2020

CHEMISTRY (Honours)

Paper Code : VII - A & B

[New Syllabus]

Important Instructions for Multiple Choice Question (MCQ)

- Write Subject Name and Code, Registration number, Session and Roll number in the space provided on the Answer Script.

  Example : Such as for Paper III-A (MCQ) and III-B (Descriptive).

  Subject Code : | III | A | & | B |

  Subject Name : | |

- Candidates are required to attempt all questions (MCQ). Below each question, four alternatives are given [i.e. (A), (B), (C), (D)]. Only one of these alternatives is 'CORRECT' answer. The candidate has to write the Correct Alternative [i.e. (A)/(B)/(C)/(D)] against each Question No. in the Answer Script.

  Example — If alternative A of 1 is correct, then write :
  1. — A

- There is no negative marking for wrong answer.

মাল্টিপল চয়েস প্রশ্নের (MCQ) জন্য জরুরী নির্দেশাবলী

- উত্তরপত্রে নির্দেশিত স্থানে বিষয়ের (Subject) নাম এবং কোড, রেজিস্ট্রেশন নম্বর, সেশন এবং রোল নম্বর লিখতে হবে।

  উদাহরণ — যেমন Paper III-A (MCQ) এবং III-B (Descriptive)।

  Subject Code : | III | A | & | B |

  Subject Name : [ ]

- পরীক্ষার্থীদের সবগুলি প্রশ্নের (MCQ) উত্তর দিতে হবে। প্রতিটি প্রশ্নে চারটি করে সম্ভাব্য উত্তর, যথাক্রমে (A), (B), (C) এবং (D) করে দেওয়া আছে। পরীক্ষার্থীকে তার উত্তরের স্বপক্ষে (A) / (B) / (C) / (D) সঠিক বিকল্পটিকে প্রশ্ন নম্বর উল্লেখসহ উত্তরপত্রে লিখতে হবে।

  উদাহরণ — যদি **1** নম্বর প্রশ্নের সঠিক উত্তর **A** হয় তবে লিখতে হবে :

  1. — A

- ভুল উত্তরের জন্য কোন নেগেটিভ মার্কিং নেই।

Paper Code : VII - A

Full Marks : 10 Time : Twenty Minutes

Choose the correct answer.

Answer *all* the following questions,
each question carries 1 mark.

1. In which system both upper and lower critical solution temperature is found —

   (A) Water-triethylamine system

   (B) Water-nicotine system

   (C) Water-phenol system

   (D) Water-aniline system

2. For a binary mixture of ideal gas A and ideal gas B Gibbs free energy is minimum when —

   (A) $x_a \neq x_b$

   (B) $x_a = x_b$

   (C) $x_a > x_b$

   (D) $x_a < x_b$

3. A solution of sodium chloride shows the depression of freezing point $\left(\Delta T_f\right)_{obs} = 0.614°C$ while calculated depression of freezing point is $\left(\Delta T_f\right)_{cal} = 0.316°C$. The degree of dissociation of sodium chloride is —

   (A) 61%

   (B) 71%

   (C) 81%

   (D) 91%

4. For a process in a closed system, temperature is equal to —

(A) $\left(\frac{\delta H}{\delta P}\right)_S$

(B) $-\left(\frac{\delta A}{\delta V}\right)_S$

(C) $\left(\frac{\delta G}{\delta P}\right)_T$

(D) $\left(\frac{\delta H}{\delta S}\right)_P$

5. Which of the following 0.1 molar solutions has the lowest freezing point?

(A) urea

(B) glucose

(C) KCl

(D) Na_2SO_4

6. The correct half cell reaction for the electrode Cl^-, AgCl/ Ag is —

(A) $Ag^+(aq) + e^- = Ag(s)$

(B) $AgCl(s) + e^- = Ag(s) + Cl^-(aq)$

(C) $AgCl(s) = Ag + (aq) + Cl^-(aq)$

(D) $Ag^+(aq) + Cl^-(aq) = AgCl(s)$

7. Triple point pressure of substance A, B, C and D are 0.2, 0.5, 0.8 and 1.2 bar respectively. The substance which sublimes under standard conditions on increasing temperature is —

(A) A

(B) B

(C) C

(D) D

8. The ionic product of water at 50°C is 1.9×10^{-13}. The pH of neutral water at this temperature is —

(A) 7

(B) 6.50

(C) 6.36

(D) –6.36

9. For an ideal solution formed by mixing of pure liquids A and B —

(A) $\Delta H_{mixing} = 0$

(B) $\Delta H_{mixing} < 0$

(C) $\Delta H_{mixing} > 0$

(D) $\Delta S_{mixing} = 0$

10. For the Electrochemical cell $Zn \mid Zn^{2+} \mid\mid Pb^{2+} \mid Pb, E^0_{Zn^{2+}/Zn} = -0.762\,V$ and $E^0_{Pb^{2+}/Pb} = -0.126\,V$. The E^0_{Cell} is —

(A) – 0.888V

(B) + 0.888V

(C) – 0.636V

(D) + 0.636V

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CHEMISTRY (Honours)

Paper Code : VII - B

[New Syllabus]

Full Marks : 40 Time : One Hour Forty Minutes

The figures in the margin indicate full marks.

