

**M.Sc. CHEMISTRY**  
**First Semester**  
**Analytical Chemistry**  
**(MSC - 04)**

**Duration: 3Hrs.**

**Full Marks: 70**

**Part-A (Objective) =20**  
**Part-B (Descriptive)=50**

**(PART-B: Descriptive)**

**Duration: 2 hrs. 40 mins.**

**Marks: 50**

**1. Answer the following questions (any five):**

**2 × 5 = 10**

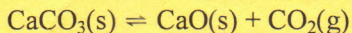
- How would you calibrate an analytical balance and a volumetric flask, explain?
- Discuss two sources of errors in sample decomposition and dissolution processes.
- Calculate the mean and median for the given data 18.4, 18.5, 18.6, 18.8, 19.1, 19.3.
- Write the difference between absolute and relative error.
- For a reaction  $A(g) + B(g) \rightleftharpoons C(g) + D(g)$ ;  $K_c = 49 \text{ mol dm}^{-3}$  at  $125^\circ\text{C}$ . Calculate  $K_p$ .
- At  $40^\circ\text{C}$ ,  $K_p$  for the reaction  $\text{SO}_2\text{Cl}_2(g) \rightleftharpoons \text{SO}_2(g) + \text{Cl}_2(g)$  is 0.029 atm. If the total pressure is 1 atm, calculate the degree of dissociation of  $\text{SO}_2\text{Cl}_2$ .
- Calculate the number of atoms present in 5.6 litres of a monoatomic gas at NTP.

**2. Answer the following questions (any five):**

**3 × 5 = 15**

- What is wet ashing? Why it is important to perform wet ashing in a fume hood?
- What is gross sample? Discuss the laboratory practices regarding the use of spatulas and recrystallization of an organic sample.
- Name different type of systematic error and how can you avoid it.
- How many significant figures are present in the following numbers?  
0.0110, 0.0104, 0.1213, 0.4000, 0.06, (1.21+1.313+0.01)

(e) Calcium carbonate undergoes thermal decomposition



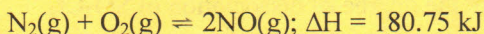
at high temperatures. The equilibrium constant for the reaction is 0.0120 at 900 K. Calculate the partial pressure of carbon dioxide,  $\text{CO}_2$ , when calcium carbonate,  $\text{CaCO}_3$ , is heated at 900 K.

- f) How many milliliter of a 0.05M  $\text{KMnO}_4$  solution are required to oxidize 2.0gm of  $\text{FeSO}_4$  in a dilute acid solution?
- g) Calculate the number of oxygen atoms and its weight in 50g of  $\text{CaCO}_3$

**3. Answer the following questions (any five):**

**5 × 5 = 25**

- a) Explain the classical and instrumental methods of analysis. Describe various numerical criteria for selecting analytical methods.
- b) What is buoyancy correction? Why buoyancy correction is important? How would you calculate the buoyancy correction, explain?
- c) Calculate the relative error in pph, if the value of absolute error is 0.2000 and the standard value of Ag in a coin is 5.000 gm. What is the value of F-test, if the value of standard deviation for set 1 and 2 is 0.05 and 0.07 respectively?
- d) The volumetric analysis of oxalic acid with  $\text{KMnO}_4$  gives the following titre value 22.62, 22.73, 22.75, 22.78, 22.83, 22.85 ml. Calculate standard deviation, mean and variance.
- e) Derive van't Hoff equation in the form  $d(\ln K_p)/dT = \Delta H^\circ/RT$ . Integrate this equation and discuss the effect of temperature on  $K_p$ .
- f) State and explain Le-Chateliers principle. With the help of this principle, work out the conditions which would favour the formation of ammonia and nitric oxide in the following reactions:



- g) A bottle of commercial sulphuric acid (density 1.787gm/ml) is labeled as 80% by weight. What is the normality of the acid? What volume of the acid has to be used to make 1 litre of 0.2M  $\text{H}_2\text{SO}_4$ ?

