

BITS PILANI-DUBAI CAMPUS, DUBAI
I YEAR SECOND SEMESTER, 2011-2012
COMPREHENSIVE EXAM-CLOSED BOOK

Course Title : General Chemistry

Course No: CHEM F111

Date: 10.06.2012

Total Marks: 80

Time: 3 Hrs

Question paper contains 2 pages

Weightage: 40%

1. Answer all questions sequentially. (PART-A and PART-B separately)

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

3. Useful data: $h = 6.626 \times 10^{-34}$ J. sec, $c = 3 \times 10^{10}$ cm/s, $R_H = 109677$ cm⁻¹, $R = 8.314$ J/K/mol,

1 eV = 1.602×10^{-19} J, Atomic Numbers of H=1, B=5, C=6, F=9, O= 8, Ne=10, Mn=25, Fe=26, Co=27

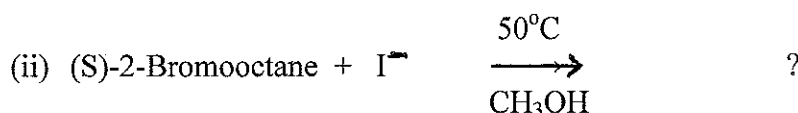
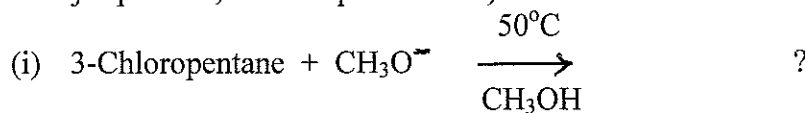
PART-A

1. (a) Give the Born interpretation of ψ and ψ^2 graphically. (2M)
- (b) The work function of a particular metal is 3.2×10^{-19} J. Calculate the kinetic energy and predict the possibility of ejection of electron if an electromagnetic radiation of wavelength 450 nm falls on it. (3M)
- (c) Deduce the electronic structure of F₂ molecule using MO diagram. Also predict the Bond order. (5M)
2. (a) If the uncertainty in the velocity of an electron in a hydrogen atom is 5.8×10^5 ms⁻¹, calculate the uncertainty in the position. (2M)
- (b) Given that the ionization energy of He⁺ is 54.36 eV. Predict the ionization energy in Be to Be⁺. (3M)
- (c) What is steady state approximation? Apply the principle to determine the rate of formation of NO₂ molecule. (5M)
3. (a) State how the number of modes of vibrations of a molecule varies with the types. Predict the number of normal modes of vibrations of cyclohexene molecule. (2M)
- (b) In an electronic transition what is the implication of a selection rule? Give the selection rule for the spectral transition in a hydrogenic atom. (3M)
- (c) Discuss the formation of BF₃ with the help of VB theory. (5M)
4. (a) State Frank-Condon principle. (2M)
- (b) A cooling system emits heat at a rate of 100 kW to the surrounding at temperature of 45 °C. How much entropy is generated in the surrounding? (3M)
- (c) Discuss the trend of electron affinity in the elements oxygen, fluorine and neon. (5M)

PART-B

1. (a) Write the chair conformation of 1-methyl, 3-butylcyclohexane. Show that which conformational isomer is more stable. Give reason for your answer. (4M)
- (b) Write three dimensional formulae for all of the stereo isomers of each of the following compounds. Label pairs of enantiomers and meso compounds.
(i) CH₃CHOHCH₂CHOHCH₃ (ii) CH₂ClCHFCHFCH₂Cl (4M)

2. (a) Which product (products) would you expect to obtain from the following reactions? Give the mechanism (SN^1 , SN^2 , E^1 or E^2) by which each product is formed and predict the relative amount of each product (i.e. only product, major product, a minor product etc.) (4M)



- (b) Starting from (S)-2-bromobutane, outline the synthesis of
 (R)- $CH_3 \underset{\substack{| \\ SCH_3}}{CH} CH_2 CH_3$ (4M)

3. (a) Write the product obtained during acid catalyzed hydration of 2-methyl propene along with mechanism of the reaction (4M)

- (b) Label the following compounds as Aromatic / anti aromatic / non aromatic / homo aromatic based on Huckel's rule of aromaticity.

