the temperature is changed from 298. 15k to 299.00k, and the amount of gas in moles is changed from 1.0000 mol to 1.0015 mol. 7.5

(b) Using the trapezoidal approximation with five panels, calculate the value of the integral $\int_{10}^{20} 2x^2 dx$. 7.5

(c) If all values of x between a and b are equally probable, find the mean value of x, the root mean square value of x and the standard deviation of x. 7.5

**4.** (a) Fit a straight line to the data given below : 7.5

| | | | | | |
|---|---|---|---|---|---|
| x : | 1 | 2 | 3 | 4 | 5 |
| y : | 30 | 34 | 37 | 43 | 45 |

(b) If $u=\sin^{-1}\left(\frac{x^2+y^2}{x+y}\right)$, show that

$$x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\tan u.$$ 7.5

(c) Perform the line integral :

$$\int_C du = \int_C x^2y\,dx + y^2x\,dy$$

where C represents the line segment from (0,0) to (2,2). Also perform the line integral from (0, 0) to (2, 0) and then from (2,0) to (2,2). 7.5

**5.** (a) Evaluate $\int \frac{x^2+1\,dx}{(x+2)^3(x-1)}$. 7.5

(b)(i) If f(x,y)= $ae^{-b(x^2-y^2))}$, then evaluate

$\left(\frac{\partial f}{\partial x}\right)_y$ and $\left(\frac{\partial f}{\partial y}\right)_x$. 2

(ii) If x= sint, y =sing pt, then prove that

$(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + p^2y = 0$. 5.5

(c) Evaluate

(i) $\lim_{x\to 0}\frac{e^x \sin x - x - x^2}{x^2 + x\log(1-x)}$ 4

(ii) $\lim_{x\to 0}\left(\frac{1}{x} - \frac{1}{\sin x}\right)$. 3.5