2019/TDC/ODD/SEM/CHMH–101/220

TDC Odd Semester Exam., November—2019

CHEMISTRY

(Honours)

(1st Semester)

Course No. : CHMH–101

(Inorganic Chemistry—I)

Full Marks : 35
Pass Marks : 12

Time : 2 hours

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

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

UNIT—I

1. *(a)* What are the major postulates made by
        Bohr that allow him to derive an
        equation for the energies of electron in a
        hydrogen atom?   2

(Turn Over)

(2)

(b) The energy of an electron in an excited hydrogen atom is -3.4 eV. Calculate the angular momentum of the electron according to Bohr's theory.

Given—

mass of an electron = 9.1×10^{-31} kg

Rydberg's constant = 1.09737×10^7 m^{-1}

Planck's constant = 6.6262×10^{-34} J-s

Speed of light = 2.998×10^8 m-s^{-1} 3

(c) Consider an electron is confined within the nucleus of diameter 10^{-14} metre. Find the uncertainty in determination of its velocity.   2

2. (a) What do you mean by radial and angular parts of the wave function for the electron in the hydrogen atom?   2

(b) What is radial distribution function? Show diagrammatically the variation of radial distribution functions of 3s and 3p orbitals in a hydrogen atom.   1+1=2

(c) In a hydrogen atom, an electron on its ground state absorbs 1.5 times as much energy as the minimum required for its escape from the atom. What is the wavelength of the emitted electron? Given, 13.6 eV energy is needed for ionization.   3

     (Continued)

(3)

UNIT—II

3. (a) Determine the bond with more ionic character in H—O—Cl using the following bond energy data :

Type of bond	Bond energy (kJ/mole)
H—H	437
Cl—Cl	239
O—O	143
H—O	462
Cl—O	218

Suggest the mode of its ionization in aqueous solution.   2+1=3

(b) Explain the Allred-Rochow scale of absolute electronegativity and show its relation with Pauling's relative electronegativity.   3

(c) Why does LiAlH$_4$ show better reducing properties than NaBH$_4$?   1

4. (a) Discuss the effect of polarizing power and polarizability on the properties of ionic compounds.   3

     (Turn Over)

(4)

(b) The dipole moment and bond dissociation of a gas phase HBr molecule are $0.827\,D$ and 141.5 pm respectively. Determine the charge distribution in this diatomic molecule $(1D = 3.336 \times 10^{-30}$ cm$)$. 3

(c) Why is Au ion stable but Cu ion not exist? 1

UNIT—III

5. (a) Explain how nanomaterials differ from their bulk counterpart. 3

(b) Illustrate with neat sketch the gas-phase synthesis of nanomaterials. Write down the advantages of gas-phase method. 3+1=4

6. (a) What are meant by 'top-down' and 'bottom-up' approaches for nano-material synthesis? Give example of each method. 2

(b) What is the difference among nanorod, nanotube and nanowire? 2

(c) Write down the applications of nanomaterials. 3

(Continued)

(5)

UNIT—IV

7. (a) The Xe—F bonds in XeF_2, XeF_4 and XeF_6 are equivalent. Justify the observation. 3

(b). Compare the acidity and oxidizing power of $HOCl$ and $HClO_4$. 2

(c) Give the uses of nitrous acid and nitrite. 2

8. (a) How can ClO_2 be prepared commercially? Sketch its structure. Comment on magnetic behaviour and explain why ClO_2 does not dimerize like NO_2. 1+1+2=4

(b) What happens when XeF_6 added to RbF and heat at 50 °C? 2

(c) Dehydration of HNO_3 with P_2O_5 at low temperature gives a colourless deliquescent solid. Identify the product and sketch its gas-phase structure. 1

UNIT—V

9. (a) What is Portland cement? State the function of gypsum in Portland cement. 1+1=2

(Turn Over)

(6)

(b) How is white Portland cement (WPC) prepared? Compare ordinary Portland cement (OPC) with white Portland cement (WPC). 1+2=3

(c) Define straight fertilizer. Give an example of straight phosphate fertilizer and its composition. 1+1=2

10. (a) How is calcium ammonium nitrate (CAN) prepared? Give the composition and uses of CAN fertilizer. 1+2=3

(b) Write the composition of ammonium sulphate phosphate (ASP) complex fertilizer. Give the advantage and disadvantage of using ASP fertilizer.