- (i) 10 annulene (ii) Thiophene (4M)

4. (a) Using CFT, find the geometry of $[CoF_6]^{3-}$ complex ion showing the distribution of 'd' electrons of the central metal atom in the splitted 'd' orbitals (4M)

- (b) Find the oxidation state, type of hybridization, geometry and magnetic behavior of the complex $[Mn(CN)_6]^{4-}$ (4M)

5. (a) Justify the fact that the crystal structure of CrF_2 contains Cr^{2+} octahedrally surrounded by six F^- ions and there are four Cr-F bonds of length 1.98 \AA and two longer bonds of length 2.43 \AA . (4M)

- (b) Write the structure of the following ligands and indicate the coordination sites
 (i) Oxalate ion (ii) 2,2'-Dipyridyl ion (2M)

- (c) Give any two examples of chelates that find application in biological systems indicating the central metal ion present in it. (2M)

BITS PILANI-DUBAI CAMPUS, DUBAI
I YEAR SECOND SEMESTER, 2011-2012
TEST-II-OPEN BOOK

Course Title : General Chemistry
Date: 06.05.2012
Time: 50 Mins

Course No: CHEM F111
Total Marks: 40
Weightage: 20%

1. Answer all questions sequentially
2. Show stepwise calculation indicating the units wherever it is required
3. The question paper contains 2 pages

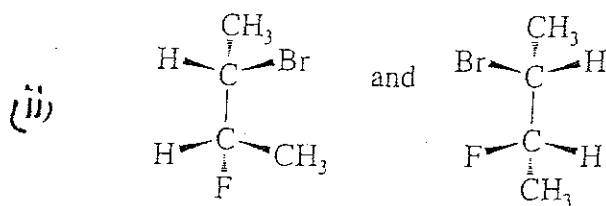
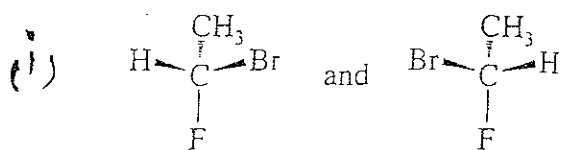
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- 1.(a) In a typical reaction, $3A + B + 2C \longrightarrow 5D + 7E$
5.1 moles of 'A' is consumed. In this reaction what will be the amount of 'E' produced? Also calculate the amount of 'B' consumed to produce 1 mole of 'D'. (3+2 M)
- (b) The rate of a particular reaction is $3.95 \times 10^6 \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$ at 300 K. Calculate the energy of activation, if the pre exponential factor is $4.05 \times 10^{10} \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$. For the same reaction calculate the rate at 350 K. (3+3 M)
2. (a) Calculate the heat energy to be supplied to ionize 5 g of solid Aluminium in to a metal gas of Al^{2+} and Al^- ions. Assume the enthalpy of sublimation of Aluminium is 326 kJ. (Use the Tables 3.2 and 3.3 from the Text Book 1.) (5 M)
- (b) 6 moles of an ideal gas is expanded reversibly and isothermally from an initial volume of 5 litres to 10 litres. What is the entropy change in the process? If the ratio of the work done by the gas to entropy change is 300, determine the temperature at which the process is carried out. (5 M)
3. (a) Sketch the potential energy curves showing energy changes that arise from rotation about $\text{C}_2 - \text{C}_3$ bond of the compounds given below (actual numerical values of energy changes are not required) Label all maxima and minima with appropriate conformations.
(i) 2,3 - dimethyl butane (ii) 2,2,3,3-tetramethyl butane (5 M)
- (b) Which member of each of the following pairs would you expect to have larger heat of combustion? Justify your answer with proper reasoning.
(i) Cis or trans -1,3-dichlorocyclohexane (ii) Cis or trans-1,4-dimethyl cyclohexane (5 M)

