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REV-00
MSC/23/28

2014/01

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**

(a) How would you calibrate an analytical balance and a volumetric flask, explain?
(b) Discuss two sources of errors in sample decomposition and dissolution processes.
(c) Calculate the mean and median for the given data 18.4, 18.5, 18.6, 18.8, 19.1, 19.3.
(d) Write the difference between absolute and relative error.
(e) For a reaction A (g) + B (g) $\rightleftharpoons$ C (g) + D (g); $K_c = 49$ mol dm^{-3} at 125 °C. Calculate K_p.
(f) At 40 °C, K_p for the reaction $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is 0.029 atm. If the total pressure is 1 atm, calculate the degree of dissociation of SO_2Cl_2.
g) 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**

(a) What is wet ashing? Why it is important to perform wet ashing in a fume hood?
(b) What is gross sample? Discuss the laboratory practices regarding the use of spatulas and recrystalization of an organic sample.
(c) Name different type of systematic error and how can you avoid it.
(d) 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

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

at high temperatures. The equilibrium constant for the reaction is 0.0120 at 900 K. Calculate the partial pressure of carbon dioxide, CO_2, when calcium carbonate, $CaCO_3$, is heated at 900 K.

f) How many milliliter of a 0.05M $KMnO_4$ solution are required to oxidize 2.0gm of $FeSO_4$in a dilute acid solution?

g) Calculate the number of oxygen atoms and its weight in 50g of $CaCO_3$

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 $KMnO_4$ 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:

$$N_2(g) + H_2(g) \rightleftharpoons 2NH_3(g);\ \Delta H = 99.38\ kJ$$

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g);\ \Delta H = 180.75\ kJ$$

g) A bottle of commercial sulphuric acid (density 1.787gm/ml) is labeled as 8(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 H_2SO_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_3 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?
   a. Guaranteed Reagents (GR)
   b. Extra Pure grade
   c. Technical grade
   d. Synthesis reagents

6. The statement "the digit zero is significant figure" is
   a. True
   b. False
   c. Both
   d. None of these

7. Instrumental error is a
   a. Determinant error
   b. Indeterminant error
   c. Both
   d. Gross error

8. What is the full form of ppt
   a. Parts per time
   b. Parts per thousand
   c. Parts per ten thousand
   d. all the above

9. The coefficient of variation (CV) is equal to
   a. $S/X \times 100$
   b. S/X
   c. S^2
   d. S/X^{-1}

   where S = standard deviation, X = mean

10. The mean value is also known as -
   a. Arithmetic mean
   b. Average
   c. Both
   d. 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
   a. increasing the amount of carbon in the system
   b. decreasing the volume of the system
   c. decreasing the pressure of the system
   d. increasing the temperature of the system

12. Chemical affinity is:
   a. The decrease in entropy of a reaction
   b. The decrease in free energy of a reaction
   c. The decrease in internal energy of a reaction
   d. The decrease in heat of a reaction

13. The expression for K_p for dissociation of N_2O_4 to NO_2 is:

a. $\frac{4\alpha^2 P}{1-\alpha}$

b. $\frac{4\alpha^2 P}{1-\alpha^2}$

c. $\frac{2\alpha^2 P}{1-\alpha}$

d. $\frac{2\alpha^2 P}{1-\alpha^2}$

14. For an ideal gas activity is:

a. Numerically equal to the gas pressure
b. Proportional to the gas pressure
c. Numerically equal to the volume of the gas
d. 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:

a. Pa
b. Pa^{-1}
c. atm
d. atm^{-1}

16. Taring in an electronic balance is the process of -

a. Setting a balance to read zero in the absence of the sample/container
b. Setting a balance to read zero in the presence of the tare
c. Setting a balance to read zero in an empty pan
d. Adjusting the display to read zero for calibration

17. Mole may be defined as

a) The weight of the substance in grams which contains Avogrado number of atoms of the substance
b) The weight of the substance in grams which contains Avogrado number of molecules of the substance
c) The weight of 22.4 liters of any gas or vapours at NTP
d) 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) 6.023×10^{23} d) 9.632×10^{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

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