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63 (FY)SEM–1/MIN1/CHMMIN1014

2024

CHEMISTRY

Paper : CHMMIN 1014

(Chemistry–1)

Full Marks : 50

Pass Marks : 20

Time : Two hours

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

1. Choose the correct answer : 1×5=5

শুদ্ধ উত্তৰটো বাছি উলিওৱা :

(a) The numbers of orbitals in the fourth principal quantum numbers will be

চতুর্থ মুখ্য কোৱান্টাম সংখ্যাত সৰ্বমুঠ কিমানটা কক্ষপথ থাকে?

(i) 4

(ii) 8

(iii) 12

(iv) 16

Contd.

(b) Which set of quantum numbers are not possible from the following ?

নিম্নলিখিত কোনটো মুখ্য কোৱান্টাম সংখ্যা সম্ভৱপৰ নহয় ?

(i) $n = 3, l = 2, m = 0, s = -\frac{1}{2}$

(ii) $n = 3, l = 2, m = -2, s = -\frac{1}{2}$

(iii) $n = 3, l = 3, m = -3, s = -\frac{1}{2}$

(iv) $n = 3, l = 0, m = 0, s = -\frac{1}{2}$

(c) Kolbe's reaction is convenient for the preparation of

ক'লব বিক্রিয়াৰ দ্বাৰা প্রস্তুত কৰিব পাৰি

(i) methane

মিথেন

(ii) alkanes containing even number of carbon atoms

যুগ্ম নম্বৰৰ কার্বন থকা এ'লকেন

(iii) alkanes containing even as well as odd number of carbon atoms

যুগ্ম আৰু অযুগ্ম সংখ্যাক কার্বন থকা এ'লকেন

(iv) alkanes containing odd number of carbon atoms

অযুগ্ম সংখ্যাক কার্বন যুক্ত এল'কেন

(d) The general formula of alkenes will be

এলকিনৰ সাধাৰণ সূত্রটো হ'ব

(i) C_nH_{2n+2}

(ii) C_nH_{2n+3}

(iii) C_nH_{2n}

(iv) C_nH_{2n-2}

(e) Which among the following is not a state function ?

নিম্নলিখিত কোনটো অবস্থাৰ কার্য্য নহয় ?

(i) Internal energy

অন্তর্নিহিত শক্তি

(ii) Free energy

মুক্ত শক্তি

(iii) Work

কার্য্য

(iv) Enthalpy

এনথালপি

2. Answer the following questions briefly : ***(any five)*** 2×5=10

তলৰ প্ৰশ্নবোৰৰ চমু উত্তৰ দিয়া ঃ *(যিকোনো পাঁচটা)*

(a) Derive the de-Broglie's relation.

ডি-ব্ৰগলীৰ সূত্ৰটো আহৰণ কৰা।

(b) State and explain the Heisenberg uncertainty principles.

হাইজেনবাৰ্গ অনিশ্চয়তা নীতিটো লিখি ব্যাখ্যা কৰা।

(c) What do you mean by Homolytic and Heterolytic fission ?

সম আৰু অসম বিভাজন বুলিলে কি বুজা ?

(d) What is Markovnikov's rule ?

মাৰ্কভনিকভৰ সূত্ৰটো কি ?

(e) What do you mean by electromeric effect ?

ইলেক্ট্ৰ'মেৰিক প্ৰভাৱ বুলিলে কি বুজা ?

(f) What is zeroth law of thermodynamics ?

তাপগতি বিজ্ঞানৰ শূন্যতম সূত্ৰটো কি ?

(g) Define Enthalpy.