(PTO)

4. (a) Which of the following are chiral and hence capable of existing as enantiomers?
(i) 1,2-Dichloro propane (ii) 3-ethylpentane

(4 M)

- (b) Consider the following pairs of structures. Identify the relationship between them by describing them as representing enantiomers, diastereomers, constitutional isomers or two molecules of the same compound. (6 M)



BITS PILANI-DUBAI CAMPUS, DUBAI

I YEAR SECOND SEMESTER, 2011-2012

TEST-I-CLOSED BOOK

Course Title : General Chemistry

Course No:CHEM F111

Date: 18.03.2012

Total Marks: 50

Time: 50 Mins

Weightage: 25%

1. Answer all questions sequentially.
2. Show stepwise calculation indicating the units wherever it is required
3. Useful data: $h = 6.626 \times 10^{-34}$ J.sec , $c = 3 \times 10^{10}$ cm/s, $R_H = 109677$ cm⁻¹, $R = 8.314$ J/K/mol, $1 \text{ eV} = 1.602 \times 10^{-19}$ J, Atomic Number of H=1, C= 6, Mn=25

1. (i) The work function for a given metal is 1.90eV. Find whether light of wavelength 450nm can cause ejection of electron.(Show calculations)
(ii) Calculate the de Broglie wavelength of an electron that has been accelerated by a potential difference of 500V.
(iii) Write time dependant Schrodinger equation for a single particle of mass **m** moving with energy **E** in one dimension and define the terms in the equation. [4+6+3M]
2. (i) What are the boundary conditions that a wave function must satisfy for it to be acceptable?
(ii) The speed of certain projectile of mass 2 g is known to be within 1×10^{-5} m/s. What is the minimum uncertainty in its position along its line of movement ?
(iii) Write any three important applications of Tunnelling. [4+5+3M]
3. (i) Write any four allowed transitions of a 3p electron based on the selection rule.
(ii) Write a note on penetration and shielding.
(iii) Write the ground state electronic configuration of Mn. Show the distribution of electrons in the 3d orbital. [2+4+4M]
4. (i) Explain the concept of hybridization in the formation of a methane molecule with a neat sketch.
(ii) Calculate the energy associated with Balmer series, when coupled with Bohr's frequency condition.
(iii) The wave function of an electron in a hydrogen atom is $1/(\pi a_0^3)^{1/2}$. Calculate the probability of finding the electron in a volume of 1.5 pm^3 centered on the nucleus. [5+5+5M]

BITS, PILANI-DUBAI CAMPUS
I Year B.E. (Hons) Second Semester-2011-2012
QUIZ-2

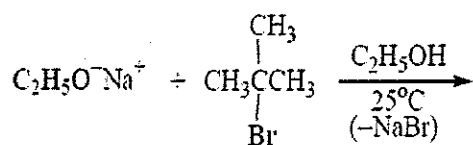
SET-A

Course Code: CHEM F 111
Course Title: General Chemistry
Duration: 20 minutes

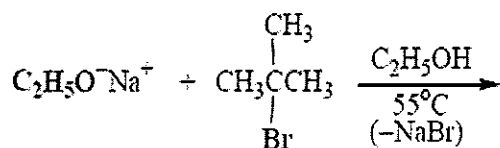
Date: 27.05.2012
Max Marks: 14
Weightage: 7%

Name :	I.D.No:	Sec:
Instructions: Over writing will be taken as wrong answer		

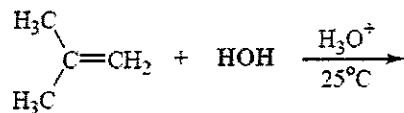
1. Predict the products in the following reaction (2 M)



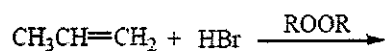
2. Write the possible products the following reaction (2M)



