

**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.

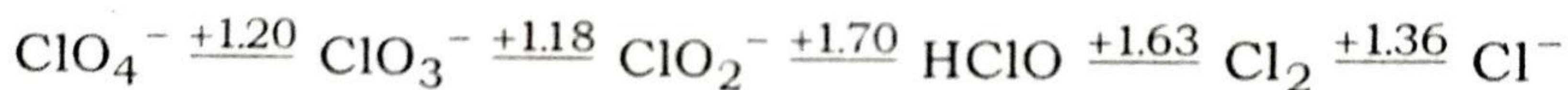
*(Turn Over)*



(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.

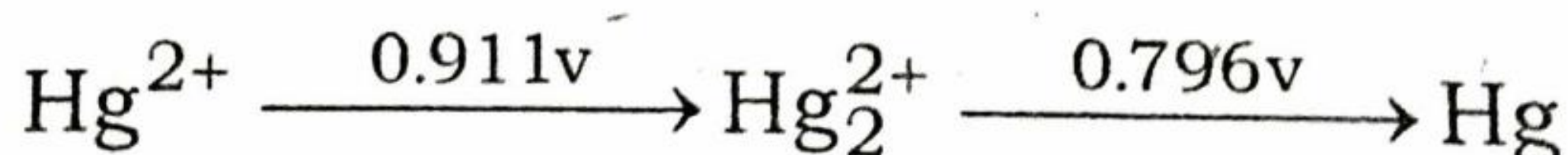
4×5

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

(a) The equilibrium constant of the disproportionation reaction  $2\text{Cu}^{+1}(\text{aq.}) \rightleftharpoons \text{Cu} + \text{Cu}^{+2}(\text{aq.})$  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.

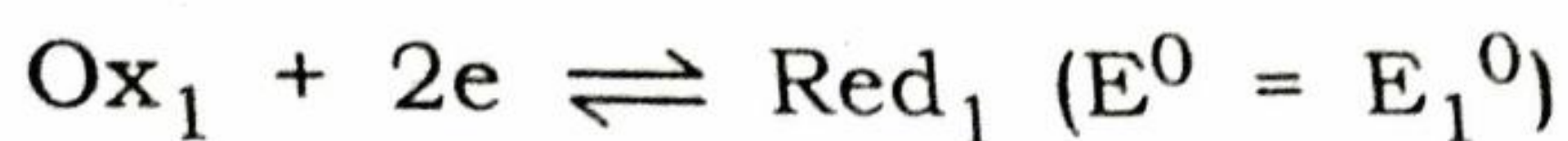


- (b) Although In and Tl occur in the same group of the periodic table, In show +3 oxidation state in most of its compounds, however, Tl is +1. Explain.
- (c) Draw the acid-base neutralisation curve for
- (i) Strong acid by strong base
  - (ii) Weak acid by weak base.
- (d)  $\text{H}_3\text{BO}_3$  is a very weak acid ( $\text{p}K_a = 9.2$ ), 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)  $\text{CaO} + \text{P}_4\text{O}_{10} \xrightarrow{\Delta} ?$  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