

BITS PILANI-DUBAI CAMPUS, DUBAI
I YEAR FIRST SEMESTER, 2011-2012
COMPREHENSIVE EXAMINATION

Course Title : General Chemistry

Course No: CHEM F111

Date: 9.1.2012

Total Marks: 120

Time: 3 hours

Weightage: 40%

1. Answer all questions sequentially.
2. Answer PART A, B and C in separate answer sheets.
3. Show stepwise calculation indicating the units wherever it is required
4. Useful data : $h = 6.626 \times 10^{-34}$ J.sec , $c = 3 \times 10^{10}$ cm/s, $H = 1.008$ amu , $F = 18.99$ amu
 $R_H = 109677$ cm⁻¹, $R = 8.314$ J/K/mol, $1 \text{ a.m.u} = 1.660 \times 10^{-27}$ kg.
Atomic Numbers of H=1, C=6 N=7, O=8, F=9, Cr=24, Fe=26.
5. Question paper contains 3 pages.

PART – A

1. (i) The force constant of HF molecule is 970 Nm^{-1} . Calculate the fundamental vibrational frequency and zero point energy.
(ii) Calculate the wavelength of radiation emitted producing a line in Lyman series when an electron falls from fourth stationary state in H atom.
(iii) Draw the MO diagram of O₂ molecule. Write the MO configuration, calculate the bond order and find out its magnetic behaviour.
(iv) Write the principle involved in the flow method used for studying the kinetics of reactions.

[5+5+8+2M]
2. (i) Write the gross selection rule and specific selection rule of vibrational Raman spectra.
(ii) Predict the possible electronic transitions in Cl₂ and CH₃CHO molecule.
(iii) What is meant by chemical shift in NMR spectra? Write the internal reference used in NMR spectroscopy.
(iv) Write the Arrhenius equation with the terms involved in it.

[2+4+3+2M]
3. (i) Write the equation for the variation of molar Gibbs energy with pressure for a perfect gas.
(ii) It was found that 1.36 g of boiling benzene is vapourized when a current of 0.835 A from a 12.0 V source is passed for 53.5s. Calculate the enthalpy of vapourization of benzene at its boiling point.
(iii) State the Third law of thermodynamics.

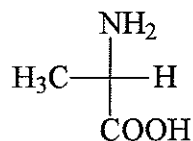
[2+5+2M]

PART-B

1. (i) Write the structure of isomers of $[\text{Pd}(\text{NH}_3)_2\text{Cl}_2]$ and indicate which will show dipole moment.
 - (ii) Write the structure of cis and trans isomers of $\text{Co}(\text{NH}_3)_4\text{Cl}_2$.
 - (iii) Give the names of any two coordination complexes that play an important role in living systems indicating the central metal and ligands in them.
 - (iv) Draw the structure of any two polydentate ligands showing the bonding sites
[4+4+4+6M]
2. (i) Based on VBT, find out the state of hybridization of the central metal showing the electronic configuration, geometry, spin and magnetic properties of Hexammine Chromium(III) ion.
 - (ii) For Hexacyano Iron(III) complex, the pairing energy is 17600cm^{-1} and Δ_o is $32,850\text{cm}^{-1}$. Predict whether this complex is high spin or low spin based on CFSE calculations.
 - (iii) Write the three factors that affect the magnitude of Δ_o .
 - (iv) Write the two reasons for the fact that Δ_t in tetrahedral complexes is considerably less than that in octahedral complexes
[7+8+3+4M]

PART-C

1. (i) Draw the P.E. diagram of ethane and depict its conformations in Newman Projection formula.
- (ii) State two strains in the boat conformation of cyclohexane.
- (iii) Draw both the chair conformations of methyl-cyclohexane and indicate the most stable one.
- (iv) A common amino acid, alanine is shown below:



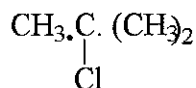
- (a) Is it *R* or *S* compound?
- (b) Draw its enantiomer and its diastereoisomer.
- (c) When a neat, liquid chiral compound at a concentration of 1.5g/ml was analyzed in a 2dm cell in a polarimeter, it gave an optical rotation of 45.6° . Find out its specific rotation $[\alpha]$.

[4+2+4+7M]

- 2.(i) State the Rule which explains the addition reaction below and give the mechanism for the formation of the major product.



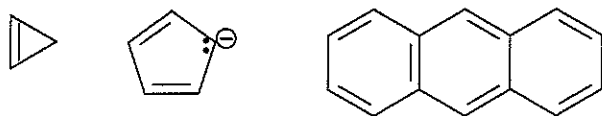
- (ii) Give an example of polar aprotic solvent. They are excellent solvents for which type of substitution reaction?
- (iii) t-Butyl chloride shown below, undergoes both $\text{S}_{\text{N}}1$ or $\text{E}1$ reaction depending on the reaction condition.



- (a) Give the common intermediate it will form in either of the two reactions.
- (b) Which major product would form when the above halide is treated with sodium ethoxide at high temperature?

