CENTRAL LIBRARY N.C.COLLEGE

TDC (CBCS) Odd Semester Exam., 2018

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

(*Marks* : 20)

Answer **ten** questions, taking **two** from each Unit

UNIT—I

1. Write the electronic configuration of *(i)* Cr^{3+} ion and *(ii)* Fe^{2+} ion. 1+1=2

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2. Designate the orbitals bearing quantum numbers : 1+1=2

(i) $n = 2, l = 1$

(ii) $n = 3, l = 2$

3. Atomic number of an element is 30. To which group, period and block of periodic table will it belong? 2

UNIT—II

4. First ionization energy of N_2 is higher than that of O_2. Explain. 2

5. Which of the following elements has the lowest and which has the highest negative electron-gain enthalpy? 1+1=2

F, Cl, P, S

6. What is the difference between electron affinity and electronegativity? 2

UNIT—III

7. Write two important properties of ionic bond. 1+1=2

8. What is meant by 'resonance'? 2

9. Which of the following species are paramagnetic? 2

H_2, H_2^+ and H_2^-

UNIT—IV

10. Using Fajan's rule, explain that Ag_2S is much less soluble than Ag_2O. 2

11. What is semiconductor? Mention the two main types of semiconductor. 1+1=2

12. Define hydrogen bond. Name the types of hydrogen bond. 1+1=2

UNIT—V

13. Explain the terms 'oxidizing agent' and 'reducing agent'. 1+1=2

14. Arrange the following in decreasing order of oxidation number of nitrogen : 2

N_2O, N_2O_4, NO, N_2O_3

15. Name the redox indicators. 1+1=2

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SECTION—B

(*Marks* : 30)

Answer **five** questions, taking **one** from each Unit

UNIT—I

16. *(a)* What is meant by atomic orbitals? Name various types of atomic orbitals. 1+1=2

(b) Mention one important application of the de Broglie concept. 1

(c) State Heisenberg's uncertainty principle. Calculate the product of uncertainty in position and velocity of an electron in SI unit. 1+2=3

17. *(a)* Calculate the radius of first Bohr's orbit and energy of the electron of He^+ in the ground state. (The absolute permittivity in vacuum is $8 \cdot 85 \times 10^{-12} C^2 N^{-1} m^{-2}$, Planck's constant $= 6 \cdot 625 \times 10^{-34}$ Js, mass of electron $= 9 \cdot 1 \times 10^{-31}$ kg and charge of electron $= 1 \cdot 6 \times 10^{-19}$ C) 3

(b) Why is the wave function ψ called orbital wave function? 1

(c) State Hund's rule of maximum multiplicity. 2

UNIT—II

18. *(a)* What is meant by ionic radii? How do they differ from atomic radii? 1+2=3

(b) What do you mean by 'effective nuclear charge' of an atom? Calculate effective nuclear charge felt by a $2p$ electron of a nitrogen atom. 1+2=3

19. *(a)* Define electron affinity. Explain how it varies along a period and in a group. 1+2=3

(b) Write a short note on Allred-Rochow electrostatic approach to electronegativity scale. 3

UNIT—III

20. *(a)* What is Born-Haber cycle? How can lattice energy of a solid be obtained with the help of it? 1+2=3

(b) Write the MO electronic configuration of CO and draw the MO energy level diagram for CO molecule. 1+2=3

21. *(a)* Explain the concept of hybridization. Draw the shape of d^2sp^3 and dsp^2 hybrid orbitals. 1+1+1=3

(b) What are bonding and antibonding molecular orbitals? 1+1=2

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(c) How do you express bond strength in terms of bond order? 1

UNIT—IV

22. (a) Explain the terms 'polarizing power' and 'polarisability' with suitable examples. 3

(b) What are weak interactions? Explain different types of van der Waals' interaction with suitable examples. 3

23. (a) What is Fajans' rule? Use Fajans' rule to predict the salt having lower melting point from KI and CuI. 1+2=3

(b) Calculate the percentage ionic character in HCl molecule if the observed dipole moment is 1·08*D* (bond length = 1·276 Å and $1D = 3 \cdot 336 \times 10^{-30}$ cm). 3

