RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, MARCH 2022

FIRST YEAR [BATCH 2021-24]

Date : 08/03/2022 **CHEMISTRY (HONOURS)**

Time : 11 am – 1 pm **Paper : I [CC 1]** Full Marks : 50

Group :A

[Attempt one question from each Unit]

Unit – I

[1×12]

1. a) The angular momentum of an electron in a Bohr orbit of H atom is 4.2178 X 10^{-34} km^2/sec. Calculate the wavelength of spectral line emitted when the electron falls from this level to the next lower level.

   b) If the Ionization Potential for hydrogen atom is 13.6 eV then then what would be the Ionization Potential for He^+ ion?

   c) Write down the Schrödinger wave equation in certasian coordinate mentioning the terms involved.

   d) What would be the ground state term symbol for d^9 configuration?

   e) Draw and explain radial wave function and radial distribution function for '4d' orbital.

   f) An electron has magnetic quantum number as -3 then what would be the minimum value of its Principal Quantum Number – explain your justification. [2+2+2+2+2+2]

2. a) What would be the number of nodes in R(r) plots of '3s', '2p', '4d' and '5f' orbitals?

   b) A cricket ball weighing 100gms is to be located within 0.1Å. What would be the uncertainty in its velocity?

   c) Why s-orbitals are spherically symmetrical? - explain from the concept of wave mechanical model of atom.

   d) For the ground state term symbol $^3F_2$, deduce the possible values of L, S, J with their significance.

   e) If the energy of an electron in the second energy level of hydrogen atom is -E, then what would be the value in the third energy level?

   f) For Principal Quantum Number 5, what would be the total number of electrons? [2+2+2+3+2+1]

Unit – II

[1×12]

3. a) The conductivity of BrF_3 is increased by adding either AgF or SnF_4 - explain.

   b) A 50 ml solution of pH = 1 is mixed with a 50 ml solution of pH = 2. What would be the pH of the mixture?

   c) Explain the order of acidity for phenol with its ortho, para and meta nitro derivatives.

   d) Two hypothetical acids HA and HB have the dissociation constant 10^{-3} and 10^{-5} respectively in water. How many times HA would be stronger than HB?

e) Comment on the feasibility of the reaction on the basis of HSAB principle.

$LiF + CsI \rightarrow LiI + CsF$

f) List the following oxo-acids in order of their acid strength in aqueous solutions

H_2SO_4, H_3AsO_4, $HMnO_4$, H_2SO_3 [2+2+2+2+2+2]

4. a) 'Aniline is weaker base than alkyl amines'- justify your answer.

b) Comment on the order of the solvation rate for lithium halides.

c) What is the pH of a solution obtained by dissolving .0005 moles of strong electrolyte calcium hydroxide $Ca(OH)_2$ to form 100 ml of a saturated aqueous solution.

[$K_w = 10^{-14}$ moles^{2}litre^{-2} at 25°C]

d) What would be the pH of a 10^{-8} molar HCl solution at 25°C?

e) Why does aqueous solution of NH_4Cl which is weakly acidic in nature, becomes strongly acidic in presence of $CuCl_2$?

f) Why does KHF_2 exists but $KHCl_2$ does not? [2+2+2+2+2+2]

Unit – III [1×10]

5. a) Balance the following equation by ion-electron method:

$KMnO_4 + NH_3 \rightarrow KNO_3 + MnO_2 + OH^- + H_2O$

b) What is formal potential? Discuss about its importance.

c) Silver halides are least soluble in water, though their lattice energy is almost the same as that of highly soluble alkali metal halides. Explain.

d) The standard potentials of some electrodes are as follows. Arrange the metals in an increasing order of their reducing power. (i) K+/K = -2.93 v (ii) Ag+/Ag = 0.80 v (iii) Cu2+/Cu = 0.34 v (iv) Mg2+/Mg = -2.37 v (v) Cr3+/Cr = -0.74 v (vi) Fe+2/Fe = -0.44 v.

e) Discuss the structure of Zinc blende. [2+3+2+1+2]

6. a) Calculate the heat of formation of MgF_2 from its elements using Born-Haber cycle. Thermochemical data are as follows:

Sublimation energy of Mg (S) = 146.4 KJ mol^{-1}

Dissociation energy of F_2 (D) = 158.9 KJ mol^{-1}

First ionisation energy of Mg = 738 KJ mol^{-1}

Second ionisation energy of Mg = 1446 KJ mol^{-1}

Electron affinity of F(g), E (F^-) = -334700 J mol^{-1}

Lattice energy of MgF_2 (U_0) = -2922.5 KJ mol^{-1}

b) What are the coordination numbers in HCP and CCP?

c) Atoms of element B form HCP lattice and those of the element A occupy 2/3rd of tetrahedral voids. What is the formula of the compound formed by the elements A and B?

