RAMAKRISHNA MISSION VIDYAMANDIRA
(A Residential Autonomous College)
Belur Math, Howrah

B.A./B.Sc. 1st Semester (July – December 2010)
Mid-Semester Examination, September 2010

Date: 06.09.2010   **Chemistry (Honours)**   Full Marks 50
Time: 11 am – 1 pm

**[USE SEPARATE ANSWER SCRIPT FOR EACH GROUP]**
[Answer any one question from each group]

GROUP A (INORGANIC)

1. (a) (i) Write down the IUPAC name with symbol of the elements with atomic numbers 107 and 109. [1]

   (ii) What do you mean by auride ion and sodide ion? [1]

   (iii) Comment on the oxidation state of thalium in TlI_3. [1]

   (b) Compare and contrast of the followings: (any two)

   (i) Li and Mg, (ii) B and Si, (iii) Be and Al. [3]

   (c) Justify *any one* of the followings: [2]

   (i) Lithium is sometimes referred to as super alkali metal.

   (ii) Fluorine is sometimes referred to as super halogen.

   (d) What do you mean by relativistic effect? Explain with examples. [2]

   (e) State Heisenberg's uncertainty principle and explain its significance. [2]

   (f) Calculate the radius of the first allowed Bohr orbit for hydrogen. Why the uncertainty principle is not so important for macroscopic bodies. [2]

   (g) If an electron is moving at $100 ms^{-1}$ within $1 ms^{-1}$, what is the theoretical uncertainty in its position? [2]

2. (a) Explain the followings: (any three) [2 x3]

   (i) It is hard to separate zirconium and haufmium.

   (ii) PbI_4 is nonexistent whereas $PbCl_2$ is a stable compound.

   (iii) The stability of Hg_2^{2+}, Cd_2^{2+} and Zn_2^{2+} differs significantly.

   (iv) The bond angle of OF_2 is $103°$ and that of Cl_2O is $111°$.

   (b) (i) Distinguish between clusters compounds and clathrates compounds.

   (ii) What do you mean by catenation? Give examples.

   (iii) Compare the thermal stability of $CaCO_3$ and $MgCO_3$.

   (iv) Justify the position of nobel gases in the Periodic table. [4x1]

   (c) Find out the ground term symbol for Cr. Distinguish between resonance energy and ionization energy. [2]

   (d) Prove that electron cannot exist in nucleus. [2]
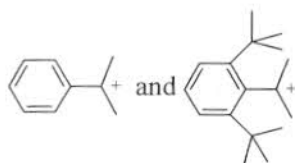
   (e) State and explain Hund's rules. [2]

GROUP B (ORGANIC)

3. (a) Draw the orbital picture of $HC≡C–CHO$ and π_y-diagram of $MeCH=C=CHMe$ indicating the state of hybridization of C, and O atoms. [3]

   (b) The pKa values of following acid 1 and 2 are 6.07 and 5.67, respectively. Account the fact. [2]

1(pk$_a$=6.07)   2(pk$_a$=5.67)
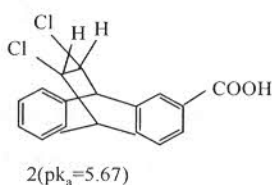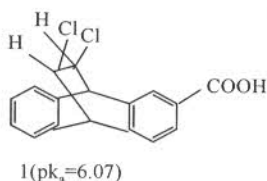
(c) Which carbocation of the following pair is more stable? [2]

(d) Write down the structure of Erythro-butane-2,3-diol in Fischer projection formula. Represent the most stable conformer in Newman projection formula and justify. [3]
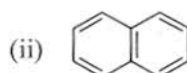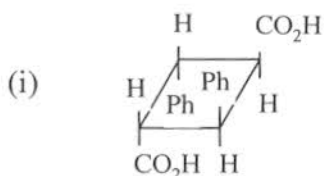
(e) Justify or criticize:

(i) Methane molecule has a S_4 – axis.