UNIT—V

24. (a) Define the term 'standard reduction potential'. 1

(b) Balance the following equations by ion-electron method : 1½+1½=3

(i) $Cr(OH)_3 + IO_3^- + OH^- \rightarrow I^- + CrO_4^{2-} + H_2O$

(ii) $Br_2 + NaOH \rightarrow NaBr + NaBrO_3 + H_2O$

(c) What is stock notation? Give example. 2

25. (a) What are redox reactions? 1

(b) Name the factors on which electrode potential depends. 2

(c) Explain the principle involved in the estimation of Fe^{2+} ion by $KMnO_4$. Write the necessary chemical reactions. 3

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TDC (CBCS) Odd Semester Exam., 2018

CHEMISTRY

(1st Semester)

Course No. : CHMHCC-102T

(States of Matter and Ionic Equilibrium)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 20)

Answer **ten** questions, taking **two** from each Unit

UNIT—1

1. Write two important postulates of kinetic theory of gases. 2

2. Calculate the most probable velocity of oxygen molecule at 27 °C. 2

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3. Define collision frequency and collision diameter. 1+1=2

UNIT—2

4. What are the causes of deviation of real gas from ideal behaviour? 2

5. What is Boyle's temperature? State the law of corresponding states. 1+1=2

6. Draw isotherms of carbon dioxide at the following temperatures : ½×4=2

(a) 13·1 °C

(b) 21·5 °C

(c) 31·1 °C

(d) 35·5 °C

UNIT—3

7. Define angle of contact for a liquid that *(a)* wets glass and *(b)* does not wet glass. 1+1=2

8. What are surface active agents? Give examples. 2

9. Distinguish between Newtonian and non-Newtonian liquids. 2

UNIT—4

10. State the law of rational indices. 2

11. What are Bravais lattices? 2

12. Define glass and liquid crystal. 1+1=2

UNIT—5

13. Define pH. Calculate the pH of 100 ml *M*/50 HCl solution. 1+1=2

14. Give the theory of acid-base indicators, taking methyl orange as an example. 2

15. Give two applications of solubility product principle. 2

SECTION—B

(*Marks* : 30)

Answer **five** questions, taking **one** from each Unit

UNIT—1

16. Give an account of Maxwell's distribution of velocities. Explain graphically how the velocity changes with temperature. 4+2=6

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17. Discuss the principle of equipartition of energy. Calculate the average internal energy of a diatomic molecule at 27 °C using law of equipartition of energy. 3+3=6

UNIT—2

18. *(a)* Starting from van der Waals' equation, obtain an expression for critical constants in terms of van der Waals' constants *a* and *b*. 3

(b) The critical temperature and critical pressure of chlorine are 146 °C and 93·5 atm respectively. Calculate the values of van der Waals' constants *a* and *b*. Also find its critical volume. 2+1=3

19. *(a)* Describe virial equation of state for real gases. 3

(b) What is the molar volume of $N_2(g)$ at 500 K and 600 atm according to *(i)* the perfect gas law and *(ii)* the virial equation? Given the virial coefficient *B* of $N_2(g)$ at 500 K is $0 \cdot 0169\ L\,mol^{-1}$. 1+2=3

UNIT—3

20. *(a)* Describe drop number method for the determination of surface tension of a liquid using stalagmometer. 4

(Continued)

(b) Explain the cleansing action of soaps and detergents. 2

21. *(a)* Write Poiseuille's equation. Use this equation to determine the relative viscosity of a liquid experimentally. Mention the name of the apparatus used for the purpose. 1+3+1=5

(b) Show that 1 Pa.s = 10 poise. 1

UNIT—4

22. Derive Bragg's equation. How can this equation be used to determine the structure of NaCl? 4+2=6

23. Differentiate between Weiss and Miller indices. Calculate the Miller indices of crystal planes which cut through the crystal axes at—

(a) (2*a*, 3*b*, *c*);

(b) (6*a*, 3*b*, 3*c*);

(c) (2*a*, −3*b*, −3*c*). 3+3=6

UNIT—5

24. *(a)* Derive expressions for the hydrolysis constant, degree of hydrolysis and pH for hydrolysis of ammonium nitrate salt. 3

(Turn Over)

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(b) Calculate the solubility of $BaSO_4$ at 298 K in *(i)* pure water and *(ii)* 0·05 (*M*) $BaCl_2$ solution. Given solubility product of $BaSO_4$ at 298 K is $1 \cdot 5 \times 10^{-9}$. 1+2=3

25. (a) Derive Henderson equation for basic buffer solution. What is buffer capacity? 3+1=4

(b) Draw acid-base titration curves for—

(i) NaOH *vs.* HCl titration (conductometric);

(ii) CH_3COOH *vs.* KOH titration (conductometric). 1×2=2

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