BITS PILANI,INTERNATIONAL ACADEMIC CITY ,DUBAI
I YEAR FIRST SEMESTER,2009-2010
COMPREHENSIVE EXAMINATION

Course Title :Chemistry- I **Course No:CHEM C141**
Date: 24.12.2009 **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 its required
4. Useful data : h = 6.626 x 10^{-34} J.sec , c = 3 x 10^{10} cm/s, m_e = 9.110 x 10^{-31} Kg,
R_H = 109677 cm^{-1} ,R = 8.314 J/K/mol, R = 0.0821 litre atmK^{-1} mol^{-1},
Atomic numbers : H =1 B=5 ,C= 6, N=7, F = 9
5. Question paper contains 2 pages .

PART – A

1. (i) Draw the MO diagram of N_2 molecule .Write the MO configuration ,calculate the bond order and find out its magnetic behaviour .
(ii) Explain the hybridization involved in BF_3 molecule.
(iii) Write the expression for the pressure dependence of the chemical potential of a perfect gas. **[7+3+1M]**

2. (i) Give the practical significance of depression of freezing point.
(ii) Calculate the mass of methanol which when dissolved in 100g of water just prevents the formation of ice at -10°C (K_f of water is 1.86 K kg mol^{-1})
(iii) Sketch the pH curve for the titration of HCl versus NaOH and clearly indicate the stoichiometric point.
(iv) The molar concentration of OH^- ions in a certain solution is 0.10mol dm^{-3} . Calculate the pH of the solution. **[2+4+4+3M]**

PART-B

1.(i) Draw a neat sketch of a glass electrode and give an account of measurement of pH using a glass electrode.
(ii) Write the Nernst equation and define the terms involved in it.
(iii) Write Arrhenius equation that shows the relationship between rate constant and temperature and define the terms involved in it. Show the general form of Arrhenius plot. **[4+2+6M]**

2.(i) Suggest a mechanism for the gas phase oxidation of nitric oxide.
(ii) Draw a typical phase diagram, showing the regions of pressure and temperature at which each phase is the most stable.
(iii) Write Clapeyron equation and define the terms in it. **[6+3+3M]**

PART -C

1. (i) Discuss in detail any two applications of circular dichroism
(ii) Explain the broadening processes which influence the spectral width.
(iii) What are the thermodynamic criteria for a feasible chemical reaction **[4+4+4M]**

2. (i) Write a note on mutual exclusion rule with suitable example.
(ii) The wave number of the rotational transition from J=0 to J=1 of HBr is 16.93 cm^{-1}.If HBr is considered to be a rigid rotator, calculate (a) the moment of inertia (b) the bond length. Atomic masses of hydrogen and bromine are $1.673x10^{-27}$ kg and $1.3448x10^{-25}$ kg respectively. **[4+8M]**

3. (i) What is zero point energy?
(ii) A certain lamp emits blue light of wavelength 360 nm. How many photons does it emit each second if its power is 100 W?
(iii) If the uncertainty in the velocity of a certain proton is 1.244×10^{-6} ms^{-1}, what would be the minimum uncertainty in its location? **[2+5+5M]**

4. (i) Give the selection rule for the hydrogenic atoms .
(ii) Calculate the probability that the electron will be found between a shell of radius a_0 and a shell of radius 2.0 pm greater, where a_0 = Bohr's radius.
(iii) The frequency of one of the lines in the Paschen series of the spectrum of atomic hydrogen is 3.4242×10^{14} Hz. Identify the principal quantum number of the upper state in the transition . **[2+5+5M]**

5. (i) The enthalpy of sublimation of calcium at 25°C is 178.2$kJmol^{-1}$.How much energy (at constant temperature and pressure)must be supplied as heat to 10.0g. of solid calcium to produce a plasma(an ionic gas)composed of Ca^{2+} ions and electrons? First and second standard enthalpies of ionization of calcium are 590 and 1150$kJmol^{-1}$ respectively. Atomic mass of calcium = 40
(ii) Water exists as a liquid but H_2S exists as a gas. Justify your answer
(iii) Why sodium chloride is ionic but aluminium iodide is covalent? **[7+2+2M]**

6. (i) The enthalpy of combustion of glucose,$C_6H_{12}O_6(s)$ is −2816$kJmol^{-1}$ at 25°C. Write down the combustion reaction of glucose and calculate $\Delta H_f°(C_6H_{12}O_6)$. The $\Delta H_f°$ values for $CO_2(g)$ and $H_2O(l)$ are −393.5 and −285.9 $kJmol^{-1}$, respectively.
(ii) What is meant by standard enthalpy of formation and ionization enthalpies. Give example.
(iii) State and explain Hess's law with a suitable example. **[[6+4+3M]**

****

BITS PILANI,INTERNATIONAL ACADEMIC CITY ,DUBAI
I YEAR FIRST SEMESTER,2009-2010
TEST- 2 (Open book)

Course Title :Chemistry-I **Course No:CHEM C141**
Date:6.12.09 **Total Marks:60**
Time: 50 min **Weightage:20%**

1.Answer all questions sequentially.
2.Show stepwise calculation indicating the units wherever it is required
3. Only prescribed Text book and original hand written Notes are allowed.
4.Question paper has 2 pages.

