KATHMANDU UNIVERSITY
End Semester Examination
February 2023

Marks Scored:

Level : B.Pharm.
Year : I

Course : CHEM 101
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 023 Feb-12

SECTION "A"
[20Q. × 1 = 20 marks]

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

1. Given,

$NH_3(g) + 3Cl_2(g) \rightarrow NCl_3(g) + 3HCl(g) + x_1$
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + x_2$
$H_2(g) + Cl_2(g) \rightarrow 2HCl(g) - x_3$

The heat of formation of $NCl_3(g)$

[ ] $-x_1 - x_2/2 - 3x_3/2$
[ ] $x_1 - x_2/2 - 3x_3/2$
[ ] $x_1 + x_2/2 - 3x_3/2$
[ ] $x_1 + x_2/2 + 3x_3/2$

2. Which of the following salts undergo anionic hydrolysis?

[ ] $CuSO_4$ [ ] Na_2CO_3 [ ] NH_4Cl [ ] $FeCl_3$

3. The value of activation energy for a chemical reaction is primarily dependent on:

[ ] Temperature
[ ] Collision frequency
[ ] Nature of reacting species
[ ] Concentrations of reactants

4. Two gases A and B are filled in a container. The experimental rate law for the reaction between them has been found to be, Rate = K $[A]^2[B]$. Predict the effect on the rate of reaction when the pressure is doubled:

[ ] The rate becomes six times
[ ] The rate becomes eight times
[ ] The rate becomes four times
[ ] The rate becomes doubled

5. A hypothetical reaction, $X_2 + Y_2 \rightarrow 2XY$ follows the mechanism as below:

$X_2 \rightleftharpoons X + X$ (fast equilibrium)
$X + Y_2 \rightarrow XY + Y$ (slow)
$X + Y \rightarrow XY$ (fast)

The order of the overall reaction is:

[ ] 0 [ ] 1 [ ] 1.5 [ ] 2

6. For the chemical reaction,
$2C_6H_6(s) + 15O_2(g) \rightarrow 12CO_2(g) + H_2O(l)$,
At constant temperature, $\Delta H - \Delta E$ is,

[ ] + RT [ ] +3 RT [ ] - RT [ ] -3 RT

7. What is the correct representation for the solubility product constant of Ag_2CrO_4?

[ ] $[Ag^+]^2[CrO_4^{2-}]$
[ ] $[2Ag^+]^2[CrO_4^{2-}]$
[ ] $[Ag^+][CrO_4^{2-}]^2$
[ ] $[2Ag^+]^2[CrO_4^{2-}]^2$

8. 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

9. The significance of the Second Law of Thermodynamics is that for spontaneous processes
[ ] Entropy of the universe is increasing.
[ ] Entropy is the driving force of all chemical reactions.
[ ] Entropy of an ideal solid does not change.
[ ] Absolute value for entropy can be calculated.

10. The vapor pressure of water at 20 ^{0}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 [ ] 12.39 atm

Fill in the blanks with the most appropriate value or words.

11. Total number of oxygen atoms present in 10.6 gm of Na_2CO_3 is.....

12. The charge required for the reduction of one mole of $Cr_2O_7^{--}$ ion to Cr^{3+} is .....Coulombs.

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

14. The ΔE^o for the reaction $Fe(s) + Zn^{++}(aq) \rightarrow Zn(s) + Fe^{2+}(aq)$ is -0.32V. Equilibrium concentration of Fe^{++} when a piece of iron is placed in a 0.001M Zn^{++} is.....

15. ..... reaction shifts the equilibrium to the reactants side with increase in temperature.

16. In galvanic cell, reduction always occurs at.....

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

18. 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, Kf for water is 1.86]

19. If ΔH^0 and ΔS^0 are constants, LnK is a linear function of.....

20. Non ideal solutions are formed by ..... heat.

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12/ February 2023

Level : B.Pharm.
Year : I
Time : 2 hrs. 30 mins.

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

SECTION "B"
[5Q × 6 = 30 marks]

Attempt *ANY FIVE* questions.

1. State the Le-chatelier's principle. For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI\ (g)$; 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 with the help of Le-chatelier's principle. [2+4=6]

2. Give reasonable explanations.
   a. The relative lowering of vapour pressure is a colligative property? [2]
   b. The color of acid base indicator in the solution will depend on the concentration of H_3O^+. [2]
   c. Bimolecular elementary process is always second order. [2]

3. Define Raoult's law and state its application. $P_{oBenzene}$ and $P_{oToluene}$ are 22 mm and 75 mm respectively while the mole fraction of toluene in a liquid mixture is 0.33. Calculate the vapor composition of benzene and toluene. [2.5+3.5=6]

4. Define the following terms: [2+2+2=6]
   a. Azeotrope
   b. Osmotic pressure
   c. State function

5. Hydrogen and nitric oxide react according to the following equation:
   $2H_2(g) + 2NO(g) \rightarrow 2H_2O(g) + N_2(g)$
   Experimentally, it was found that the rate of reaction is first order with respect to hydrogen and second order with respect to nitric oxide.
   a. Write the rate law equation for the reaction for nitric oxide and hydrogen. [1.5]
   b. What is the unit of rate constant, K? [1.5]
   c. Why are chemists interested in obtaining order of reaction and rate equations? [1.5]
   d. Define zero order reaction and find the unit of its rate constant. [1.5]

6. a. State second law of thermodynamics. Derive an expression for the entropy changes for the ideal gases with volume changes. [1+2]
   b. Deduce the relation, Kh= Kw/Ka, where the symbols have their usual meanings. [3]

7. Show your familiarity with secondary battery with the help of lead storage cell. Also write the reaction involved during recharging of this battery. Complete and balance the following redox reaction in basic medium by ion-electron method. [2.5+1+2.5=6]

   $Al + NO_3^- \rightarrow AlO_2^- + NH_3$

SECTION "C"

Attempt *ANY THREE* questions. (**Question number 12 is compulsory**)

8. a. Define concentration cell. Two hydrogen-hydrogen half cells are connected to make a single galvanic cell. In one of the half cells the pH is 1.0, but the pH in the other half cell is not known.
The measured voltage delivered by the combination is 0.16 volt, and the electrode in the half cell of known concentration is positive. Is the unknown concentration of H^+ greater or less than 0.1M?
Calculate the unknown concentration of H^+. [1+3=4]

   b. Define the equilibrium vapor pressure of a solution. Write an explanatory note on Negative deviation from Raoult's law. [1+3=4]

9. 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]

10. a. Prove that LnK 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 increased. [3+1=4]

   b. Verify that work done for the compression of ideal gas at constant temperature by reversible and irreversible process holds the relation: Wrev < Wirrev [4]

11. a. What is Buffer solution? How will you calculate pH of acidic buffer? [1+3=4]

   b. What do you mean by solubility product? Silver ion is added to a solution that contains chloride and iodide both at 0.01M concentration. Which salt precipitates first, AgCl or AgI? Find the value of silver ion concentration when the first salt starts to precipitate. Also find the concentration of the anion of the first precipitate when the second salt just starts to precipitate. (Ksp of AgCl = 2.8×10^{-10}, Ksp of AgI=8.5×10^{-17}) [1+3=4]

12. Briefly explain *ANY THREE* of the following. [3+3+3]
   a. Liquid-vapor equilibrium
   b. Integrated rate law equation
   c. Criteria for spontaneous change
   d. Order and molecularity of a reaction
   e. Electrochemical Theory of corrosion of Iron