KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May 2023

Marks Scored:

Level : B.Sc./B.Pharm.
Year : I
Course : CHEM 101
Semester : II/I

Exam Roll No.:
Time: 30 mins.
F. M. : 20

Registration No.:
Date : 28 APR 2023

SECTION "A"
[20Q. × 1 = 20 marks]

Mark [×] for the most appropriate alternative from each set of choices.

1. Which one of the followings is state function?
[ ] Heat capacity [ ] Absolute entropy [ ] Heat [ ] Work-done

2. Consider the reaction X +Y = products. If the initial concentration of X is increased to four times its original value, keeping the concentration of Y constant, the rate of reaction increases fourfold. When the concentrations of both X and Y become four times their original values, the rate of reaction becomes sixteen times its original value. The observed rate law is
[ ] Rate= k $[X]^2[Y]^2$
[ ] Rate= k [X] [Y]
[ ] Rate= k [X] $[Y]^2$
[ ] Rate= k $[X]^2$ [Y]

3. An azeotropic mixture
[ ] is a compound with fixed boiling point.
[ ] has the same composition in vapour and liquid phase.
[ ] is pure solvent obtained by removing volatile solute.
[ ] can be separated into components only by fractional distillation.

4. The vapor pressure of water at 200C is 17.50 atm, what is the vapor pressure of sucrose solution if the mole fraction of the sucrose is 0.70 ?
[ ] 5.25 atm. [ ] 15.5 atm. [ ] 1 atm. [ ] 4.39 atm.

5. For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, if pressure of the system is doubled, the equilibrium constant value
[ ] doubles
[ ] becomes half
[ ] remains same
[ ] increases by four times

6. If the standard cell potential for the reaction: $Co + Ni^{++} = Co^{++} + Ni$ is 0.03V and $[Ni^{++}] = 1.0M$, $[Co^{++}] = 0.1M$ then cell potential for this is given by
[ ] +0.05V [ ] +0.04V [ ] -0.03V [ ] +0.06V

7. An acetic acid and sodium acetate buffer has pH = 5.36. The ratio of concentrations [OAc]/[HOAc] is (pKa of acetic acid = 4.76)
[ ] 6 : 1 [ ] 4 : 3 [ ] 1 : 1 [ ] 4 : 1

8. In the Arrhenius equation $\mathbf{k = A\ exp^{\left(\frac{-E_a}{RT}\right)}}$, the rate constant
[ ] increases with activation energy and temperature.
[ ] decreases with activation energy and temperature.
[ ] increases with activation energy and decreasing temperature.
[ ] decreases with increasing activation energy and increases with temperature.

9. If the equilibrium constants of the following equilibria, $SO_2(g) + 1/2O_2 = SO_3(g)$ and $SO_3(g) = SO_2(g)) + 1/2O_2$ (g) are K_1 and K_2 respectively. Which of the following relation is correct?
[ ] $K_2 = [1/K_1]^2$ [ ] $K_1 = [1/K_2]^3$ [ ] $K_2 = [1/K_1]$ [ ] $K_2 = [K_1]^2$

10. One faraday of electricity can reduce which one of the following
[ ] Three moles of Al^{+++} [ ] Half mole of Ca^{++}
[ ] One mole of Mg^{++} [ ] Three moles of Na^{+}

Fill in the blanks with most appropriate value or words.

11. A sample of an oxide of iron weighing 1.60 gm was heated in stream of hydrogen gas until it was completely converted to 1.12 gm of metallic iron, then the empirical formula of this iron oxide is..... ....

12. Greater the reduction potential value of the half-cell, greater is the tendency to be .....

13. The work done in the irreversible process is .....than the work done in the reversible process.

14. The logarithm of the reactant concentration decreases linearly as time increases in ..... order type of reaction.

15. The unit of rate constant for third order reaction is .....

16. The entropy is a measure of the number of ..... states associated with a particular .....state.

17. A solution contains indicator HIn ionizes as,
HIn (red) + H_2O = In^-(yellow) + H_3O^+. The colour of the solution at pH 1.02 would be .....

18. Non ideal solutions are formed by .....of heat.

19. The change in internal energy is numerically equal to the heat absorbed by the system when the process is carried out at.....

20. The weight of ethylene glycol, $C_2H_6O_2$ that must be included in each 1000 gms of aqueous solvent to lower the freezing point to -10°C is
..... [where, K_f for water is 1.86]

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Time : 2 hrs. 30 mins.

Course : CHEM 101
Semester : II/I
F. M. : 55

SECTION "B"

[5Q. × 6 = 30 Marks]

Attempt *ANY FIVE* questions.

1. What is the meaning of the equilibrium constant in a chemical reaction? Is the magnitude of the equilibrium constant affected by the units used to express reagent concentrations? Illustrate. [2+4]

2. Give reasonable explanations [2+2+2]
   a. Heat is not the state function.
   b. A galvanic cell cannot function without salt bridge.
   c. The reaction rate is generally less than the total collision rate.

3. Write the differences between ideal solution and non- ideal solution. Write an explanatory note on positive deviation from Raoult's Law. [2.5+3.5]

4. Define the following terms [2+2+2]
   a. Bumping
   b. Solubility product principle
   c. Colligative property

5. Define rate law and rate constant. Show that the logarithm of the reactant concentration decreases linearly as the time increases for the first-order kinetics. [2+4]

6. a. Define the term "entropy change". Derive the expressions for the entropy changes for the ideal gases with temperature and volume changes. [1+2]

   b. Prove that LnK is a linear function of 1/T when ΔH^0 and ΔS^0 are constant and independent of temperature. [3]

7. Define the term concentration cell with a suitable example. Complete and balance the following redox reactions by ion-electron method. [2+2+2]
   i. $C_6H_5CHO + Cr_2O_7^{--} \longrightarrow C_6H_5COOH + Cr^{3+}$ (Acidic medium)
   ii. $Ag_2S + CN^- + O_2 \longrightarrow S + Ag(CN)_2^-$ (Basic medium)

SECTION "C"

Attempt *ANY THREE* questions (**Q.N. 12 is compulsory**).

8. a. Define the term standard cell potential. How would you measure the emf of half-cell? Explain. [1+3]

   b. Exactly 1000 gm of a certain solution contains 100 gram of sodium chloride. The density of the solution is 1.071 gm/ml. Calculate the molality and the molarity of NaCl. [4]

9. a. Define cationic hydrolysis. Justify the statement "weaker the acid, greater will be the hydrolysis constant". [1+3]

b. What is conjugate acid base pair? Explain with suitable examples. Also point out the limitations of Lewis acid base concept. [1+2+1]

10. a. Derive the relation, $\Delta E = \Delta E^{\circ} - [0.059]/n \; logQ$, where the symbols have their usual meaning. [4]

b. Why is first law of thermodynamics unable to predict the direction of process? Define second law of thermodynamics and illustrate how it rectifies the weaknesses of the first law. [1+1+2]

11. a. A sample of europium dichloride, $EuCl_2$, weighing 1.00 gm is treated with excess aqueous silver nitrate, and all the chloride is recovered as 1.29 gm of AgCl. What is the atomic weight of europium? [4]

b. Prove that the reciprocal of a reaction rate of enzyme catalytic reaction is a linear function of the substrate concentration when the total amount of enzyme is held constant. [4]

12. Explain briefly on ANY THREE of the following [3+3+3]
   a. Mechanism of buffer action
   b. Heterogenous and homogenous catalysis
   c. Molar heat capacities
   d. Le-chatelier's principle
   e. Electrochemical theory of corrosion of iron