3. Write the possible products and label the dominant, Justify your answer (2M)



4. Complete the reaction (1M)



5. Which alkyl halide would you expect to react more rapidly by S_N2 mechanism? Give reason.
1-Bromo propane or 2 – Bromo propane (2M)
6. Give the experimental condition for the conversion of tertiary butyl chloride to tertiary-butyl ethyl ether that would ensure highest possible yield of ether (2M)
7. Draw the 3D structure of cis and trans isomers of 1,2-dichloro cyclopentane (1M)
8. Write the expression for the specific rotation of an optically active substance (1M)
9. Write the appropriate structural formula for the constitutional isomer of cyclohexane (1M)
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BITS,PILANI-DUBAI CAMPUS
I Year B.E. (Hons) Second Semester-2011-2012
QUIZ-2

SET-B

Course Code: CHEM F 111
Course Title: General Chemistry
Duration: 20 minutes

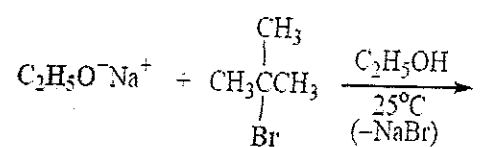
Date: 27.05.2012
Max Marks: 14
Weightage: 7%

Name :	I.D.No:	Sec:
Instructions: Over writing will be taken as wrong answer		

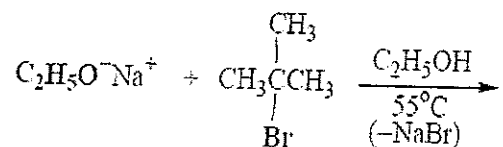
1. Which alkyl halide would you expect to react more rapidly by S_N2 mechanism? Give reason.
1-Bromo propane or 2 - Bromo propane (2M)
2. Give the experimental condition for the conversion of tertiary butyl chloride to tertiary-butyl ethyl ether that would ensure highest possible yield of ether (2M)
3. Draw the 3D structure of cis and trans isomers of 1,2-dichloro cyclopentane (1M)
4. Write the expression for the specific rotation of an optically active substance (1M)

5. Write the appropriate structural formula for the constitutional isomer of cyclohexane (1M)

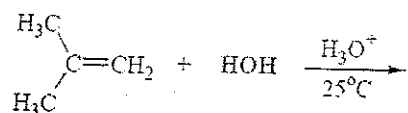
6. Predict the products in the following reaction (2M)



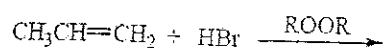
7. Write the possible products the following reaction (2M)



8. Write the possible products and label the dominant, Justify your answer (2M)



9. Complete the reaction (1M)



Course Code: CHEM F 111
Course Title: General Chemistry
Duration: 20 minutes

Date: 11.04.2012
Max Marks: 16
Weightage: 8%

Name :	I.D.No:	Sec:
Instructions: Over writing will be taken as wrong answer Useful data : (At No: N=7, O=8, P=15, Cl=17 ; $\epsilon_0 = 8.854 \times 10^{-12} \text{ J}^{-1} \text{ C}^2 \text{ m}^{-1}$; electronic charge = 1.602×10^{-19} Coulomb)		

1. Calculate the Coulombic repulsion in a chlorine molecule, if the atoms stay apart at 1.75 \AA .
(2M)
2. Draw the Molecular Orbital diagram in the formation of NO molecule
(2M)
3. For the above molecule write the electronic configuration and comment on the Bond Order
(2M)

4. Predict the hybridization and shape of PCl_5 molecule

(2M)

5. For two atoms of masses m_A and m_B attached by a bond of force constant K , Write the expression for vibrational energy E_V and frequency of it's vibration(ν). (2M)

6. Number of possible vibrational modes for non linear molecule is equal to _____ and for linear molecules is equal to _____ (2M)

7. Write one example each for a charge transfer donor and a charge transfer acceptor. (2M)

8. Arrange different types of electronic transitions in increasing order of energy (2M)