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*(The figures in the margin indicate full marks for the questions)*

**Duration: 20 minutes**

**Marks – 20**

**PART A- Objective Type**

**I. Choose the correct options from the following: 1×20=20**

1. Aqua regia is a mixture of concentrated HCl and HNO<sub>3</sub> in the ratio –
  - a. 1:3
  - b. 2:2
  - c. 3:1
  - d. 4:0
  
2. Concentrated hydrochloric acid is about 12 M, but on heating, HCl gas is lost until a constant boiling solution remains. What is the concentration of this solution?
  - a. 12 M
  - b. 10 M
  - c. 8 M
  - d. 6 M
  
3. *Electrical current* is the analytical signal observed in which instrumental methods?
  - a. Polarography
  - b. Conductometry
  - c. Fluorescence
  - d. Hyper Rayleigh scattering
  
4. Which one of the following is not a quantitative separation technique?
  - a. Chromatography
  - b. Distillation
  - c. Electrophoresis
  - d. Field flow fractionation

5. Which grading (quality) is the most pure chemical for laboratory purposes?
- Guaranteed Reagents (GR)
  - Extra Pure grade
  - Technical grade
  - Synthesis reagents
6. The statement "the digit zero is significant figure" is
- True
  - False
  - Both
  - None of these
7. Instrumental error is a
- Determinant error
  - Indeterminant error
  - Both
  - Gross error
8. What is the full form of ppt
- Parts per time
  - Parts per thousand
  - Parts per ten thousand
  - all the above
9. The coefficient of variation (CV) is equal to
- $S/X \times 100$
  - $S/X$
  - $S^2$
  - $S/X^{-1}$
- where S = standard deviation, X = mean
10. The mean value is also known as -
- Arithmetic mean
  - Average
  - Both
  - None of these
11. Consider the reaction  $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$  at equilibrium. The equilibrium can be shifted to forward direction by
- increasing the amount of carbon in the system
  - decreasing the volume of the system
  - decreasing the pressure of the system
  - increasing the temperature of the system
12. Chemical affinity is:
- The decrease in entropy of a reaction
  - The decrease in free energy of a reaction
  - The decrease in internal energy of a reaction
  - The decrease in heat of a reaction

13. The expression for  $K_p$  for dissociation of  $N_2O_4$  to  $NO_2$  is:
- $\frac{4\alpha^2 P}{1-\alpha}$
  - $\frac{4\alpha^2 P}{1-\alpha^2}$
  - $\frac{2\alpha^2 P}{1-\alpha}$
  - $\frac{2\alpha^2 P}{1-\alpha^2}$
14. For an ideal gas activity is:
- Numerically equal to the gas pressure
  - Proportional to the gas pressure
  - Numerically equal to the volume of the gas
  - Proportional to the volume of the gas
15. For a reaction  $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ ,  $K_p$  in SI unit is given by:
- Pa
  - $Pa^{-1}$
  - atm
  - $atm^{-1}$
16. Taring in an electronic balance is the process of -
- Setting a balance to read zero in the absence of the sample/container
  - Setting a balance to read zero in the presence of the tare
  - Setting a balance to read zero in an empty pan
  - Adjusting the display to read zero for calibration
17. Mole may be defined as
- The weight of the substance in grams which contains Avogadro number of atoms of the substance
  - The weight of the substance in grams which contains Avogadro number of molecules of the substance
  - The weight of 22.4 liters of any gas or vapours at NTP
  - All of the above
18. How many atoms of hydrogen are present in 0.8 mole of  $H_2S$ ?
- a) 2                                      b) 1.6                                      c)  $6.023 \times 10^{23}$                                       d)  $9.632 \times 10^{23}$
19. The solution whose concentration is known is called
- a) concentrated solution                      b) normal solution                      c) standard solution                      d) molar solution
20. 0.4g of NaOH dissolved in 250ml solution. The normality of the solution is
- a) 0.4N                                      b) 4N                                      c) 0.04N                                      d) 0.004N