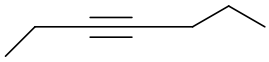
d) Calculate the potential of hydrogen electrode placed in a solution of pH= 6.

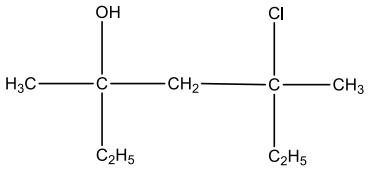
e) Why are CdI_2 crystals flaky? [2+2+2+2+2]

Group :B

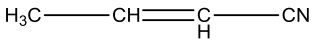
Answer **any one** question of the following: [1×16]

7. a) Write down the IUPAC name of the following compounds [2]

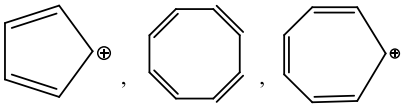
i) 

ii) 

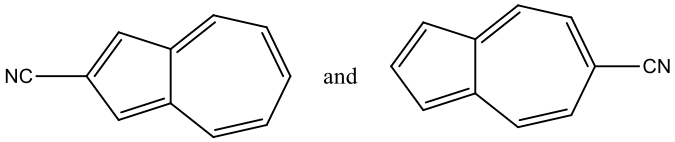
b) Draw the complete orbital picture of the following compound and also show the nature of hybridization of each carbon atom. [3]



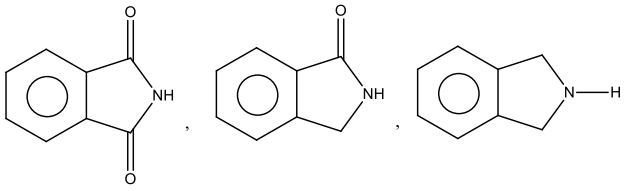
c) Identify the following molecules as aromatic, non-aromatic or anti-aromatic using Frost diagram. [3]



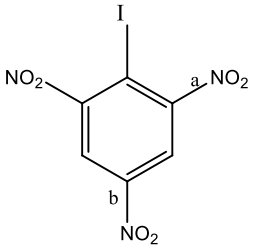
d) Which of the following compounds should have higher dipole moment and why? [2]



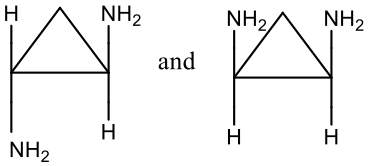
e) Arrange the following molecules in increasing order of acidity and also give explanation for the answer. [2]



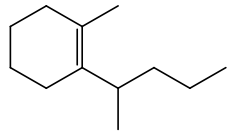
f) Which C-N bond among 'a' or 'b' should be shorter in bond length and why? [2]

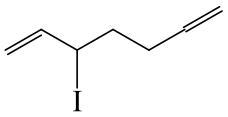


g) Which of the following molecules should be more basic and why? [2]

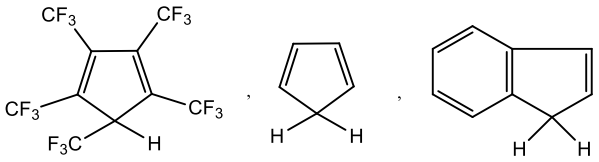


8. a) Write IUPAC name of the following molecules. [2]

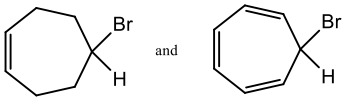
(i) 

(ii) 

b) Arrange the following compounds in increasing order of acidity and explain. [3]



c) Compare the dipole moment for the following compounds with reason. [2]

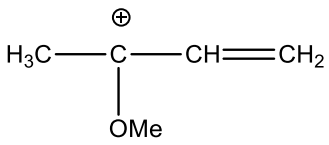


d) Calculate double bond equivalents for the following compounds [2]

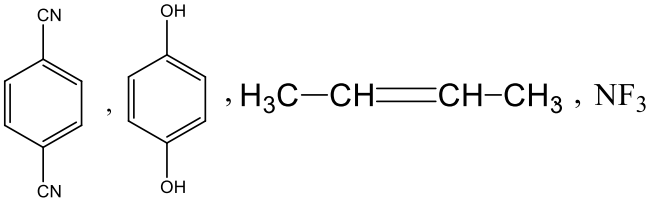
i) Cl_3H_9BrS

ii) $Cl_2H_{16}N_2O_4$

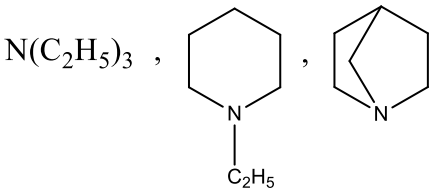
e) Draw the all possible resonating structure of the following cation and also indicate most stable form among them. [2]



f) Which of the following molecules should have permanent dipole moment and why? $(\mu \neq 0)$. [2]



g) Arrange the following molecules in increasing order of basily and why? [3]



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