

**2020/TDC(CBCS)/ODD/SEM/  
CHMHCC-101T/285**

**TDC (CBCS) Odd Semester Exam., 2020  
held in March, 2021**

**CHEMISTRY**

**( 1st Semester )**

**Course No. : CHMHCC-101T**

**( Atomic Structure and Chemical Bonding )**

Full Marks : 50

Pass Marks : 20

**Time : 3 hours**

*The figures in the margin indicate full marks  
for the questions:*

**SECTION—A**

**1. Answer any ten of the following questions :**

**2×10=20**

**(a) Mention two important limitations of  
Bohr's theory.**

**1+1=2**

**(b) State and explain Pauli's exclusion  
principle.**

**2**

- (c) Calculate the wavelength of 1000 kg rocket moving with a velocity of 3000 km per hour ( $\mu = 6.626 \times 10^{-34}$  Js). 2
- (d) State and explain Aufbau principle. 2
- (e) Mention four important characteristics of *d*-block elements.  $\frac{1}{2} \times 4 = 2$
- (f) What are meant by tetrahedral and octahedral covalent radii?  $1+1=2$
- (g) Explain why ionisation energy of neon is more than that of fluorine. 2
- (h) van der Waals' radius is greater than covalent radius. Justify. 2
- (i) Draw the Lewis dot structures of  
(i)  $\text{PO}_4^{3-}$ , (ii)  $\text{O}_2^{2-}$ , (iii)  $\text{SO}_4^{2-}$ , (iv)  $\text{H}_2\text{O}_2$   
 $\frac{1}{2} \times 4 = 2$
- (j) Mention two important postulates of valence bond theory for covalent bond.  $1+1=2$
- (k) Explain why LiCl is soluble in organic solvents. 2
- (l)  $\text{He}_2$  does not exist but  $\text{He}_2^+$  does. Explain. 2
- (m) Explain why  $\text{H}_2\text{O}$  is a liquid but  $\text{H}_2\text{S}$  is a gas. 2
- (n) Metals show lustre and malleable and ductile. Explain. 2

- (o) Mention two important characteristics of van der Waals' forces. 2
- (p) The dipole moments of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are different. Explain. 2
- (q) What do you mean by primary and secondary standard substances? Give examples of each type. 2
- (r) What is meant by standard electrode potential? Give examples. 2
- (s) Which of the following species do not show disproportionation reaction and why?  
 $\text{ClO}^-$ ,  $\text{ClO}_2^-$ ,  $\text{ClO}_3^-$  and  $\text{ClO}_4^-$  2
- (t) What is meant by formal electrode potential? 2

## SECTION—B

Answer any five questions

2. (a) State and explain Heisenberg's uncertainty principle. 2
- (b) State and explain normalised wave function. 2
- (c) Explain the shapes of 2s and 2p orbitals in the light of angular wave function. 2

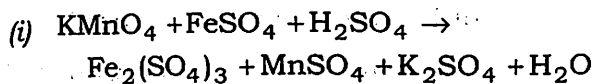
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3. (a) What are quantum numbers? Explain the significances of each quantum number. 2
- (b) Calculate the uncertainty in the velocity of an electron, if the uncertainty in its position is of the order of  $\pm 10$  pm. The mass of electron is  $9.11 \times 10^{-31}$  kg. 2
- (c) State and explain orthogonal wave function. 2
4. (a) Define electron gain enthalpy. Discuss the variation of electron gain enthalpy in group and period in s- and p-block elements of the periodic table. 1+2=3
- (b) State Slater rules. Calculate the effective nuclear charge of 3d electron in Zn. 1+2=3
5. (a) Calculate the C—F bond length if covalent radius of C =  $0.77 \text{ \AA}$ , F =  $0.72 \text{ \AA}$ ,  $\chi_C = 2.5$ ,  $\chi_F = 4.0$ . 2
- (b) Explain why halogens have highest electron gain enthalpies. 2
- (c) Explain the variation of electronegativity with partial charge, hybridization and bond order. 2

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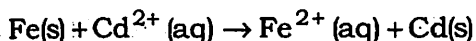
6. (a) Draw the MO energy level diagram of CO molecule. Comment on its bond order and magnetic properties. 3
- (b) Calculate the lattice energy of NaCl with the help of following data : 3
- Electronic charge =  $4.8 \times 10^{-10}$  e.s.u.  
Born exponent = 9  
Madelung constant for NaCl = 1.748  
Ionic radius of  $\text{Na}^+$  =  $0.95 \text{ \AA}$   
Ionic radius of  $\text{Cl}^-$  =  $1.81 \text{ \AA}$
7. (a) Discuss the structure of  $\text{IF}_7$ ,  $\text{NH}_3$  and  $\text{BeCl}_2$  with the help of VSEPR theory. 3
- (b) Distinguish between bonding and anti-bonding molecular orbitals. What is meant by resonance energy? 2+1=3
8. (a) What is meant by H-bonding? What are its different types? Cite suitable examples. Explain why water has maximum density at and minimum volume at  $4^\circ\text{C}$ . 1+2+1=4
- (b) Explain dipole-dipole interaction with suitable examples. 2
9. (a) What is meant by intrinsic semiconductor? What are its different types? Explain with examples. 3
- (b) State and explain Fajan's rules with suitable examples. 3

10. (a) Balance the following reactions by ion-electron method :  $1\frac{1}{2} \times 2 = 3$



- (b) Explain the principle and write the redox reactions involved in volumetric quantification of  $\text{Fe}^{2+}$  by  $\text{KMnO}_4$ . 3

11. (a) Determine the cell e.m.f. at  $25^\circ\text{C}$  for



where

$$[\text{Cd}^{2+}] = 1.0 \text{ M and } [\text{Fe}^{2+}] = 0.1 \text{ M}$$

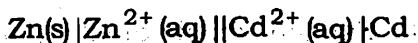
and

$$E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$$

$$E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.40 \text{ V}$$

3

- (b) (i) Write the cell reaction and calculate the standard e.m.f.  $E^\circ$  of the cell



Given

$$E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V and } E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.4 \text{ V}$$

- (ii) Calculate the oxidation no. of S in  $\text{H}_2\text{S}_2\text{O}_5$  and  $\text{H}_2\text{S}_2\text{O}_8$ .  $2+1=3$

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