এনথালপিৰ সংজ্ঞা দিয়া।

3. Answer the following questions : ***(any five)*** 5×5=25

তলৰ প্ৰশ্নবোৰৰ উত্তৰ দিয়া ঃ *(যিকোনো পাঁচটা)*

(i) Write short notes on : 2½×2=5

চমু টোকা লিখা ঃ

(a) Hund's rule of maximum multiplicity

হুণ্ডৰ সৰ্বোচ্চ গুণিতক নীতি

(b) Pauli's exclusion principle

পাউলিৰ নিষেধ নীতি

(ii) What are ψ and ψ^2 ? Write its significances ? 2+3=5

ψ আৰু ψ^2 কি ? তেওঁলোকৰ গুৰুত্বসমূহ লিখা।

(iii) Write down the Schrödinger equation and define each of the terms in it.

স্ক্ৰ'ডিনজাৰৰ সমীকৰণ লিখা আৰু ইয়াৰ প্ৰতিটো ৰাশিৰ সংজ্ঞা দিয়া।

(iv) *(a)* What do you mean by nucleophiles and electrophiles ? Give examples. 3

উদাহৰণসহ নিউক্লিয়ফাইল আৰু ইলেক্ট্ৰফাইলৰ সংজ্ঞা দিয়া।

(b) Define Inductive effect and Resonance energy. 2

আগমণিক প্রভাৱ আৰু সংস্পন্দন প্রভাৱৰ সংজ্ঞা দিয়া।

(v) Write short notes on : 2½×2=5

চমু টোকা লিখা ঃ

(a) Carbocation

কার্বকেটায়ন

(b) Carboanion

কার্বেনায়ন

(vi) Define : 1×5=5

সংজ্ঞায়িত কৰা ঃ

(a) State function

অৱস্থাৰ ফলন

(b) Path function

পথ ফলন

(c) Open system

মুক্ত তন্ত্র

(d) Close system

বন্ধ তন্ত্র

(e) Isolated system

অন্তৰিত তন্ত্র

(vii) (a) Write the differences between : 3

পার্থক্য লিখা ঃ

Reversible and irreversible process

একমুখী বিক্রিয়া আৰু উভমুখী বিক্রিয়া

(b) Define second law of thermodynamics. 2

তাপগতি বিজ্ঞানৰ দ্বিতীয় সূত্রটো লিখা।

(viii) Show that $C_P - C_V = R$ for one mole (n = 1) of an ideal gas.

আদর্শ গেছৰ একমল ($n = 1$)ৰ বাবে দেখুওৱা যে $C_P - C_V = R$ ।

4. Answer the following questions : ***(any one)*** 10×1=10

তলৰ প্রশ্নবোৰৰ উত্তৰ দিয়া ঃ *(যিকোনো এটা)*

(i) (a) What are quantum numbers? Describe the significance of all the four quantum numbers. 1+4=5

কোৱান্টাম সংখ্যা কি? চাৰিওটা কোৱান্টাম সংখ্যাৰ তাৎপর্য্য বর্ণনা কৰা।

(b) Write short notes on : 2½×2=5

চমু টোকা লিখা ঃ

(i) Saytzeff's rule

ছেইট'জেফ নীতি

(ii) Ozonolysis

অজ'ন'লাইছিছ

(ii) (a) What do you mean by Wurtz reaction and dehydro-halogenation reaction of alkyl halides? Write proper reactions. 2½×2=5

এল'কিল হেলাইডৰ বাবে উৰ্য বিক্রিয়া আৰু ডি'হাইড্র' হেল'জেনেছন বিক্রিয়া বুলিলে কি বুজা? উপযুক্ত সমীকৰণবোৰ লিখা।

(b) Write short notes on : 2½×2=5

চমু টোকা লিখা ঃ

(i) Flame temperature

শিখা উষ্ণতা

(ii) Explosion temperature

বিস্ফোৰণ উষ্ণতা

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63 (FY)SEM–3/MAJ/CHMMAJ2014

2024

CHEMISTRY

Paper : CHMMAJ2014

(Inorganic Chemistry–I)

Full Marks : 50

Pass Marks : 20

Time : Two 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 metal hare similar properties to that of Li^+ metal ion.

   (i) Be^{2+}

   (ii) Mg^{2+}

   (iii) Ca^{2+}

   (iv) Sr^{2+}

Contd.