[6+2+6M]

- 3.(i) Give any one experimental evidence to show that benzene is more stable than cyclohexa triene.
- (ii)Applying Huckel's Rule, show which of the following is aromatic or non-aromatic.



[3+6M]

BITS PILANI, DUBAI CAMPUS
I YEAR FIRST SEMESTER, 2011-2012
TEST- 2 (Open book)

Course Title : General Chemistry

Date: 11.12.2011

Time: 50 min

Course No: CHEM F111

Total Marks: 60

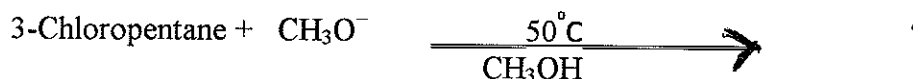
Weightage: 20%

1. Answer all questions sequentially
2. Useful atomic numbers: C=6, N=7, O=8, F=9, Br=35

1. (i) Draw a Newmann projection of ethane with a dihedral angle of 30° .
(ii) Draw the most stable and least stable conformation of 2-bromo-3-chloro-butane using Sawhorse formula.
(iii) Write the types of strain present if any, in chair and boat conformations of cyclohexane.
(iv) Draw the two possible chair conformations of isopropyl substituted cyclohexane using Newmann projection and show the possible interactions. Indicate which is more stable?

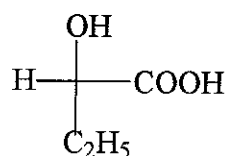
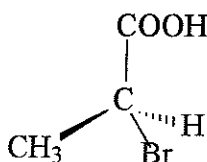
[4+4+4+8M]

2. (i) Outline the synthesis of $\text{CH}_3\text{CH}_2\text{-I}$ from ethyl chloride. Show the mechanism of the reaction involved in detail.
(ii) Heating of (S)-3-Bromo-3-methylheptane with aqueous acetone leads to formation of a racemic mixture of alcohol- write the mechanism with names of products formed.
(iii) Which product (products) would you expect to obtain from the following reaction? Predict the mechanism by which each product is formed and predict the relative amount of each product (major/minor)

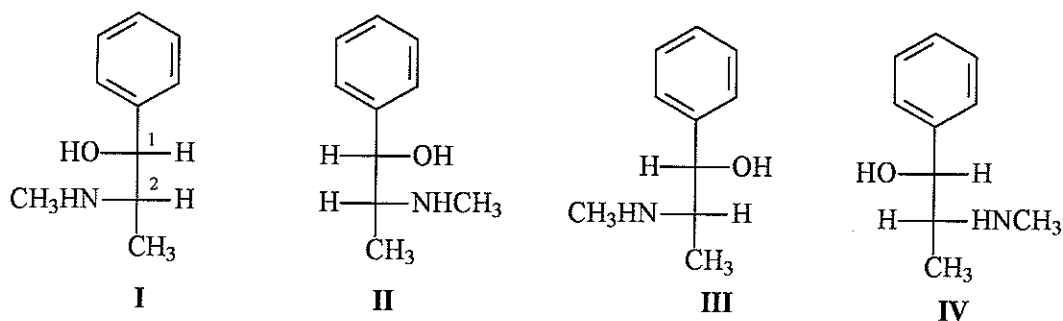


[6+7+7M]

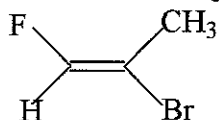
3. (i) Set priority to the groups around the chiral carbon and assign R & S configuration.



- (ii) Assign R and S configuration to carbon 1 and 2 in isomer I.
 (iii) Among the stereo isomers depicted below, state the relationship between:
 (a) **I** and **IV** (b) **I** and **II** (c) **II** and **III** (d) **III** and **IV**.



- (iv) Draw all the possible stereoisomers of 2,3-Dihydroxy butane and indicate which are optically active.
 (v) Draw the structure of: (*Z*)-1,2-Difluoroethene
 (vi) Name the following compound.



[4+6+6+4M]

BITS PILANI, DUBAI CAMPUS
I YEAR FIRST SEMESTER, 2011-2012
TEST- 1 (Closed book)

Course Title : General Chemistry

Course No: CHEM F111

Date: 16.10.2011

Total Marks: 75

Time: 50 min

Weightage: 25%

1. Answer all questions

2. Show stepwise calculation indicating the units wherever it is required

3. Useful data : $h = 6.626 \times 10^{-34} \text{ J sec}$, $c = 3 \times 10^8 \text{ m/sec}$, $m_e = 9.11 \times 10^{-31} \text{ Kg}$.

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}, R_H = 109677 \text{ cm}^{-1}$$

4. Atomic numbers: He=2, Be=4, C=6, O=8, S=16, I=53

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1. (i) Mention any three crucial experiments from which quantum theory emerged.
(ii) Write any three boundary conditions for a molecule subjected to vibration.
(iii) An electron is confined to a molecule of length 1 \AA . Calculate its minimum energy.
(iv) Calculate the wavelength of electrons that have been accelerated from rest through a potential difference of 2.00 GeV .

