2024

(Nov-Dec)

CHEMISTY

Discipline Specific Elective

(Physical Chemistry: Chemical Thermodynamics)

Course Code : **DSE-2-CHE-301 (A)**

Credit : **2**

NEP

Total Marks : 28   Time : $1\frac{1}{2}$ Hours

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

1. Answer the following questions :   1×2=2

   (a) Select the intensive property –

   (i) U (ii) H $PV = nRT$

   (iii) G (iv) C_p $\Rightarrow V = \frac{nRT}{P}$

   (b) A process is never spontaneous when –

   (i) $\Delta H > 0,\ \Delta S > 0$ (ii) $\Delta H < 0,\ \Delta S < 0$

   (iii) $\Delta H > 0,\ \Delta S < 0$ (iv) $\Delta H < 0,\ \Delta S > 0$

2. Answer the following questions (*any two*) : $\Delta S > \frac{Q}{?}$ 2×2=4

   (a) Entropy of CO is not zero at $0K$. Why ?

(b) What is inversion temperature ? Give an example of a gas which shows heating effect during adiabatic expansion.

(c) Deduce the Maxwell relationship $\left(\dfrac{\delta V}{\delta T}\right)_P = -\left(\dfrac{\delta S}{\delta P}\right)_T$.

$dg = dv + Pdv$

$du + Pdv \cdot ds -$

3. Answer *any three* of the following questions :

$6 \times 3 = 18$

(a) Define molar heat capacities at constant pressure and constant volume and deduce a relation between then for 'n' moles of ideal gases.

$2+4=6$

(b) Prove that for a reversible adiabatic proces,

$$PV^\gamma = Constant$$

Also, prove that the slope of $P-V$ curve during adiabatic expansion is steeper than that during isothermal expansion.

$3+3=6$

(c) Calculate heat (q), work done (w), internal energy change (ΔU), enthalpy change (ΔH) and entropy change (ΔS) for the isothermal reversible expansion of 5 mole of ideal gas at $27^0 C$ from $10L$ to $20L$.

6

(d) Deduce Gibb's Helmholtz Equation. Hence prove that

$$\left[\dfrac{\delta}{\delta T}\left(\dfrac{G}{T}\right)\right]_P = \dfrac{-H}{T^2}.$$

$\dfrac{dq}{dT}$

$4+2=6$

4. (a) What is Chemical Potential ? Derive different form of the Gibb's Duhem Equation.

$1+3=4$

Or

(b) Derive an expression for the chemical potential of ith component in a mixture of ideal gases.

$pv = nR^4T$ (2)

$\Rightarrow p = \dfrac{RT}{V}$

=====0=====

$G = H - TS$

2024

(November)

CHEMISTRY

Major

(*Inorganic Chemistry*)

Course Code : **MAJ-4-CHE-301**

Credit : **4**

Total Marks : 42   Time : 2 Hours

The figures in the margin indicate full marks

for the questions

1. Choose the correct answer :   1×5=5

    (a) Which of the following cannot be employed for purification of metal extracted ?

    (i) Zone refining   (ii) Van-Arkel process

    (iii) Gravity separation   (iv) Electron refining

    (b) Which of the following can act as Lewis acid ?

    (i) CO_2 (ii) NH_3

    (iii) OH^- (iv) R_2O

    (c) The chemical formula for Cyanogen is –

    (i) $(SeCN)_2$ (ii) $(SCN)_2$

    (iii) $(CN)_2$ (iv) $(SCSN_3)_2$

(d) Number of (2C–2e) bonds present in diborane is –

(i) 1   (ii) 2   (iii) 3   (iv) 4

(e) Which one of the following is the strongest acid ?

(i) $HClO$ (ii) $HClO_2$ (iii) $HClO_3$ (iv) $HClO_4$

2. (a) Which metals generally occur in their native state in nature ?

2

(b) Explain the process hydrometallurgy with suitable example.

