

KATHMANDU UNIVERSITY
End Semester Examination [C]
December, 2024

Marks Scored:

Level : B.E./B.Sc.

Year : I

Course : CHEM 101

Semester : I

Exam. Roll No. :

Time : 30 mins.

F.M. : 20

Registration No :

Date

18 DEC 2024

SECTION "A"

[20 Q. × 1 = 20 marks]

Choose the most appropriate answer and mark [X] in the box.

- Which of the following is true for the irreversible process
 $\Delta G \leq 0$ $\Delta G = 0$ $\Delta G \geq 0$ $\Delta G < 0$
- A solution contains indicator HIn, which ionizes as, $\text{HIn (blue)} + \text{H}_2\text{O} = \text{In}^- \text{(yellow)} + \text{H}_3\text{O}^+$. The colour of the solution at pH 1.02 is :
 blue yellow green intermediate colour
- The vapor pressure of water at 20°C 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
- Which of the followings is the molality of the solution if elevation of the boiling point of an aqueous solution is 0.54°C and the boiling point elevation constant for water is 0.52?
 1.038 m 0.667 m 0.445 m 0.777 m
- The total number of electrons contained in 9 gm of pure water is:
 3.011×10^{24} 3.011×10^{23} 6.023×10^{23} 3.011×10^{-24}
- If standard electrode potentials for Ni^{++}/Ni and Zn^{++}/Zn are -0.25V and -0.76V then which one is the strongest reducing agent?
 Ni Zn Zn^{++} Ni^{++}
- The sum of pH and pOH is :
 10 12 14 16
- Which one of the followings is independent of temperature?
 Rate constant Rate of reaction
 order of reaction Equilibrium constant
- Addition of sulphate ions into a solution containing Ba^{++} and SO_4^{--} in equilibrium with the undissociated salts shifts the equilibrium to a new position. At this final state,
 Ba^{++} is greater than initial concentration and SO_4^{--} is greater than initial concentration
 Ba^{++} is greater than initial concentration and SO_4^{--} is less than initial concentration
 Ba^{++} remains unchanged and SO_4^{--} is greater than initial concentration
 Ba^{++} is less than initial concentration and SO_4^{--} is greater than initial concentration

10. A solution contains 0.1 M Cl^- and $0.0001 \text{ M CrO}_4^{2-}$. Upon addition of Ag^+ ion to this solution, what is the silver ion concentration by the time Ag_2CrO_4 just begins to precipitate. (K_{sp} for AgCl 2.8×10^{-10} and K_{sp} for Ag_2CrO_4 1.9×10^{-12})
 $1.4 \times 10^{-4} \text{ M}$ $1.5 \times 10^{-5} \text{ M}$ $1.4 \times 10^{-5} \text{ M}$ $1.4 \times 10^{-6} \text{ M}$

Fill in the blanks with most appropriate value or word.

11. Relative lowering of vapor pressure of ideal solution of non volatile solute and volatile solvent is equal to _____.
12. According to IUPAC convention, the sign of work done by the surrounding on system is _____.
13. The change in enthalpy is numerically equal to the heat absorbed by the system when the process is carried out at _____.
14. The logarithm of the reactant concentration decreases linearly as time increases in _____ Order type of reaction.
15. All reactions that follow second order rate laws are not necessarily _____.
16. The minimum amount of energy that needed for a reaction in order to give product is known as _____.
17. The ratio sodium acetate and acetic acid that has to be taken in order to prepare the buffer solution of 6 pH ($K_a = 1 \times 10^{-5}$) is _____.
18. The oxidation number of O in OF_2 is _____.
19. The entropy change associated with thermodynamic expansion of 2 moles of a gas from a volume of 1 liter to a volume of 10 liters at 333 K is _____ JK^{-1}
20. 2.50 gm of NaCl dissolved in 550 gm H_2O , the resulting density of solution 0.997 gm/ml . The molarity of the solution is _____.

