

2018

2nd Semester

CHEMISTRY

PAPER—C3T

(Honours)

Full Marks : 40

Time : 2 Hours

*The figures in the right-hand margin indicate full marks.*

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

*Illustrate the answers wherever necessary.*

**Group-A**

1. Answer any five questions :

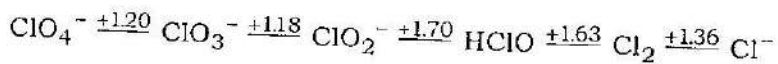
5×2

(a)  $\text{SnCl}_2$  is reducing while  $\text{PbCl}_2$  is neither reducing nor oxidising. — Explain.

(b) Show that de Broglie's hypothesis applied to an electron moving in a circular orbit leads to Bohr's Postulate of quantisation of angular momentum.

(c) Find out the pH of  $10^{-8}\text{M}$  HCl solution.

(d) From the following Latimer diagram, Calculate the reduction potential of  $\text{ClO}_4^- - \text{HClO}$



(e)  $\text{Me}_3\text{P}$  acts as a stronger base than  $\text{Me}_3\text{N}$  in their reaction with  $\text{B}_2\text{H}_6$  — Explain.

(f) Calculate the screening constant ( $\sigma$ ) for the 3d electron of iron (26).

(g) The kinetic energy of an electron is  $5.76 \times 10^{-15}\text{J}$ .

Calculate the wavelength associated with the electron

(Given mass of an electron =  $9.1 \times 10^{-31}\text{ kg}$  ;

$h = 6.626 \times 10^{-34}\text{ JS}$ ).

- (h) State the role of  $\text{H}_3\text{PO}_4$  in the estimation of iron by  $\text{Cr}_2\text{O}_7^{2-}$  in presence of diphenyl amine indicator.

### Group-B

Answer any four questions.

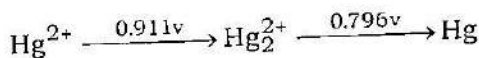
4×5

2. (a) For the hydrogen spectrum show that Lyman series occurs between 912 Å and 1216 Å and Balmer series occurs between 3647 Å and 6564 Å.  
( $R = 1.0968 \times 10^7 \text{ m}^{-1}$ )

- (b) Comment on the relative ionic radii of  $\text{O}^{2-}$ ,  $\text{F}^-$  and  $\text{Na}^+$ .

3+2

3. (a) Draw a Frost Diagram for Hg in acid solution from the given Latimer Diagram



comment on the tendency of any of the species to undergo disproportionation.

(b) What is acidity function? How does it behave in dilute aqueous solution? (2+1)+2

4. (a) Calculate the electronegativity of chlorine in Mulliken's scale and hence find out the electronegativity of the same element in Pauling's Scale.

(Given electron affinity of Cl = 4.0 eV per atom ;  
Ionisation energy of Cl = 13.0 eV per atom)

(b) The solubility of a sparingly soluble salt in water increases in presence of added salt without common ion -- Explain. 3+2

5. (a) What are Eigen functions? What are their characteristics?

(b) Arrange  $\text{BF}_3$ ,  $\text{BCl}_3$ ,  $\text{BBr}_3$  and  $\text{BI}_3$  in order of their Lewis acidity with justification. 3+2

6. (a) The equilibrium constant of the disproportionation reaction  $2\text{Cu}^+ (\text{aq.}) \rightleftharpoons \text{Cu} + \text{Cu}^{+2} (\text{aq.})$  at 298 K is  $1.66 \times 10^6 \text{ M}^{-1}$ . If the standard reduction potential

of  $\text{Cu}^{+2}/\text{Cu}$  system is 0.337 volt, Calculate the standard reduction potential of  $\text{Cu}^{+1}/\text{Cu}$  system.

- (b) Deduce ground state term symbol for atom having atomic number 22. 3+2

7. (a) How pH of an aqueous solution of KF will be affected if solid HgO is added ?

- (b) How  $\text{Cu}^{+2}$  can be estimated in presence of  $\text{Fe}^{+3}$  iodometrically ?

Given that  $E_{\text{Fe}^{+3}/\text{Fe}^{+2}}^0 = +0.77\text{V}$  ;  $E_{\frac{1}{2}\text{I}_2-\text{I}^-}^0 = +0.54\text{V}$  .

2+3

### Group-C

Answer any one question.

1×10

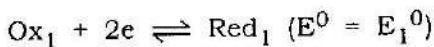
8. (a) What is radial distribution function ? Show diagrammatically the variation of radial distribution function with 'r' for the 3s, 3p and 3d orbitals in a hydrogen atom.

- (b) Although In and Tl occur in the same group of the periodic table, In show +3 oxidation state in most of its compounds, however, Tl is +1. Explain.
- (c) Draw the acid-base neutralisation curve for
- Strong acid by strong base
  - Weak acid by weak base.
- (d)  $H_3BO_3$  is a very weak acid ( $pK_a = 9.2$ ), but in presence of any cis 1, 2 diol it behaves as strong acid. Explain.

(1+3)+2+2+2

9. (a) What is quantum mechanical interpretation of an orbital?
- (b)  $CaO + P_4O_{10} \xrightarrow{\Delta} ?$  Predict the product and hence explain the reaction by Lux-Flood concept.
- (c) Calculate the first ionization energy of oxygen using Slater's rule.

(d) Consider two redox couples as follows :



What should be the minimum difference between  $E_1^0$  and  $E_2^0$  in order to have 90% complete reaction between the two systems at equilibrium at 25°C ?

(e) Ionisation energy of nitrogen is higher than that of oxygen—Explain. 1+2+3+2+2