3

(c) Write short note on (*any one*) :

4

    (i) Zone refining

    (ii) Van-Arkel process

3. (a) Answer *any two* from the following :

$2\times2=4$

    (i) What is meant by conjugate acid-base pair ? Write example.

    (ii) Define acids and bases in terms of Bronsted-Lowry concept with suitable example.

    (iii) Select the Lewis acids and bases from the following :

$$AlCl_3, \quad H^+, \quad ROH, \quad SO_3$$

(b) Answer *any two* from the following :

$3\times2=6$

    (i) Justify the following order of acidic nature of halides of Boron –

$$BBr_3 > BCl_3 > BF_3$$

(*ii*) AgI_2^- is a stable complex where as AgF_2^- is an unstable complex. Explain with reason.

(*iii*) What is the effect of polarity of solvent on relative strengths of acids and bases ?

4. (*a*) $PbCl_2$ is more stable than $PbCl_4$. Explain the reason.   2

(*b*) Name one oxyacid of Phosphorous and draw its electron-dot picture.   2

(*c*) What is catenation ? What are the conditions necessary for catention.   1+2=3
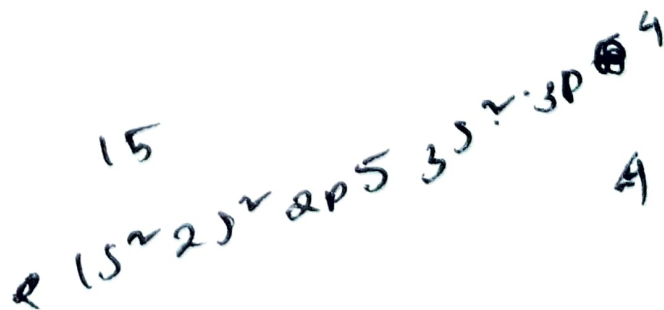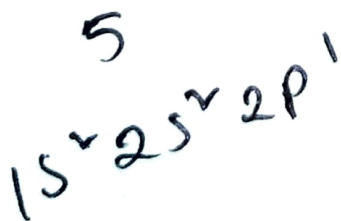
(*d*) Write three similarities between *Li* and *Mg*.   3
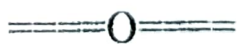
Or

Explain the structure of diamond with diagram.

(*e*) Answer *any two* from the following :   4×2=8

(*i*) How is inert pair effect related to the stability of +2 oxidation state of group-14 elements ?

(*ii*) Explain the structure of diborane with orbital diagram.

(*iii*) Write a short note on Fullerene.

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5

$1S^2 2S^2 2P^1$

15

$2 (5^2 2)^2 2p5\ 3S^2\ 3p^4$

P

(3)

2024

(Nov-Dec)

CHEMISTRY

Major

(Organic Chemistry)

Course Code : **MAJ-4-CHE-302**

Credit : **4**

NEP-CBCS

Total Marks : 42   Time : 2 Hours

The figures in the margin indicate full marks

for the questions

1. Choose the correct answer :   1×4=4

   (a)   Which of the following solvent will accelarate SN^2 reaction?

      (i) H_2O (ii) DMSO

      (iii) CH_3OH (iv) CH_3COOH

   (b)   Which product is obtained when RX is treated with $AgCN$

      (i) RCN (ii) RNC

      (iii) RNO_2 (iv) $RONO$

(c) The suitable reagent to selectively oxidise $1°$ alcohol into aldehyde is

    (i) PCC   (ii) $KMnO_4$

    (iii) $K_2Cr_2O_7$ (iv) CrO_3

(d) The stereochemistry of SN^1 reaction is

    (i) Inversion   (ii) Retention

    (iii) Recemisation   (iv) None of the above

2. Answer *any four* of the following :   3×4=12

    (a) $Me_3C - CH_2OH \xrightarrow{HCl} I + II + III$

    (b) Write down the SN^2 mechanism with stereochemistry of the product.