Answer any *four* questions taking *two* from each group.

Group - A

1. (a) Starting from the Clapeyron equation, deduce the Clausius-Clapeyron equation.

   (b) Explain the term fugacity and activity coefficient.

   (c) State the basic law that governs the solvent extraction method.

   (d) Calculate the change in free energy when two moles of H_2, three moles of O_2 and five moles of N_2 are mixed at 1 atm, 300K. Calculate ΔS_{mix} and also calculate ΔG when the pressure of the mixture is increased to 5 atm. 3+2+2+3

2. (a) Draw the phase diagram of the phenol-water system and explain the various lines.

   (b) A mixture of 50 gm of water and 40 g of phenol separate into two layers at 60°C. One layer, L_1, consists of 44.9% water by mass; the other L_2 consists of 83.2% water by mass. Calculate the total number of moles in L_1 and L_2.

   (c) Derive Duhem-Margules equation.

   (d) For a binary liquid mixture, assuming Duhem-Margules equation, derive Konowaloff's rule. 2+3+3+2

3. (a) Find the criterion for a spontaneous process in a system at constant temperature and volume and apply the condition to explain that mixing of two ideal gases at constant temperature and volume should be spontaneous. (The gases are non-reactive)

   (b) Iodine is distributed between water and benzene at 1atm. pressure with no solid iodine present. Calculate the number of phases, components and degrees of freedom, suggest variables corresponding to degrees of freedom.

   (c) Explain Eutectic point, Eutectic temperature and Eutectic composition with the help of a phase diagram.

   (d) Eutectic mixture is physical mixture not a true compound — Explain.

3+2+3+2

4. (a) Show that from an osmometric study of a polymer solution one obtains number average molecular weight.

   (b) A solution contains 1:2 ratio of masses of particles of two substances with molar masses 10,000 gm mol^{-1} and 20,000 gm mol^{-1} respectively. Determine the number average and weight average molar masses.

   (c) Derive the integrated rate equation for the condensation polymerization in the presence of an external catalyst. 4+3+3

Group - B

5. (a) Define the terms 'ionic mobility' and 'transport number' of an ion.

   (b) In a moving boundary experiment with 0.011(N) HCl solution, a current of 11.5 milliamps moved the boundary through a distance of 7.5 cm in 12 minutes. The radius of the tube is 5mm. Calculate the transport number of H^+ ion.

   (c) Why is alternating current used for the measurement of conductance?

   (d) Sketch and explain the nature of the conductometric titration curve of the displacement reaction between CH_3COONa and HCl (titrant).

2+4+2+2

6. (a) The standard reduction potential for Fe^{2+}, Fe : Pt and Sn^{4+}, Sn^{2+} : Pt at 25°C are 0.77V and 0.15V. Set up the cell, write down the cell reactions and calculate the equilibrium constant of the reaction occurring in the cell.

   (b) Discuss the physicochemical principle involved in the determination of pH of an aqueous solution by using a quinhydrone electrode.

   (c) The emf of the concentration cell with transference:

   $$\mathrm{Pt; H_2(1\,atm), HCl}\left(a_{\pm} = 0.009048\right) \mid \mathrm{HCl}\left(a_{\pm} = 0.001751\right), \mathrm{H_2}\left(1\,\mathrm{atm}\right);\ \mathrm{Pt}$$

   is 0.02802V at 25°C. The emf of the cell without transference is 0.01696V. Calculate the transference number of the H^+ ion.

   (1+1+2)+3+3

7. (a) Show that degree of hydrolysis of salt of weak acid and weak base is independent of concentration of the solution.

   (b) You are supplied two weak acids A and B of pK_a values 4.8 and 5.8 respectively. State with reasons which one you would prefer to prepare a a buffer solution of pH 5.1.

   (c) The amount (in grams) of potassium hydrogen tartarate (KHTa) which dissolve in 50 ml each of water, 0.1M KCl and 0.1M $NaNO_3$ to produce a saturated solution are S_0, S_1 and S_2. Give proper arguments to show $S_2 > S_0 > S_1$.

   (d) What kind of mean is used to express mean ionic activity. Comment on the unit of ionic activity. 3+2+3+2

8. (a) Derive thermodynamically using chemical potentials a relation between the elevation of boiling point of a dilute solution and molality.

   (b) Is it possible for a solvent in any solution to have elevation of freezing point?

   (c) Benzoic acid dimerizes when dissolved in benzene. The osmotic pressure of a solution of 5gm of benzoic acid in 100 ml of benzene is 5.73 atm at 10°C. Find the van't Hoff factor and the degree of association.

   4+2+4