(ii) If a molecule has a (R)-configuration, it must be dextrorotatory. [4]

(f) Write down the structure of the following molecule: Acetophenone – (E) – oxime. [1]

(g) Indicate the symmetry elements present in the following compounds: [2]

(i)

(ii)

4. (a) Derive the major resonance structures for each of the following species and determine which structure is most important in each case.
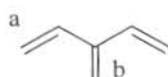
(i)

(ii) $H_3C-CH=CH-O-CH_2-CH_3$

(iii)
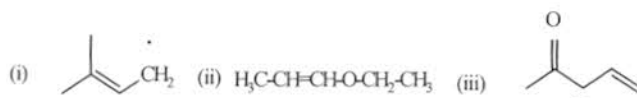
[3]

(b) Which is more polar in each of the following pairs? [2]

(i) $H_2C=CH-Cl$ and $HC\equiv C-Cl$

(iii) $H_2C=CH-H$ and $HC\equiv C-H$

(c) Which bond length 'a' and 'b' is shorter in the following compound? [2]

(d) Assign R / S designation at the Chiral centres of the following compounds showing the priority sequence. [4]

(i)

(ii)

(iii)

(iv)
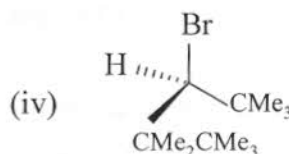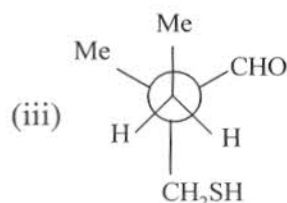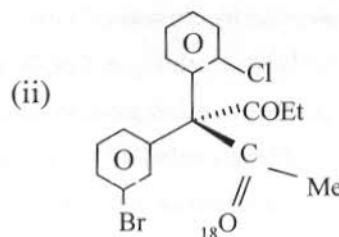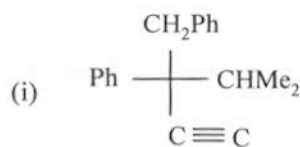
(e) Justify or Criticize:

(i) If a molecule has a S_2 – axis, it must have a centre of symmetry.

(ii) 180^0 but not 90^0 rotation is allowed for a Fischer projection formula. [4]

(f) Write the structure of the following compounds:

    (i) (2E, 4Z) – Hexadienoic acid.

    (ii) Erythro–3–bromo–2–butanol (in sawhorse projection)   [2]

GROUP C (PHYSICAL)

5. (a) Explain the nature of Z-P curve for a real gas with the help of vander Waals gas equation in the regions

    (i) $T<T_B$

    (ii) $T=T_B$

    (iii) $T>T_B$ [3]

(b) Make an approximate plot of T Vs V for water at 1 atm pressure. The range of V values should be from about 0.017 litres/mole to about 40 litres/mole. Given the molar volume of water at 1 atm, 373 K is 0.018 litres/mole and the same for water vapour under the same condition is around 30 litres/mole.   [2]

(c) The parameter 'b' in the vander-Waals gas equation may be interpreted as a measure of repulsive forces present among the gas molecules. Explain from the equation.   [2]

(d) Two separate bulbs contain gases A and B respectively. The pressures and volumes are such that the PV product is same for both the gases. However gas A is an ideal gas while B is non-ideal. Explain with the help of appropriate diagram whether the temperature of the non-ideal gas will be greater or less than the temperature of the ideal gas in the following two situations :

    (i) The temperature of the non-ideal gas is less that the Boyle's temperature

    (ii) The temperature of the non-ideal gas is higher that the Boyle's temperature ·   [3]

(e) What do you mean by *'intensive* and *extensive' properties?* Give two examples for each.

(f) An ideal gas undergoes a reversible expansion /compression obeying the condition PT= constant. Find out the expression for work and calculate its value, the initial and the final temperatures being 300K and 400K, for 2 mole gas. Comment on the nature (expansion or compression) of the process.   [3]

(c) $\left(\frac{\partial U}{\partial V}\right)_T = 0$ for an ideal gas. What does this statement signify?   [3+1]

6. (a) Explain how far the nature of the P Vs V curve for a real gas can be explained using the van-der-Waals gas equation at a temperature lower that the critical, in the (i)low (ii) intermediate and (iii) high volumes regions.

         [3]

(b) Draw and explain the nature of a Z Vs P curve for a real gas at temperature below the critical point   [2]

(c) (i) Starting from the van-der-Waals equation arrive at the reduced equation of state.

    (ii) State and explain the law of the correspondence of states   [2]

(d) Calculate the V for a van-der-Waals gas at temperature and pressures 300 Kelvin and 1 atm for which the 'a' and 'b' values are given as 0.244 lter and 0.0266 liter/mole.   [3]

(e) Show that $C_P-C_V = \left[V - \left(\frac{\partial H}{\partial P}\right)_T\right]\left(\frac{\partial P}{\partial T}\right)_V$.   [2]

(f) Prove that work is not a state function.   [2½]

(g) A real gas is allowed to undergo free expansion in an adiabatic enclosure. Will its temperature remain the same, decrease or increase? Give reason.   [2½]