*SH-II/CHE/201/C-3/19*

# B.Sc. 2nd Semester (Honours) Examination, 2019

## CHEMISTRY

## (Inorganic Chemistry-I)

## Paper : SH/CHE/201/C3

## Course ID : 21411

**Time: 1 Hour 15 Minutes** **Full Marks: 25**

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

**1.** Answer *any five* questions: 1×5=5

(a) Calculate the number of unpaired electrons in $Cr^{2+}$.

(b) Work out the ground state term symbol of Ni(II) ion.

(c) Why is the electron affinity value of Cl greater than that of F?

(d) Specify the number of radial and angular nodes present in 3p and 3d orbitals.

(e) Cite one example of a super acid.

(f) What information do we get from Latimer's diagram?

(g) Furnish one example of secondary periodicity.

(h) Work out the oxidation state of sulfur in $K_2S_2O_8$.

**2.** Answer *any two* questions: 5×2=10

(a) (i) The first Bohr radius of hydrogen atom is 0·529Å; find the same for $He^+$ ion.

(ii) Enunciate de Broglie's concept on wave-particle duality. Derive Bohr's quantum restriction from de Broglie's equation. 2+3=5

(b) (i) State Slater's rules and apply those to calculate the screening constant and effective nuclear change experienced by a *d* electron of copper (II) ion.

(ii) Of nitrogen and oxygen atoms which one has higher ionisation potential and why? 3+2=5

(c) (i) Define formal potential. On this context explain the statement that a neutral solution of $K_3[Fe(CN)_6]$ cannot oxidise iodide to iodine but it can do so in presence of $Zn^{2+}$. [Given: $E^0_{Fe(CN)_6^{3-}/Fe(CN)_6^{4-}} = 0 \cdot 36V$; $E^0_{I_2/2I^-} = 0 \cdot 54V$]

(ii) Enumerate the potential at the equivalence point in the titration of 25mL 0·1M $Fe^{2+}$ by 0·5M $KMnO_4$. [Given: $E^0_{Fe^{3+}/Fe^{2+}} = 0 \cdot 77V, E^0_{MnO_4^-,H^+/Mn^{2+}} = 1 \cdot 51V$] 3+2=5

(d) (i) Point out the main reason why Al and Ni are, respectively found as oxide and sulphide in nature.

(ii) Calculate the change of pH when 1 mL 0·1M HCl is added to 1L of a buffer solution containing 0·1M $CH_3COOH$ and 0·1M $CH_3COONa$. (pKa of $CH_3COOH$=4·74) 2+3=5

**3.** Answer *any one* question: 10×1=10

(a) (i) Relate the Rydberg constant of H-atom and $He^+$ ion.

(ii) Write down the Schrödinger's wave equation indicating the terms involved.

(iii) Calculate the radius of $Na^+$ and $F^-$ ions from Pauling's concept of univalent radii. Equilibrium inter-ionic distance in NaF crystal is 2·31Å.

(iv) HI is a stronger acid than HCl, while $HClO_4$ is stronger acid then $HIO_4$. — Explain. 2+2+3+3=10

(b) (i) Interpret comproportionation and disproportionation reactions on the basis of Frost diagram.

(ii) $NH_4HF_2$ fulfils two requisites in the iodometric estimation of copper in presence of ion. — Explain. [Given: $E^0_{I_2/2I^-} = 0 \cdot 54V, E^0_{Cu^{2+}/Cu} = 0 \cdot 17V, E^0_{Fe^{3+}/Fe^{2+}} = 0 \cdot 77V$]

(iii) What is common ion effect? State with equation(s) what happens when $H_2S$ gas is passed through an acidified aqueous solutions of $CuSO_4$ and $ZnSO_4$.

(iv) The solubility of $CaF_2$ in water at 18°C is $2{\cdot}0\times10^{-4}$ mol $L^{-1}$. Calculate the solubility product of $CaF_2$. 2+3+3+2=10

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