KATHMANDU UNIVERSITY
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Level : B.E./B.Sc.
Year : I
Time : 2 hrs. 30 mins.

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

18 DEC 2024

SECTION "B"

[5 Q. × 6 = 30 marks]

Attempt ANY FIVE questions.

1. State Le-chatelier's principle. For the reaction, $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$; $K = 55.3$ at 699 K. In a mixture that consists of 0.70 atm. of HI and 0.02 atm. each of H_2 and I_2 at 699 K, will there be any net reaction? If so, will HI be consumed or formed, justify numerically. [2+4]
2. Give reasonable explanations: [2+2+2]
 - a. Heat is not a state function.
 - b. Voltage associated with a reaction is unaffected by multiplying that reaction by a positive number.
 - c. Weighing is not the only way of counting the number of molecules in a given chemical system.
3. What are the differences between ideal solution and non-ideal solution? "When an ideal solution is in equilibrium with its vapor, the vapor is always richer than the liquid in the more volatile component of the solution". Construct an example to illustrate this fact. [2.5+3.5]
4. Deduce the Henderson's equation for acid buffer solution. Calculate the hydrolysis constant and pH of 0.625 M solution of CH_3COONa . [K_a of $\text{CH}_3\text{COOH} = 1.75 \times 10^{-5}$] [4+2]
5. Why is it necessary to express rate of reaction as time derivative of concentration? Derive integrated rate law equation for second order reaction. [2+4]
6. "A gas expands spontaneously into a vacuum". How can you justify this fact in the light of entropy? How can you relate quantitatively equilibrium constant with temperature using thermodynamic concepts available? Show the relationship. [2+4]
7. Show your familiarity with salt bridge? Complete and balance the following redox reactions by ion-electron method. [2+2+2=6]
 - i. $\text{Zn} + \text{NO}_3^- \longrightarrow \text{Zn}^{++} + \text{NH}_4^+$ (Acidic medium)
 - ii. $\text{Cu}(\text{NH}_3)_4^{++} + \text{S}_2\text{O}_4^{--} \longrightarrow \text{SO}_3^{--} + \text{Cu} + \text{NH}_3$ (Basic medium)

SECTION "C"

[25 marks]

Attempt *ANY THREE* questions. **Question No. 12 is compulsory.**

- 8.
- a. Define concentration cell. A concentration cell is constructed by placing identical Zn electrodes in two Zn^{2+} solutions. If the concentration of the two Zn^{2+} solutions are 0.01 M and 0.00001 M respectively, what is the potential of the cell? [1+3]
 - b. At 20°C, the vapor pressure of pure benzene is 22 mm, and that of pure toluene is 75 mm. What is the composition of the solution of these two components that has a vapor pressure of 50 mm at this temperature? What is the composition of the vapor in equilibrium with this solution? [4]
- 9.
- a. Define the hydrolysis. Deduce the relation, $K_h = K_w/K_a$, where the symbols have their usual meanings. [1+3]
 - b. How does Lowry-Bronsted concept help to overcome limitations of Arrhenius theory? Show your familiarity with conjugate acid base pair in the light of Lowry- Bronsted.[4]
- 10.
- a. Prove that $\ln K$ is a linear function of $1/T$ when ΔH^0 and ΔS^0 are constant and independent of temperature. For endothermic reaction, predict what happens to the value of K when $1/T$ is decreased. [3+1]
 - b. Verify that work done for the compression of ideal gas at constant temperature by reversible and irreversible process holds the relation: $W_{rev} < W_{irrev}$ [4]
- 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 weight of europium? [4]
 - b. Derive the Michaelis- Menten equation beginning with the usual two –step mechanism. [4]
12. Explain briefly on *ANY THREE* of the following. [3×3=9]
- a. Liquid Vapor equilibrium
 - b. Steady state approximation
 - c. Order and molecularity of a reaction
 - d. Electrochemical Theory of corrosion of Iron
 - e. Extensive and intensive properties