B.Sc. 2nd Semester (Honours) Examination, 2022 (CBCS)

Subject: Chemistry

(Inorganic Chemistry-I)

Paper: CC-3

Time: 2 Hours **Full Marks: 40**

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

1. Answer any *five* questions from the following: **5 x 2 = 10**

a. What is the maximum number of electrons that can be accommodated in atom having highest principal quantum number value is 4?

b. Explain why the ionization energy of mercury is comparable to an inert gas.

c. Find out the ground state term for Cu^{2+}ion.

d. "Elemental chromium has four unpaired electron in its ground state."-Comment.

e."1 (N) $KMnO_4$ may mean either 0.33 M or 0.20 M $KMnO_4$."-Comment

f. What do mean by leveling solvent and differentiating solvent?

g.Why atomic radii of Zirconium and Hafnium are almost same?

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

2. Answer any *two* questions from the following: **2 x 5 = 10**

a.i) "Disproportionation and comproportionation reactions are actually redox cell reaction". Justify the statement with suitable example.

ii) "Chloride ion is oxidized by this system at low pH (<1.5) but not in neutral medium. Given E^0 values are MnO_4^-/Mn^{2+}= 1.52 V, Cl_2/Cl^-=1.36 V." – Explain. **2+3=5**

b.i) What are the demerits of Bohr's theory regarding structure of atom? Assuming Bohr's theory is applicable, deduce an expression for radius of the n^{th} orbit for the movement of a particle having mass 200 times that of electron and charge equal to that of electron, around a nucleus of infinite mass and charge equal to +3e (e= electronic charge). The particle move in a circular orbit. **2+3=5**

c.i) State the principle of solubility product. What is common ion effect? Explain the significance of these two aspects in the precipitation of iron and aluminium as hydroxide using ammonium hydroxide in presence of ammonium chloride. **1+1+3=5**

d.i) Successive pKa values of H_3PO_4 are 2.1, 7.4 and 12.7 respectively. Explain the data using Pauling's rule.

ii) The F-F bond distance in F_2 molecule is 143.3pm. Calculate the Alred-Rochow electronegativity of Fluorine using Slater's rule. **2+3=5**

3. Answer any *two* questions from the following: 2 x 10= 20

a. i) What are superacids? Indicate the parameter used to have a quantitative measure of superacid strength. Mention the basis to set up this parameter and the condition when this becomes pH of the medium.

ii) A100 ml buffer of pH 9.50 is to be prepared by mixing 0.30 M $NH_3$and 0.10 M HCl. How many mililitres of each solution should be taken assuming volumes are additive.

(2+2+2)+4=10

b. i) What are Soft and Hard Acids and Bases? 'Hard-Hard and Soft-Soft interactions are stronger than Hard-Soft and Soft-Hard interactions?-Explain using appropriate pictorial diagram.

ii) Write concisely,with example, the influence of complexation and precipitation on redox potential.

iii) "Reaction between CaO and P_4O_{10} in molten state is an acid base reaction".-Comment

4+4+2=10

c.i) State Sommerfeld's modifications on Bohr's concept of hydrogen atom and comment on the new energy states.

ii) What optical transition in He^+ spectrum would have the same wavelength as the first Lyman transition of hydrogen (Ignore the effect of reduced mass).

iii) Give qualitative pictures of the shapes of the d-orbitals on x,y,z axes showing the proper signs of wave functions. **4+3+3=10**

d. i) State Pauli Exclusion Principle, Hund's Rule and Aufbau Principle. Utilise these in predicting ground state electron distributions of Si,P and S.

ii) Indicate the positions of titanium and molybdenum in the modern form of periodic table.

iii) Solubility of CaF_2 in water at 18^0C is 2.04 x10^{-4} mol/lit. Calculate I) the solubility product and II) the solubility of CaF_2 in 0.01 (M) NaF solution. **5+2+3=10**

–×–