1+1=2

(c) Write down the mechanism of setting of cement. 2

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2019/TDC/ODD/SEM/CHMH–102/221

TDC Odd Semester Exam., November—2019

CHEMISTRY

(Honours)

(1st Semester)

Course No. : CHMH–102

(Organic Chemistry—I)

Full Marks : 35

Pass Marks : 12

Time : 2 hours

The figures in the margin indicate full marks for the questions

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

UNIT—I

1. (a) Which of the following has only one type of hybridized carbon? Mention the type of hybridization of the carbon of that species : $\frac{1}{2}+\frac{1}{2}=1$

    (i) $CH_2{=}C{=}CH_2$

    (ii) $CH_3{-}C{\equiv}CH$

    (iii) $CH_2{=}CH{-}\overset{\oplus}{CH}_2$

(2)

(b) Draw the orbital diagram of $\overset{\ominus}{C}H_3$, clearly specifying each orbital. 2

(c) Which of the following is more basic? Give reason : 1+1=2

(i) $\overset{\ominus}{C}H_2CH_3$

(ii) $\overset{\ominus}{C}\equiv CH$
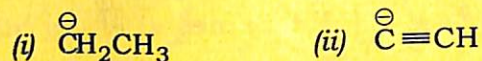
(d) Which one of the following two compounds has shorter carbon-carbon double bond length and why? 1+1=2

(i) $CH_3-CH=CH_2$

(ii) $CH_2=CH_2$
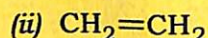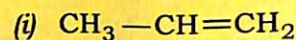
2. (a) 1,3-butadiene when accepts a proton, an allylic cation is formed. Which one of the following does not represent a resonance structure and why? 2

(i) $CH_3-\overset{\oplus}{C}H-CH=CH_2$

(ii) $CH_3-CH=CH-\overset{\oplus}{C}H_2$

(iii) $\overset{\oplus}{C}H_2-CH_2-CH=CH_2$
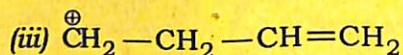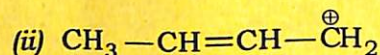
(b) Which of the following two resonating structures of acyl cation is more stable? Justify : 2

(i) $R-\overset{\oplus}{C}=O$

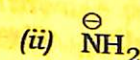(ii) $R-C\equiv\overset{\oplus}{O}$

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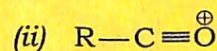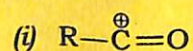
(3)

(c) How would you account for the fact that in ethane carbon-carbon bond length is 154 pm while in ethene it is 134 pm? 1½
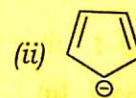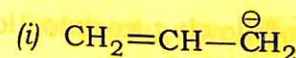
(d) Ethanol and dimethyl ether have the same molecular mass. Predict which of them has higher boiling point and why? 1½
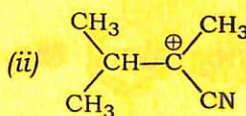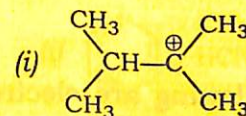
UNIT—II

3. (a) Which of the following species has higher nucleophilicity and why? 1½

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

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

(b) Which of the following carbanions is more stable and why? 2

(i) $CH_2=CH-\overset{\ominus}{C}H_2$

(ii)

(c) Which of the following carbocations is more stable? Give reason : 1½

(i)

(ii)

(Turn Over)

(4)

(d) Write the products formed when the marked bond of the following molecule is cleaved (i) homolytically and (ii) heterolytically?   1+1=2
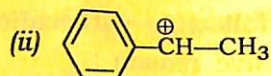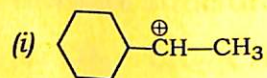
4. (a) Which of the following CH_3-Cl is a better nucleophile and why?   ½+1½=2

$$Cl^{\ominus} \text{ or } Br^{\ominus} \text{ ion}$$

(b) Predict what is generated by the following reaction :   1

$$CH_3CH_2CH_2Cl + AlCl_3 \rightarrow ?$$

(c) Which of the following carbocations is more stable and why?   2

(i) $\overset{\oplus}{CH}-CH_3$

(ii) $\overset{\oplus}{CH}-CH_3$
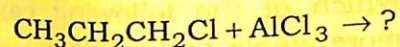
(d) Which of the following are electrophile and nucleophile?   ½×4=2

$$Cu^{2+}, CH_3\overset{..}{N}H_2, AlCl_3, CH_3\overset{\ominus}{O}$$
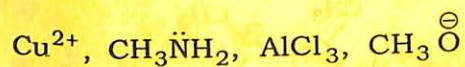
(5)

UNIT—III

5. (a) Complete the following reactions and propose a reasonable mechanism for each reaction :   (½+2)×2=5

(i) + HBr $\longrightarrow$?