(b) Which one is the best levelling solvent for acids—

(i) H_2SO_4

(ii) H_2O

(iii) NH_3

(iv) $(CH_3)_2SO$

(c) The molecular formula of Iodinetrichloride is—

(i) I_3Cl_9

(ii) ICl_3

(iii) ClI_3

(iv) I_2Cl_6

(d) Which straight chain polymer of silicones are used as silicones fluid

(i) 1 to 5 unit chain

(ii) 6 to 15 unit chain

(iii) 15 to 19 unit chain

(iv) 20 to 500 unit chain

(e) Which of the compouns exhibit super-conductivity at law temperature.

(i) $(SN)_x$

(ii) S_4N_4

(iii) S_2N_2

(iv) $B_3N_3N_6$

2. Answer ***any five*** of the following questions : 2×5=10

(a) Explain the clathrates compounds with at least one example of Xe-compounds.

(b) What do you mean by phosphazenes ? Explain its structure. 1+1=2

(c) Why NH_3 is consider as Bronsted-Lowry base ? Arrange NH_3, CH_3NH_2, $(CH_3)_2NH$ & $(CH_3)_3N$ 1+1=2

(d) What do you mean by pseudohalogens ? Give examples and reactions resembelance to that of halogens. 1+1=2

(e) Explain the shape of $XeOF_2$ in the light of VSEPR theory.

(f) Write short notes on polyhalides.

(g) Explain the anomalous behaviour of B with the rest members of its group.

3. Answer ***any five*** of the following questions : 5×5=25

(a) What are Boranes ? Give the preparative methods for Diborane and Explain its structure. 1+2+2=5

(b) Explain the transformation of Blue colour to Bronze colour of Metal solution in liquid NH_3.

(c) What do you mean by Allotropy ? Explain the different allotropic form of carbon.

(d) Describe the uses of the noble gases– *He, Ne, Ar, Kr* and *Xe*.

(e) What is Barazines ? How the Barazines can be prepared ? Explain its structure and give one example of its addition reaction. 1+2+2=5

(f) Explain the shape and acidic strength of ClO^-, ClO_2^-, ClO_3^- and ClO_4^- and arrange them in increasing order of their acidic strength.

(g) Describe the following recetions in liquid NH_3 solvent—

(i) Precipitation reaction

(ii) Neutralization reaction

(iii) Amphoteric behaviour

(iv) Solvolysis reaction

(v) Disproportionation reaction

(h) Draw the Frost diagram from the given Latimer diagram and predict the stability of the oxidation state of chlorine.

ClO_4^- 1.201 ClO_3^- 1.18 $HClO_2$ 1.70
$HClO$ 1.63 Cl_2 1.358 Cl^-

4. Answer the following question : ***(any one)*** 10×1=10

(a) Write short notes on the following : 5+5=10

(i) Oxy acids of nitrogen

(ii) Peroxy acids of sulphur

(b) (i) Compare the valence bond and molecular orbital treatments to understand the bonding in XeF_2. 5

(ii) What are silanes? Explain why silanes are more reactive than alkanes. 5

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Total number of printed pages – 7

63 (FY)SEM–3/MAJ/CHMMAJ2024

2024

CHEMISTRY

Paper : CHMMAJ2024

(Physical Chemistry–I)

Full Marks : 50

Pass Marks : 20

Time : Two hours

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

1. Choose the correct answer : 1×5=5

(i) A well-stoppered thermos flask contains some ice cubes. This is an example of

(a) Isolated system

(b) Open system

(c) Closed system

(d) Non-thermodynamic system

Contd.

(ii) The first law of thermodynamics is the relation between

(a) Heat and work of the system

(b) Heat, work and internal energy of the system

(c) Entropy, enthalpy and surface tension of the system

(d) Heat capacity and entropy of the system

(iii) The heat change at constant pressure q_p is equal to

(a) ΔU

(b) ΔG

(c) ΔH

(d) ΔA

(iv) What is chemical potential?

