BITS, PILANI- DUBAI CAMPUS
INTERNATIONAL ACADEMIC CITY, DUBAI
I YEAR SECOND SEMESTER- 2013-2014
Comprehensive Exam (Closed book)

Course Title: General Chemistry | Course No: CHEM F111
Date: 26.05.14 | Total Marks: 80
Time: 3 Hrs | Weightage: 40%

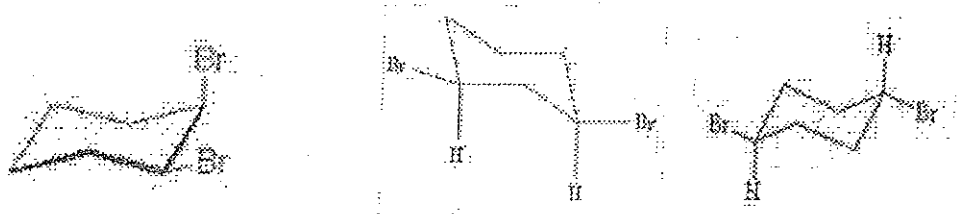
1. Answer all questions-Part-A, B and C should be answered separately
2. Show stepwise calculation indicating the units wherever it is required
3. Useful data: h =6.626 x 10^{-34} J s, c = 3 x 10^{8} m/s, m_e = 9.11 x 10^{-31} Kg, R=8.314 J/K/mol
1 eV = 1.602 x 10^{-19}J, m_p = 1.672 x 10^{-27}Kg , 1 a.m.u = 1.660x 10^{-27}Kg, R_H = 109677 cm^{-1}
Atomic No: H=1, C=6, B=5,Be=4,Al=13, N=7,O=8,Br=35, Co=27, Mn=25, Zn=30 Fe =26 Ni =28
F =9 Cr = 24, Cl = 17, Pt = 78.

PART-A

1) a) Draw a potential energy diagram showing the relative energies of various conformations of cyclo hexane. Account for the stability of chair conformation in comparison to boat conformation.

b) Identify whether the following compounds are cis or trans. Justify your answer.

(i) (ii) (iii)



[6+3M]

2) a) When t-butyl bromide undergoes solvolysis in a mixture of water and methanol, the rate of solvolysis increases when the amount of water in the solvent mixture is increased – Write the mechanism of the reaction and give reason.

b) Find out whether the following compounds are aromatic or anti aromatic applying Huckel's rule
(i) cyclo heptatrienyl anion
(ii) Pyridine [5+4M]

3) a) Write the reaction product of electrophilic addition of HBr to cis – 2- butane with the reaction mechanism.

b) Write the product of elimination reactions of 2-bromo-2-methyl butane with the mechanism [5+4M]

PART – B

1. (i) Discuss the oxidation state, hybridization and magnetic property of the following complexes with the help of VB Theory.
   a. $[Cr(H_2O)_6]^{3+}$ b. $[Zn(NH_3)_4]^{2+}$.

(ii) Draw the CFSE diagram and calculate the CFSE values in terms of Δ_o for d^6 system for both strong and weak field in the case of octahedral geometry. [4+5M]

2. (i) Calculate the Effective atomic number of Fe^{2+} in the complex $[Fe(CN)_6]^{4-}$.

(ii) Based on Werner's coordination theory write the primary and secondary valency of the complex $[Co(NH_3)_6]Cl_3$.

(iii) Write the structure of the following chelating ligands and indicate their donor atoms.
(a) Salicylaldehyde anion. (b) Dimethylglyoxime anion.

(iv) Clearly show the d-orbital splitting (with electronic configuration) of Co^{2+} in tetrahedral and square planar complexes. [2+2+3+3M]

3. (i) Mention any two applications of Tunnelling.

(ii) Draw the cis and trans isomers of the complex $[Pt(NH_3)_2Cl_2]$ and comment on their dipolemoment.

(iii) Estimate the zero point energy (in eV) of a proton confined to a square well of 2 pm length. [2+2+3M]

PART -C

1. Calculate the heat of formation of ethane from carbon (graphite) and gaseous hydrogen from the following data.

$C_2H_{6(g)} + 7/2O_{2(g)}\ 2CO_{2(g)} + 3H_2O_{(l)}$ $\Delta H = -1560\ kJmol^{-1}$

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta H = -285.84\ kJmol^{-1}$

$C_{(graphite)} + O_{2\,(g)}\ CO_{2(g)}$ $\Delta H = -393.51\ kJmol^{-1}$ [4M]

2. Write a note on the spectral transitions and selection rules for the electron in a hydrogenic atom [4M]

3. In an aldehyde the force constant of C=O bond is 1199 Nm^{-1}. Treating the group as $C^{12}O^{16}$, calculate the approximate frequency of absorption. [4 M]

4. Explain the formation of Carbon monoxide molecule on the basis of Molecular Orbital theory. [5M]

5. With the help of Arrhenius equation discuss the temperature dependence of reaction rates. [5M]

6. Apply the steady state principle to determine the rate of formation of NO_2 from NO and O_2. [5M]

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BITS PILANI, DUBAI CAMPUS
I YEAR SECOND SEMESTER, 2013-2014
TEST-II- OPEN BOOK

Course Title: General Chemistry **Course No: CHEM F111**
Date: 08.04.2014 **Total Marks: 40**
Time: 50 Min **Weightage: 20%**

1. Answer all questions sequentially. 2. Show stepwise calculation indicating the units wherever it is required.

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1. (i) Calculate the heat of hydrogenation of [22]Annulene on the basis of expected heat of hydrogenation of benzene.