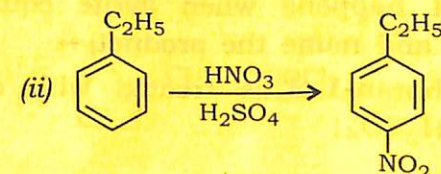(ii) + $CH_2=CH-CH_3$ $\xrightarrow{H^{\oplus}}$?
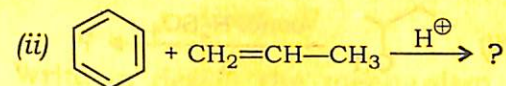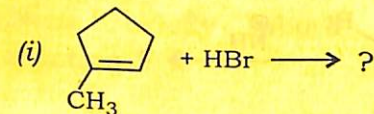
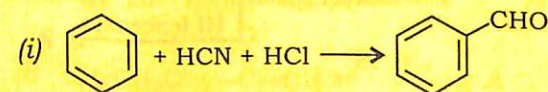(b) How would you synthesize propanal as the only product through ozonolysis? Write chemical equation for the reaction.   2

6. (a) Bring out the following conversions :   1½×2=3

(i) 1-bromopropane from propene
(ii) Acetophenone from benzene

(b) Write the mechanism for the following reactions :   2×2=4

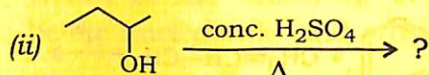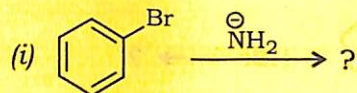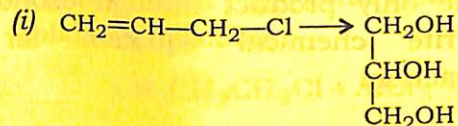(i) + HCN + HCl $\longrightarrow$

(ii) $\xrightarrow[H_2SO_4]{HNO_3}$

(6)

UNIT—IV

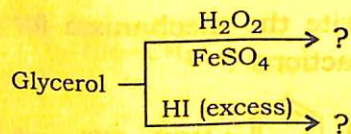7. (a) Complete the following reactions and provide mechanism for the reactions :
2×2=4

(i) $\underset{}{\bigcirc}\text{—Br} \xrightarrow{\overset{\ominus}{N}H_2} ?$

(ii) $\underset{OH}{\bigwedge} \xrightarrow[\Delta]{\text{conc. } H_2SO_4} ?$

(b) Bring out the following conversions :
1½×2=3

(i) $CH_2=CH-CH_2-Cl \longrightarrow \underset{\underset{CH_2OH}{\overset{|}{CHOH}}}{\overset{|}{CH_2OH}}$

(ii) $\bigwedge\!\!\bigwedge \longrightarrow \bigwedge\!\!\bigwedge OH$

8. (a) Predict the products of the following reaction :
1+1=2

Glycerol $\begin{cases} \xrightarrow[FeSO_4]{H_2O_2} ? \\ \xrightarrow{HI \text{ (excess)}} ? \end{cases}$

(b) What happens when (write equation only and name the product)—

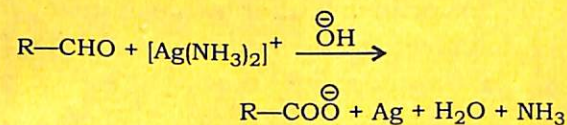(i) butan-1-ol is treated with conc. H_2SO_4;

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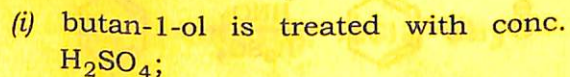
(7)

(ii) methyl magnesium bromide reacts with ethanol;

(iii) ethanol reacts with ethanoic acid in presence of little conc. H_2SO_4? 1×3=3

(c) Write briefly about hydroboration reaction.
2

UNIT—V

9. (a) Write in detail, the mechanism of the following reaction :
3

$$R-CHO + [Ag(NH_3)_2]^+ \xrightarrow{\overset{\ominus}{O}H}$$

$$R-C\overset{\ominus}{O}O + Ag + H_2O + NH_3$$

(b) Reaction of cyclohexanone with dimethylamine in the presence of catalytic amount of an acid forms a compound. Identify the compound and propose a reasonable mechanism for the reaction.
2½

(c) Identify the following products : ½×3=1½

(i) $CH_3CH_2CH_2-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{LiAlH_4} A$

(ii) $\bigcirc\!\!-\!COOH \xrightarrow{SOCl_2} B \xrightarrow[\Delta]{H_2/Pd\text{-}BaSO_4} C$

(Turn Over)