    (c) Explain why nucleophilic substitution in chlorobenzene is difficult.

    (d) Write down the method of preparation of an alkyl halide by Hundsdiecker reaction.

    (e) What happens when $RMgX$ and RLi react with CO_2.

4. Answer *any four* of the following :   3×4=12

    (a) How do you distinguish $1^0, 2^0$ and 3^0 alcohol by HNO_2 test?

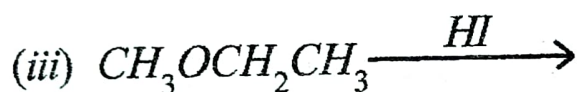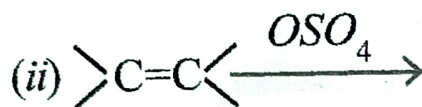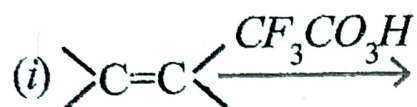   (b) Discuss Pinacol-Pinacolone reaction.

3

(c) Write short notes on : $1\frac{1}{2}\times2=3$

    (i) Reimer-Tieman reaction

    (ii) Kolbe's–Schmidt reaction

(d) Write short notes on (*any two*) : $1\frac{1}{2}\times2=3$

    (i) $>C=C< \xrightarrow{CF_3CO_3H}$

    (ii) $>C=C< \xrightarrow{OSO_4}$
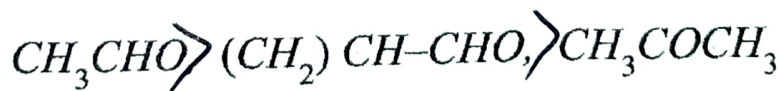
    (iii) $CH_3OCH_2CH_3 \xrightarrow{HI}$

(e) Write down the method of preparation of phenol by Cumene peroxide method.

(f) Write down the preparation pf glycerol.
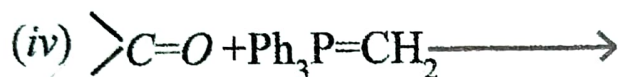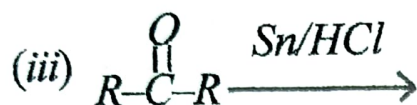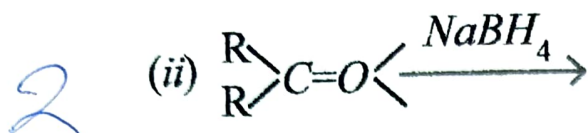
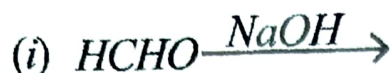4. Answer *any four* of the following : $3\times4=12$

    (a) Arrange the following compounds in order of increasing reactivity towards nucleophilic addition reaction with explanation :

$$CH_3CHO > (CH_2) CH-CHO, > CH_3COCH_3$$

(b) Complete the following reactions (*any three*): 1×3=3

(i) $HCHO \xrightarrow{NaOH}$

(ii) $\underset{R}{\overset{R}{\diagdown}}C=O\diagup \xleftarrow{NaBH_4}$

(iii) $R-\overset{\overset{O}{\|}}{C}-R \xrightarrow{Sn/HCl}$

(iv) $\diagup\diagdown C=O + Ph_3P=CH_2 \longrightarrow$

(c) Write down the mechanism of any one of the following :

(i) Aldol condensation

(ii) Cannizaro reaction

(d) Write down the preparation of the following: $1\frac{1}{2}\times2=3$

(i) Methyl Vinyl Ketone (MVK)

(ii) Acrolein

(e) Explain the two basic reactions shown by carbonyl compounds with mechanism.

5. Answer *any two* of the following : 1×2=2

(a) Write the preparation of ethyl acetoacetate.

(b) What are active methylene compounds? Write one example.

(c) Write a short note on Keto-enol tautomerism.

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(4)