

CS/B.TECH/BME/ECE/EE/EEE/EIE/ICE/PWE(N)/ODD/  
SEM-1/BS-CH-101/2019-20



**MAULANA ABUL KALAM AZAD UNIVERSITY OF  
TECHNOLOGY, WEST BENGAL**

**Paper Code : BS-CH-101**

**PUID : 01034 ( To be mentioned in the main answer script )**

**CHEMISTRY-I**

*Time Allotted : 3 Hours*

*Full Marks : 70*

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own  
words as far as practicable.*

**GROUP - A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any ten of the following : 10 × 1 = 10

i) Energy required to remove an electron from outermost shell of an isolated gaseous atom is called

- a) potential energy      b) kinetic energy  
c) electron affinity      d) ionization energy.

ii) At inversion temperature Joule-Thomson coefficient is

- a) zero      b) positive  
c) negative      d) none of these.

iii) If uncertainty in position and momentum are equal, the uncertainty in velocity is

- a)  $\sqrt{h/\pi}$                       b)  $\frac{1}{2m} \sqrt{h/\pi}$   
c)  $\sqrt{h/2\pi}$                       d) none of these.

iv) For transition metal octahedral complexes, the choice between high spin and low spin electronic configurations arises only for

- a)  $d^1$  to  $d^3$  complexes  
b)  $d^4$  to  $d^7$  complexes  
c)  $d^8$  to  $d^9$  complexes  
d)  $d^1$ ,  $d^2$  and  $d^8$  complexes.

v) Which one of the following correctly represents the formation of bonding molecular orbital from the atomic orbitals having wave functions  $\psi_A$  and  $\psi_B$ ?

- a)  $\psi_A \times \psi_B$                       b)  $\psi_A / \psi_B$   
c)  $\psi_A + \psi_B$                       d)  $\psi_A - \psi_B$

vi) IR spectra detects

- a) functional group  
b) unsaturation  
c) number of protons  
d) nature of nuclei.

vii) What is the fingerprint region range in IR?

- a)  $4000 - 400 \text{ cm}^{-1}$                       b)  $4000 - 1600 \text{ cm}^{-1}$   
c)  $1600 - 400 \text{ cm}^{-1}$                       d) No range.

viii) During the motion, if the centre of gravity of molecule changes, the molecule possesses

- a) Electronic energy      b) rotational energy
- c) Translational energy      d) Vibrational energy.

ix) The strength of van der Waals forces depends upon

- a) size of the molecule
- b) molecular structure
- c) number of electrons present in the molecule
- d) all of these.

x) In which of the following reactions is  $\Delta H = \Delta U$  ?

- a)  $H_2(g) + I_2(g) \rightarrow 2HI(g)$
- b)  $KI(aq) + I_2(s) \rightarrow KI_3(aq)$
- c)  $6NaOH(aq) + 3Cl_2(g) \rightarrow 5NaCl(aq) + NaClO_3(aq) + 3H_2O(l)$
- d)  $N_2O_4(g) \rightarrow 2NO_2(g)$

xi) Water at  $4^\circ C$ , under pressure of 1 atm, ( $C_p - C_v$ ) is

- a) positive      b) negative
- c) zero      d)  $R$ .

xii) In which of the following processes does the entropy decrease ?

- a) The dissolving of NaCl in water
- b) The evaporation of water
- c) The conversion of  $CO_2(g)$  into dry ice
- d) When one dozen marbles are taken out of a small bag and dropped on the ground.

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**GROUP - B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. Explain the following reactions with a suitable example :

a) Wolff-Kishner reduction

b) Cannizzaro reaction.  $3 + 2$

3. a) State the reason for the presence of only one electron in the 4s subshell of chromium ?

b) Which of the following has larger size and why ?

i)  $Mg^{2+}$                       ii)  $N^{3-}$ .  $2 + 3$

4. a) Give molecular orbital energy level diagram of CO. Write its electronic configuration, magnetic behaviour and bond order. <http://www.makaut.com>

b) Discuss types and conditions for hydrogen bonding.  $3 + 2$

5. a) For a reaction both  $\Delta H$  and  $\Delta S$  are positive. Under what conditions will the reaction be spontaneous ?

b) What will be the conjugate acids for the following Bronsted bases ?