1.(i) Why pure rotational spectra is studied in the gaseous state of the molecules.
(ii)Calculate the frequency (in cm^{-1}) of the rotational line shown by a diatomic molecule having the moment of inertia value 16.5×10^{-40} gcm^2 the excited molecule being in the quantum state J= 4. **[2+10M]**

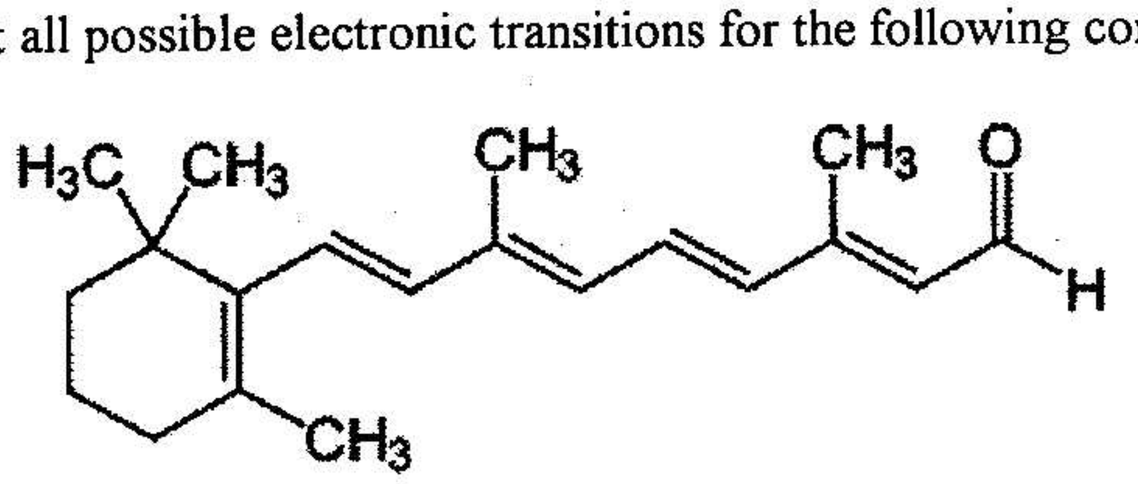
2. (i) $\rangle$C=O has a force constant of 1032 Nm^{-1}.
(a)Calculate the wave number of its vibration and (b) Find out the energy difference between any two adjacent energy levels.
(ii) Determine the number of vibrational modes possible in Aniline and Hydrogen cyanide. **[6+6M]**

3. (i) An organic compound in solution of path length 2 cm absorbs in the UV region at 250 nm with $I / I_0 = 0.42$. Find the concentration of the solution, if the molar extinction coefficient is 11,500 L $mol^{-1}cm^{-1}$.
(ii)Given the equilibrium bond length for the molecule, $^{13}C^{16}O_2$ is $R_e = 112$ pm.
(a)Calculate the moment of inertia. and rotational constant.
[4+8M]

4. (i) Account for the formation of "Overtone bands".
(ii) A triatomic molecule XY_2 has three fundamental vibrational frequencies two of them are IR active and the third is Raman active. Illustrate the different modes of vibrations. **[4+8M]**

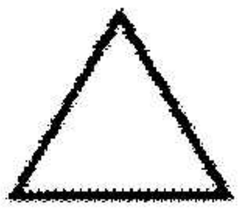
5. List all possible electronic transitions for the following compounds. **[12M]**

(a)



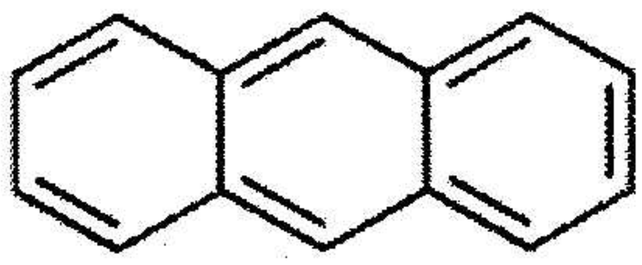
retinal

(b)



cyclopropane

(c)



Anthracene

****

BITS, PILANI - DUBAI
I YEAR FIRST SEMESTER,2009-2010
TEST- 1 (Closed book)

Course Title :Chemistry-I **Course No:CHEM C141**
Date:11.10.09 **Total Marks:75**
Time: 50 min **Weightage:25%**

1.Answer all questions Sequentially
2.Show stepwise calculation indicating the units wherever it is required
3.Useful data : h =6.626 x 10^{-34} J sec,c = 3 x 10^{8} m/sec, m_e = 9.11 x 10^{-31} Kg.
1 eV = 1.602 x 10^{-19}J , m_p = 1.672 x 10^{-27} Kg

1.(i) Write any two cyclic boundary conditions. Differentiate between degenerate and nondegenerate states for a particle rotating on a circular path of radius r.

