2020

CHEMISTRY (Honours)

Paper : CEMH - DC - T3

[Inorganic Chemistry]

(CBCS)

Full Marks : 25   Time : Two Hours

The figures in the margin indicate full marks.

1. Answer any *five* questions from the following :   1×5=5

    (a) A 0.66 kg ball is moving with a speed of 100 m/s. Find its wavelength —

    (i) 6.6×10^{-34}m

    (ii) 6.6×10^{-32}m

    (iii) 1.0×10^{-32}m

    (iv) 1.0×10^{-35}m

   (b) 3p orbital has _____ radial nodes —

    (i) Three

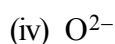   (ii) Two

    (iii) One

    (iv) None

(c) Find the successive elements of the periodic table with ionization energies, 2372, 520 and 890 kJ per mol respectively —

   (i) Li, Be, B

   (ii) H, He, Li

   (iii) B, C, N

   (iv) He, Li, Be

(d) Which of the following is least acidic in aqueous medium?

   (i) HF

   (ii) HCl

   (iii) HBr

   (iv) HI

(e) Which of the following is a redox indicator ?

   (i) EBT

   (ii) Barium diphenylamine sulphonate (BDS)

   (iii) Phenolphthalein

   (iv) Murexide

(f) The orbital angular momentum of an electron is zero. In which orbital may it be present ?

   (i) 4f

   (ii) 2p

   (iiii) 3d

   (iv) 2s

(g) In which of the following complex, the oxidation number of Fe is +1 ?

    (i) $Fe_4[Fe(CN)_6]_3$

    (ii) $[Fe(H_2O)_5NO]SO_4$

    (iii) $[FeBr_4]^-$

    (iv) $[Fe(H_2O)_6]^{2-}$
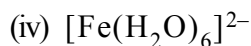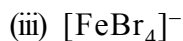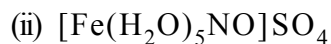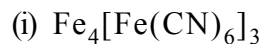
(h) Which of the following is a soft base ?

    (i) H^-

    (ii) H^+

    (iii) F^-

    (iv) O^{2-}

2. Answer any *four* questions :   2×4=8

  (a) Calculate the shortest wave-length in the absorption spectrum of deuterium. (Given $R = 109,737$ cm^{-1}).
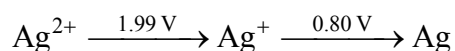
  (b) The electron affinity of Au is abnormally high and it may exist as auride — Justify.

  (c) Prove that the total probability density for the three 2p orbitals is a sphere.

  (d) Distinguish between Slater's orbital and valence shell atomic orbital.

  (e) Write down the limitations of SHAB principle.

  (f) The Latimer diagram of silver in acid medium is

$$Ag^{2+} \xrightarrow{\ 1.99\ V\ } Ag^+ \xrightarrow{\ 0.80\ V\ } Ag$$

Construct the Frost diagram and calculate the K for this reaction.

  (g) Calculate the screening constant of the first valence electron in Mn (Z=25) with the help of Slater's rule.

  (h) What is the ground state term symbol of Cr^{+3} ?

3. Answer any *two* questions : 6×2=12

(a) (i) What is Hammett acidity function? Show how it compares the strengths of strong acids.

(ii) "$SnCl_4$ is relatively more stable than $SnCl_2$ but the reverse is true for corresponding lead compounds" — Comment.

(iii) Give example of each comproportionation reaction and disproportionation reaction. (1+2)+2+1

(b) (i) Calculate the electronegativity of bromine in Allred-Rochow scale (Given : $r_{covalent}$ = 114 pm).

(ii) In Group-IIIA for precipitation of Fe^{3+}, Cr^{3+}, Al^{3+} mixture of $NH_4Cl + NH_4OH$ is used but not NaOH — Explain.

(iii) Define the term 'exchange energy'. 3+2+1

(c) (i) What do you mean by radial distribution function ? Plot the radial distribution function for the 1s orbital of hydrogen and explain.

(ii) Justify the inclusion of the word "**inner**" in Inner Transition Series.

(iv) What do you mean by lanthanide contraction ? (1+2)+2+1

(d) (i) When PbO_2 reacts with water, it yields the hypothetical hydrated product : $Pb(OH)_4$. On the other hand, CO_2 reacts with water to make carbonic acid, H_2CO_3. Explain the differences in reactivity between these two molecules in as much detail as possible.

(ii) Given the standard reduction potentials below, calculate the standard reduction potential for the Au^{3+}/Au^+ redox couple and sketch the Latimer diagram for gold.

$$Au^+(aq) + e^- \rightarrow Au(s)\,E° = 1.69\ V$$

$$Au^{3+}(aq) + 3e^- \rightarrow Au(s)\,E° = 1.40\ V \qquad 3+2+1$$