TDC (CBCS) Odd Semester Exam., 2018

CHEMISTRY

(1st Semester)

Course No. : CHMGEC–101 T/CHMDSC–101 T

(Atomic Structure Bonding, General Organic Chemistry and Aliphatic Hydrocarbons)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

UNIT—I

1. Answer any *three* questions from the following : 1×3=3

(a) Write the expression for the time independent Schrödinger equation.

(b) Write the values of n and l for 3d-orbital.

(c) Write the electronic configuration of Cu^+ ion.

(d) What does magnetic quantum number signify?

2. Answer any *one* question from the following : 2

(a) What is exchange energy? Write its significance. 1+1=2

(b) If the velocity of an electron in Bohr's first orbit is $2{\cdot}19\times10^6$ m-s^{-1}, calculate the de Broglie wavelength associated with it. 2

3. Answer any *one* question from the following : 5

(a) (i) Draw the radial probability distribution curves for 1s and 2s electrons. What observations are made from the graphs? 2+2=4

(ii) What is nodal point? 1

(b) (i) Write the significance of ψ in Schrödinger equation. 2

(ii) Write the essential conditions to be fulfilled by ψ to become an well-behaved wave function. 2

(iii) What is meant by dual nature of particles in motion? 1

UNIT—II

4. Answer any *three* questions from the following : 1×3=3

(a) Which of the following species is diamagnetic in nature?

(i) H_2^-

(ii) H_2^+

(iii) H_2

(iv) He_2^+

(b) CO_2 has zero dipole moment. Justify.

(c) Fill in the blanks :

According to Fajan's rules, covalent bonding is favoured by _____ cations and _____ anions.

(d) Draw the molecular orbitals obtained by the overlapping of two 1s atomic orbitals.

5. Answer any *one* question from the following : 2

(a) $AlCl_3$ is mostly covalent while AlF_3 is mostly ionic. Explain. 2

(b) (i) What is lattice energy? 1

(ii) Mention two factors on which the solubility of a solid in a solvent depends. 1

6. Answer any *one* question from the following : 5

(a) *(i)* Write the basic features of LCAO. 2

(ii) Bond dissociation energy of N_2 molecule is higher than that of O_2 molecule. Explain the observation using MOT. 3

(b) Describe Born-Haber cycle to calculate the lattice energy of a solid. 5

SECTION—B

UNIT—III

7. Answer any *three* questions from the following : 1×3=3

(a) Which of the following is more nucleophilic and why?

(i) $\overset{\ominus}{N}H_2$

(ii) $\overset{\ominus}{O}H$

(b) Which of the following carbanion is more stable and why?

(i) $\overset{\ominus}{C}H_3$

(ii) $CH_3\overset{\ominus}{C}H_2$

(Continued)

(c) Why is ethanoic acid weaker than methanoic acid?

(d) Carbon tetrachloride has zero dipole moment. Explain.

8. Answer any *one* question from the following : 2

(a) What is resonance? Draw the resonance structure of CH_3CO_2H. 1+1=2

(b) Distinguish between inductive effect and resonance. 2

9. Answer any *one* question from the following : 5

(a) *(i)* Which of the following ions is more stable? Give reasons for your choice : 1+2=3

$CH_3—\overset{\ominus}{O}$ *or* $C_6H_5—\overset{\ominus}{O}$

(ii) What are electrophiles and nucleophiles? Give one example each of a neutral nucleophile and a neutral electrophile. 1+1=2

(b) *(i)* Compare the stability of the following species giving proper reasons : 3

$CH_3—\overset{\ominus}{C}H_2$; $CH_2=\overset{\ominus}{C}H$; $HC\equiv\overset{\ominus}{C}$

(Turn Over)

(ii) Why is C—C bond distance in benzene intermediate between C—C bond distance in ethane and ethene? 2

UNIT—IV

10. How can you prepare the following (any *three*)? 1×3=3

(a) Ethane from sodium propionate

(b) Benzene from ethyne

(c) Ethene from ethanol

(d) Ethane from bromomethane

11. Answer any *one* question from the following : 2

(a) Identify *A*, *B*, *C* and *D* in the following reactions : ½×4=2

(i) $CH_3CH{=}CH_2 \xrightarrow{B_2H_6} (A) \xrightarrow{H_2O_2/NaOH} (B)$

(ii) $CH_3CH(Br)CH_2Br \xrightarrow[\text{liq. } NH_3]{2NaNH_2} (C) \xrightarrow[NH_4OH]{AgNO_3} (D)$

(b) What happens when (write equation only)—

(i) 2-methylpropene is treated with Cl_2 and water;

(ii) propyne is treated with water in the presence of H_2SO_4 and $HgSO_4$ as catalyst? 1+1=2

12. Answer any *one* question from the following : 5

(a) (i) State and justify Markownikoff's rule choosing a suitable reaction as an example and depicting the mechanism of the reaction. 1+2=3

(ii) Convert (*x*) propyne into 2,2-dibromopropane and (*y*) 2-bromobutane to but-2-ene. 1+1=2

(b) (i) Convert but-1-ene into 1-bromobutane. 1½

(ii) Convert ethyne into glyoxal. 1½

(iii) State Saytzeff rule and give one example of a reaction where product formation follows Saytzeff rule. 1+1=2

UNIT—V

13. Answer any *three* questions from the following : 1×3=3

(a) Suggest the name of a Lewis acid other than anhydrous aluminium chloride which can be used during ethylation of benzene.

(b) *tert*-Butyl benzene ($C_6H_5—C(CH_3)_3$) does not give benzoic acid on oxidation with acidic $KMnO_4$. Why?

(c) What is the role of catalyst in the electrophilic substitution reactions in benzene?

(d) In monoalkylation of benzene with a haloalkane and $AlCl_3$. an excess of benzene is used. Why?

14. Answer any *one* question from the following : 2

(a) Why does benzene undergo electrophilic substitution reactions instead of electrophilic addition reactions? 2

(b) What is Friedel-Craft alkylation reaction? Give an example. What are the limitations of this reaction? 1+1=2

15. Answer any *one* question from the following : 5

(a) (i) Write the mechanism, including generation of electrophile, of nitration of benzene with acid mixture. 4

(ii) What happens when sodium benzoate is heated with soda lime? (Write equation.) 1

(b) (i) What is electrophile in sulphonation of benzene? Write the mechanism of the reaction involving generation of this electrophile and its subsequent reaction in sulphonation of benzene. 4

(ii) How can you convert benzene to acetophenone? (Write equation.) 1

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