(ii) Calculate the energy in eV required to excite an electron from $m_l = \pm 3$ to the next higher level of an aromatic molecule of diameter 350 pm. The electron moves only along the perimeter of the ring.

[4+3+8M]

2. (i) The force constant for H-Br is 516Nm^{-1}, Assume only H- atom moves (Mass of H atom = 1.67x10^{-27}kg). What would be the separation between adjacent vibrational levels?

(ii)Write essential characteristics of Photoelectric effect.

[9+6M]

3. (i) Estimate the wavelength of an electron accelerated from the rest through a potential difference of 100 kV.

(ii) Write the boundary conditions for Schrodinger equation. With a neat sketch represent acceptable and unacceptable wavefunctions for the same equation.

[10+5M]

4.(i) Calculate the ratio of the total power emitted by a ceramic material of 6.0cm × 2.5 cm section of the surface of a hot body that could be used as a filament at 3727°C instead of 2927 °C

(ii)Discuss the reason for the success of Einstein's model

[9+6M]

5.(i) Estimate the zero point energy (in eV)of a proton confined to a square well of 1 pm length .

(ii) Give any three applications of tunnelling

[9+6M]

****

A

BITS, PILANI – DUBAI

FIRST SEMESTER 2009 – 2010

Course Code: CHEM C141 | **FIRST YEAR Quiz-2** | Date: 12.11.2009

Course Title:Chemistry I | Max Marks: 21

Duration : 20 minutes | Weightage: 7 %

Name: ..... **ID No:** ..... **Sec / Prog:** .....

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

Question paper has 3 pages.

Atomic numbers : B=5, C=6, N=7, O=8, Cl=17

1.Predict the hybrid state of the central metal atom in the following

(i) CO_3^{2-} (ii) BCl_3 **(2M)**

2.Schematically represent the overlap for the formation of σ_{2pz} bonding molecular orbital. **(2M)**

3. Illustrate inter and intra molecular H-bonding with suitable examples. **(2M)**

4.Arrange the following compounds in the order of increasing covalency **(2M)**

KCl, RbCl, LiCl, NaCl, and CsCl.

5. Write the molecular orbital configuration of nitrogen molecule. **(2M)**

6.In a homonuclear diatomic molecule the wave functions of atomic orbitals are given by ψ_A and ψ_B. Give the possible linear combinations for the formation of molecular orbitals. **(2M)**

7.Write the expression for the coulombic interaction between the two positively charged nuclei.**(2M)**

8. What is the bond angle of water as predicted by VB description. **(2M)**

9.Write the valence bond wavefunction for HF molecule. **(1.5M)**

10. Calculate the bond order in NO^- and state whether the ion is stable or not. **(2.5M)**

11. Write the shape of PCl_5 molecule. **(1M)**

****

Rough work

A

BITS, PILANI – DUBAI

FIRST SEMESTER 2009 – 2010

Course Code: CHEM C141 **FIRST YEAR Quiz-1** Date: 26.10.2009
Course Title:Chemistry I Max Marks: 24
Duration : 20 minutes Weightage: 8 %

Name: . . . . . **ID No:** . . . . . **Sec / Prog:** . . . . . .

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

1.Give the possible values of l and m_l when n = 2. **(2M)**

2.Write the mathematical form of a 1s orbital for a hydrogen atom.(both Ψ and Ψ^2) **(3M)**

3. Write the expression that describes all the series of lines observed in the spectrum of hydrogenic atoms. **(2.5M)**

4.Give the expression that gives the allowed energy levels of hydrogenic atoms. **(2.5M)**

5. Differentiate between nodal plane and radial node. **(2 M)**

6. Assign the reason for the splitting of the beam of silver atoms in Walther Gerlach experiment. **(3M)**

7.What is the reason for the decrease of atomic radii from left to right across a period.**(2M)**

8. Why the second electron affinity for the formation of O^{2-} from O^{-} is strongly negative?**(2M)**

9.Which orbital is filled first 5p or 5d ? **(1M)**

10 . Which of the following transitions are allowed in the electronic spectrum of an atom (i)5 s→4s (ii) 2p→1s **(2+2M)**

****