(8)
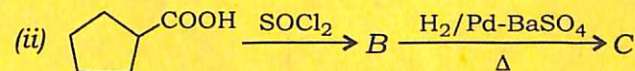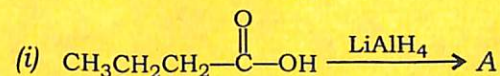
10. *(a)* Complete the following reactions and write reasonable mechanism for each :

$$2\frac{1}{2} \times 2 = 5$$

(i)

$$\underset{H}{\overset{O}{\underset{\|}{C}}}\!\!-\!OC_2H_5 \quad + \quad \text{(decalinone)} \quad \xrightarrow[\ C_2H_5OH\ ]{C_2H_5ONa} \ ?$$
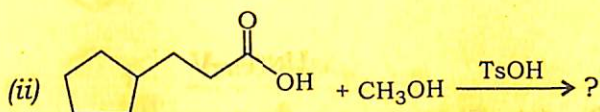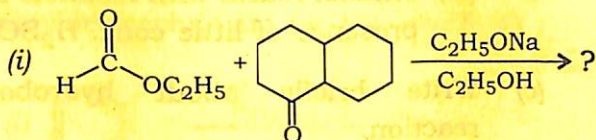
(ii) (cyclopentyl propanoic acid) $+ CH_3OH \xrightarrow{\ TsOH\ } ?$

(b) Propose a suitable mechanism for the following conversion : 2

$$\text{(benzaldehyde)} \xrightarrow[\ 2)\ H_3O^{\oplus}\ ]{1)\ KMnO_4,\ \overset{\ominus}{O}H} \text{(benzoic acid)}$$

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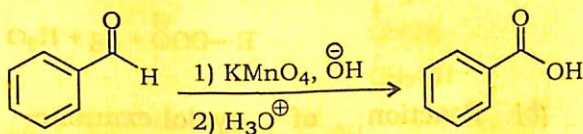
2019/TDC/ODD/SEM/CHMH–103/222

TDC Odd Semester Exam., November—2019

CHEMISTRY

(Honours)

(1st Semester)

Course No. : CHMH–103

(Physical Chemistry—I)

Full Marks : 35

Pass Marks : 12

Time : 2 hours

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

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

UNIT—I

1. *(a)* What is the significance of van der Waals' constants a and b? 1

   (b) Deduce the critical constants of a gas in terms of van der Waals' constants. 4

   (c) Write Berthelot and Dieterici equation explaining the terms involved in the equation. 1+1=2

(Turn Over)

(2)

2. *(a)* Discuss the reasons for the deviation of real gases from ideal behaviour. 2

(b) What is meant by 'Boyle temperature' of a gas? 1

(c) 100 g of CO_2 gas is contained in a 5 L container at 40 °C. Calculate its pressure *(i)* as an ideal gas and *(ii)* as a van der Waals' gas. ($a = 3.59$ and $b = 0.043$) 1½+2½=4

UNIT—II

3. *(a)* Explain Weiss and Miller indices of a plane. What would be the Miller indices of a plane which make intercepts $\frac{1}{2}$, 2, $\frac{3}{2}$ multiples of unit distances on the three axes? 2+1=3

(b) Write a short note on 'metallic bonding'. 2

(c) The distance between the successive layers of graphite is 3·35 Å. What is the carbon-carbon distance in the molecular layer? The density of graphite is 2·25 g/cc. 2

4. *(a)* *(i)* Describe Laue's method used for analyzing the structure of crystal.

(ii) Discuss Born-Haber cycle with suitable example. 2+2=4

(3)

(b) A certain solid X (at. mass = 27) crystallizes in an fcc structure. If the density of X is 2·7 g/cm^3, what is the length of the edge? 3

UNIT—III

5. *(a)* What is meant by—

(i) Joule-Thomson coefficient;

(ii) inversion temperature? 1+1=2

(b) What do you mean by state function and path function of a thermodynamic system? Give examples. 1+1+1=3

(c) Show that the inversion temperature is given by $T_i = 2a/Rb$. 2

6. *(a)* Clearly stating the assumptions and approximations involved, show that the work done in an isothermal reversible process is greater than an irreversible one. 5

(b) $\delta\omega$ is not exact differential. Justify or criticize. 2

(4)

UNIT—IV

7. (a) Discuss the salient features of phase diagram of sulphur system. 5

(b) Calculate the degrees of freedom for an aqueous solution of weak acid HCN and explain. 2

8. (a) Discuss the salient features of the phase diagram of Bi-Cd system. 4

(b) Write short notes on the following :
1½×2=3

(i) Desilverization of lead

(ii) Congruent melting point

UNIT—V

9. (a) State and explain Euler's reciprocity relations. Hence, show that internal energy, U is an exact differential. 2+2=4

(b) (i) Calculate the number of ways of dividing 10 distinguishable objects into three groups containing 2, 5 and 3 objects.

(ii) How many permutations are possible of the letters a, b and c?
1½+1½=3

(Continued)

(5)

10. (a) How many words can be formed with the letters of the word 'SILCHAR'? How many of these will begin with 'S'?
1½+1½=3

(b) In how many ways can a college cricket eleven be chosen out of 14 players? How many of them will always include a particular player as captain? 1½+1½=3

(c) Distinguish between an exhaustive and a null event. 1

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