[3+6+8+8M]

2. (i) Write the unnormalized expression for VB wave function for Hydrogen Molecule.
(ii) Find the state of hybridization of central atom of the given molecule based on VBT.
(a) SO_4^{2-} (b) IO_3^-
(iii) Show the variation of energy of the molecule with bond length with the help of a molecular potential energy curve.
(iv) Draw the molecular orbital diagram of CO indicating the salient points and find the bond order.

[4+8+5+8M]

- 3 (i) Calculate the wavelength of the line with $n=5$ in the Balmer series of the spectrum of atomic hydrogen.
(ii) Give the equation to calculate the permitted energies (E_n), of hydrogenic atom. Mention the two ways atomic number Z , impacts the overall energy of an electron.
(iii) Predict the ionization energy (I.E.) of Be^{2+} given that the I.E. of He^+ is 54.36 eV .
(iv) How many orbitals are present in the 4^{th} shell of an atom? List them.

[8+7+6+4M]

**BITS, PILANI – DUBAI CAMPUS****FIRST SEMESTER 2011 – 2012**

Course Code: CHEM F111

FIRST YEAR Quiz-2

Date: 28.11.2011

Course Title: General Chemistry

Max Marks: 21

Duration : 20 minutes

Weightage: 7 %

Name: **ID No:** **Sec / Prog:****Instructions:** (if any) Over writing will be taken as wrong answer

1. Suppose that during a chemical reaction, a system loses 1100 J of heat to the surroundings, and the system does 500 J of work on the surroundings. What is the change in internal energy of the system? (3M)

2. Write the expression for the reversible isothermal expansion of a perfect gas. (2M)

3. Define heat capacity of a substance. (2M)

4. Calculate the standard enthalpy of sublimation of naphthalene at room temperature (R.T) from its standard enthalpy of fusion at R.T(29.4 kJ/mol) and standard enthalpy of vapourization at R.T.(43.2 kJ/mol). (3M)

5. For magnesium, the ionization enthalpies are given below
$$\text{Mg(g)} \rightarrow \text{Mg}^+(\text{g}) + \text{e}^-(\text{g}) \quad \Delta H^\circ = +738 \text{ kJ}$$
$$\text{Mg(g)} \rightarrow \text{Mg}^{2+}(\text{g}) + \text{e}^-(\text{g}) \quad \Delta H^\circ = +1451 \text{ kJ}$$
The second ionization enthalpy is larger than the first. Justify. (2M)

6. What is the driving force for a spontaneous reaction? (2M)
7. Calculate the change in entropy when 25 kJ of energy is transferred reversibly and isothermally as heat to a block of metal at 10°C. (2M)
8. Entropies of vaporization of bromine and CCl_4 are the same at their respective boiling points (approx. $85 \text{ JK}^{-1}\text{mol}^{-1}$). Name the rule which explains this. Which type of compounds are exceptions to this? (3M)
9. State Hess's law. (2M)

BITS, PILANI – DUBAI
FIRST SEMESTER 2010 – 2011
FIRST YEAR (Repeaters) Quiz-1

Course Code: CHEM C142
Course Title: Chemistry II
Duration : 20 minutes

Date: 31.10.2011
Max Marks: 8
Weightage: 8 %

Name: ID No: Sec / Prog:

Instructions: (if any) Over writing will be taken as wrong answer.

Question paper has 2 pages.

At. No: Zn: 30

1. Calculate the CFSE for a high-spin octahedral complex of a d^7 ion. (1M)
2. Calculate the tetrahedral CFSE of $[\text{ZnCl}_4]^{2-}$ by showing the arrangement of electrons in its e_g and t_{2g} orbitals. (1M)
3. Explain Jahn – Teller Distortion. (2M)
4. What is dehydrohalogenation? Give one example. (1M)

5. How t-butylbromide is converted into 2-methylpropene? (1M)
6. Write the observed product in the addition of HBr to 2-methyl-2-butene. (1M)
7. Which can act as a strong nucleophile: Methoxide ion or acetate ion? (1M)



BITS, PILANI – DUBAI CAMPUS
FIRST SEMESTER 2011 – 2012
FIRST YEAR Quiz-1

Course Code: CHEM F111
Course Title: General Chemistry
Duration : 20 minutes

Date: 31.10.2011
Max Marks: 24
Weightage: 8 %

Name: ID No: Sec / Prog:

Instructions: Over writing will be taken as wrong answer
Question paper has 2 pages.

1. Calculate the normal modes of vibration for aniline $C_6H_5NH_2$ and Carbondioxide CO_2 molecule. (4M)
2. What are Overtone bands? Give the application of Overtone in IR Spectroscopy. (4M)
3. Give the gross selection rule and specific selection rule for Vibrational Raman spectra of diatomic molecules. (2M)
4. Write the exclusion rule for the Vibrational Raman spectra of polyatomic molecules. (2M)

5. Write the sources of UV-Visible light used in a UV-Vis spectrophotometer. (4M)

6. Write Franck-Condon Principle (2M)

7. Give any two examples each for Charge transfer donor and acceptor . (4M)

8. List different types of electronic transitions (taking place in molecules)
In the order of their increasing energy . (2M)