(ii) Give the balanced equation for the ionization, if the complex potassium ferricyanide would have behaved as a double salt.

(iii) How many particles and charges will be there for cryoscopic and molar conductivity measurements respectively, for the following complexes?

a. $K_2[Cr(CN)_2O_2(O_2)NH_3]$
b. $[CuCl_2(CH_3NH_2)_2]$ **[4 +3 +4 M]**

2. (i) Write the state of hybridization, geometry, magnetic behavior of $[Cu(CN)_4]^{3-}$

(ii) What would you expect the crystal field stabilization energy to be, and what value of magnetic moment would you expect for the following complexes

a. $[CoF_6]^{3-}$ b. $[Fe(CN)_6]^{4-}$

(iii) Describe and explain the Jahn teller distortion effect in octahedral complex of Cu^{2+}

[4 +6 +4 M]

3. (i) Draw the crystal field splitting diagram and calculate the CFSE in terms of Δ_t for the complex $[NiCl_4]^{2-}$.

(ii) Explain the hybridization for the formation of a square planar complex of Rh^{+1} using valence bond theory. Also predict its magnetic behavior.

(iii) Comment on the optical activity of the geometrical isomers of diiodobis(oxalato)-cobaltate(III). Justify your answer. **[6 + 5 + 4 M]**

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BITS PILANI, DUBAI CAMPUS
I YEAR SECOND SEMESTER, 2013-2014
TEST-I-CLOSED BOOK

Course Title: General Chemistry **Course No: CHEM F111**
Date: 04.03.2014 **Total Marks: 50**
Time: 50 Min **Weightage: 25%**

Answer all questions sequentially. Atomic number: H = 1, C = 6, N = 7, O = 8, I = 53, Br = 35.

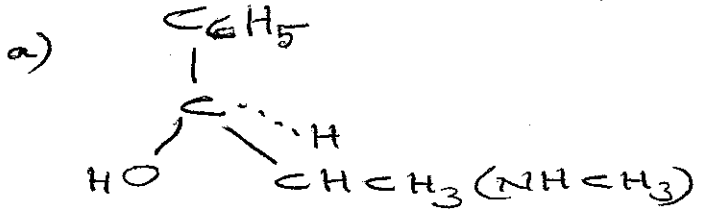
1. (i) Draw the potential energy diagram for the 6 extreme stable conformers of 1,3-difluoroethane with their structures. Write the order of their energy.

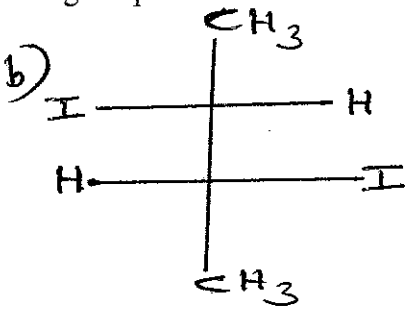
   (ii) Arrange the following compounds in the order their increasing angle strain. Give reason for your answer.

   a) cyclopentane b) cyclopropane c) cyclohexane d)cycloheptane e) cyclobutane.

   (iii) Draw the structure of two different conformers of cis1,3-dimethyl cyclohexane. With suitable justification indicate the most stable conformer. **[8+4+4M]**

2. (i) Assign R/S designation for the following compounds clearly indicating the priorities of groups.



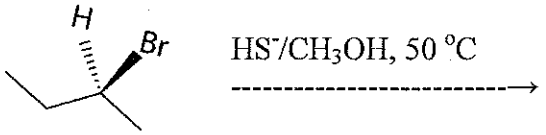


   (ii) Explain the differences between constitutional isomers and stereoisomers with suitable examples.

   (iii) Draw all the possible stereoisomers of 2,3–dibromobutane, indicating the chiral centers. **[6+4+6M]**

3. (i) If 3-iodo-3-methylhexane undergoes S_N1 reaction to yield a recemic mixture of 3-hydroxy-3-methylhexane discuss the mechanism with suitable conditions and necessary equations.

   (ii)Write the absolute configuration of the reactant and the product and the mechanism in the following reaction.



   (iii) State Zaitsav's rule. Apply it to the dehydrohalogenation of 2-Iodopentane with suitable equations. **[6+4+8M]**

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A

BITS PILANI, DUBAI CAMPUS

I YEAR SECOND SEMESTER, 2013-2014

QUIZ-I-CLOSED BOOK

Course Title: General Chemistry Course No: CHEM F111 Date: 25.03.2014

Total Marks: 16 Weightage: 8% Time: 20 Min

(At.no : H =1,C = 6, B =5, Na = 11, Ne = 10, Cl = 17,Br =35,F =9)

Name : ID No : Sec:

Answer all questions

1. Write the structure of (*Z*)-1-Bromo-2-chloro-1-fluoroethene. **(2M)**

2. Write the major and minor products of the reaction between 2-methylpropene with HBr. **(3M)**

3. Complete the following reactions **(2M)**

$CH3CH{=}CH_2 + HBr \xrightarrow{ROOR} ?$

$CH3CH{=}CH_2 + HI \xrightarrow{ROOR} ?$

4. Write the structure of protonated halohydrin. **(3M)**

5. How 2-butanol is synthesized in the laboratory by Oxymercuration-Demercuration addition reactions? Write down the chemical reactions. (3M)

6. Name the reagents used in the hydroboration of an alkene. (1M)

7. How will you convert 2-ethylpropene to 2-ethyl-2-propanol? (2M)

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