$NH_3$ ,  $HCO_3^-$ ,  $CH_3COO^-$ ,  $H_2PO_2^-$ .  $1 + 4$

6. Why violet coloured  $[Ti(H_2O)_6]Cl_3$  becomes colourless when heated ?

**GROUP - C**

**( Long Answer Type Questions )**

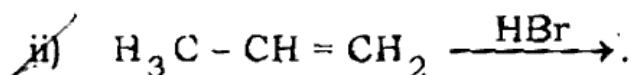
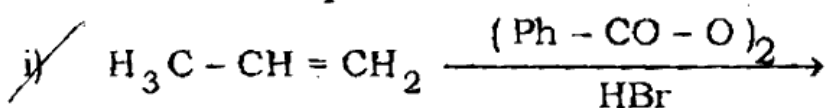
Answer any *three* of the following.  $3 \times 15 = 45$

7. a) Phenol on treatment with  $\text{Br}_2$  in  $\text{CS}_2$  at low temperature gives two isomeric monobromophenols X and Y. But phenol on treatment with bromine water gives a white precipitate Z. Identify the products X, Y and Z with chemical reactions. 6

b) What do you mean by enantiomer and diastereomer? Differentiate them with examples. 4

c) Give one example of each of Friedel-Crafts' alkylation and acylation reaction. 2

d) Predict the major product(s) of the following reactions and explain their formation: 2



e) Write down the criteria for aromaticity. 1

8. a) Calculate the force constant for the bond in HCl from the fact that the fundamental vibration frequency is  $8.667 \times 10^{13} \text{ s}^{-1}$ .

b) Calculate the energy of one photon of light of wavelength 2450 Å. Will it be able to dissociate a bond in diatomic molecule which absorbs this photon and has a bond energy equal to 95 kcal per mole?

c) "All adiabatic reversible expansions lead to a fall of temperature." — Comment or justify.  $4 + (3 + 3) + 5$

9. a) What is screening constant? Calculate the effective nuclear charge ( $Z_{eff}$ ) of one 4s electron of the following :  
Cu ( $Z = 29$ ) and K ( $Z = 19$ ).
- b) Determine the bond order of each member of the following groups, and determine which member of each group is predicted by the molecular orbital model to have the strongest bond :  
i)  $H_2, H_2^+, H_2^-$   
ii)  $O_2, O_2^{2+}, O_2^{2-}$ .
- c) p-block elements form acidic, basic and amphoteric oxides. Explain each property by giving two examples and also write the reactions of these oxides with water. 5 + 4 + 6
10. a) What is the necessary and sufficient condition to exhibit optical activity?
- b) Draw all the stereo-isomers for the following :  
 $CH_3CH(OH) - CH(Cl)COOH$
- c) Arrange the different conformations of n-butane in terms of their stability. 5 + 5 + 5
11. a) Nitration is also in absence of  $H_2SO_4$  yet  $H_2SO_4$  has no effect on benzene under the conditions employed. Show the mechanism of nitration of benzene.
- b) What is the condition of spontaneity in terms of entropy? The condition of spontaneity :  
 $\Delta G_{x,y} < 0 ; \Delta A_{p,r} < 0,$   
where  $G$  is the Gibbs free energy and  $A$  is the Helmholtz free energy. Identify  $x, y, p$  and  $r$ .

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- ✓ c) State whether the following properties are extensive or intensive properties :

Pressure, Concentration, Entropy, Viscosity,  
Temperature. 4 + (2 + 4) + 5

12. a) pH of a solution of a strong acid is 5. What will be the pH of the solution obtained after diluting the given solution 100 times ?
- b) Write the Nernst equation for the cell reaction in the Daniel cell. How will the  $E_{\text{cell}}$  be affected when the concentration of  $\text{Zn}^{2+}$  is increased ?
- c) Draw and explain the energy level diagrams for conductor, semiconductor and insulator.
- d) Explain enantiomers and diastereoisomers with examples.
- e) Write the principle and application of NMR and MRI. 3 + 3 + 3 + 2 + 4

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