(a) Partial molar enthalpy

(b) Partial molar volume

(c) Partial molar free energy

(d) Partial molar internal energy

(v) The p^H of a solution is 4. Its $[H^+]$ is

(a) 10M

(b) 10^{-4}M

(c) 10^{-10}M

(d) 10^{-14}M

2. Answer the following questions : ***(any five)*** $2\times5=10$

(a) Show that

$$W_{rev} > W_{irr}.$$

(b) Calculate ΔH_f for methane from the following data :

$CH_4(g)+2O_2(g) \rightarrow CO_2(g)+2H_2O(l)$; $\Delta H = -890.3kJ$

$H_2(g)+\frac{1}{2}O_2(g) \rightarrow 2H_2O(l)$; $\Delta H = -285.9kJ$

$C(graphite)+O_2(g) \rightarrow CO_2(g)$; $\Delta H = -393.5kJ$

(c) Define reversible and irreversible processes.

(d) Define entropy. What is its physical significance?

(e) What is ionic product of water? How does it vary with temperature?

(f) If the molarity of an HCl solution is 10^{-8}M. Calculate the p^H of the acid solution.

(g) Show that at 298K

$pK_a + pK_b = 14$

3. Answer the following questions : ***(any five)*** 5×5=25

(a) Define giving at least one example of each of the following. 1+1+1+1+1=5

(i) an open system

(ii) closed system

(iii) state function

(iv) intensive property

(v) extensive property

(b) Define C_p and C_v. Obtain relation between C_p and C_v for ideal gas. 1+1+3=5

(c) Describe Joule-Thomson experiment. What does it prove? What is the significance of Joule-Thomson coefficient? 3+1+1=5

(d) Show that for the adiabatic process

(i) $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$ $2\frac{1}{2} + 2\frac{1}{2} = 5$

(ii) PV^{γ} = constant.

(e) Define Gibbs free energy. How is it related to work function? Derive the expression 1+1+3=5

$$\Delta G = \Delta H + T\left[\frac{\partial(\Delta G)}{\partial T}\right]_p$$

(Terms signify usual meaning)

(f) (i) State and explain the Nernst heat theorem. What is the most important application of the third law of thermodynamics? 2+1=3

(ii) Calculate q, w, ΔU and ΔH for the reversible isothermal expression of one mole of an ideal gas at 27°C from a volume 10 dm^3 to a volume 20 dm^3. 2

(g) (i) For a weak monobasic acid, show that the degree of ionization at a given temperature is inversely proportional to the square root of the initial concentration of the acid. 3

(ii) Calculate the degree of dissociation and the concentration of H_3O^+ ions in a 0.01M solution of methanoic acid at 298K. ($K_a = 2.1\times10^{-4}$) 2

(h) What is common ion effect? Explain with an example. Mention one of its application in qualitative analysis of a salt. 1+2+2=5

3. (i) What is solubility product? The solubility - product of AgCl is 1.56×10^{-10} at 298K. Calculate the solubility of AgCl in (i) pure water and (ii) in a solution of 0.1M NaCl. 1+2+2=5

4. Answer ***either*** (A) ***or*** (B) : 10×1=10

(A) (a) State how entropy will change for the following process :

(i) freezing of ethanol

(ii) dissolving glucose in water

(iii) evaporation of bromine from bromine solution at room temperature, and

(iv) cooling nitrogen gas from 373K to 273K

(b) What are the characteristics of a spontaneous process? 1+1+1+1+1=5

(c) Derive Gibbs-Duhem equation. 5

B. (a) What is buffer solution? What are the various types of it? Give an example of each type. 2

(b) What is buffer capacity? When the buffer capacity will be maximum? 1+1=2

(c) Explain the mechanism of buffer action with an example. 3

(d) Write the expressions for determination of pH of a buffer solution containing

(i) weak acid and its salt; and

(ii) weak base and its salt.

$1\frac{1}{2}+1\frac{1}{2}=3$