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REV-00
MSC/94/100

2015/12

M.Sc. CHEMISTRY
First Semester
ANALYTICAL CHEMISTRY
(MSC - 104)

Duration: 3Hrs. **Full Marks: 70**

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

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

Answer any *five* of the following questions:

1. (a) (i) A standard method for determination of CO in gaseous mixture shows a standard deviation of 11 ppm CO. A new method based on 10 degrees of freedom shows a standard deviation of 14 ppm CO. The critical value F for 10 degrees of freedom is 0.60. Determine whether the new method is more precise than the standard method.

(ii) The following volumes of titrant were used in replication of a titration: 30.26, 30.24, 30.30, 30.18, 30.20 ml. Calculate the standard deviation. (2.5×2=5)

(b) (i) An acidified solution of Fe^{+2} is titrated with 0.02 (M) $KMnO_4$ solution. If the titration required 25.2 mL then how many mg of Fe^{+2} are in solution? (at. mass of Fe =55.8 g/mole) (3)

(ii) Calculate the molar concentration of Be^{+} of its 10 ppm solution. (at. mass Be =9.0 g/mol) (2)

2. (a) (i) Hydrolysis of sucrose gives, Sucrose + H_2O ⇌ Glucose + Fructose, for which the equilibrium constant K_c for the reaction is 2 ×1013 at 300 K. Calculate ΔG^0 at 300K. Also predict the spontaneity of the reaction. [Given, $\log_{10}2$= 0.303]. (3)

(ii) The value of K_C for the reaction 2 A ⇌ B + C is 2×10^{-3}. At a given time, the composition of reaction mixture is [A] = [B] = [C] = 3×10^{-4} M. In which direction the reaction will proceed? (2)

(b) Define sampling. Explain different types of weighing techniques. (5)

3. How will you clean volumetric glassware's? How will you calibrate volumetric flask and pipette? What is grab sample? Describe the ways of destruction of organic materials for inorganic analysis. (2+3+5=10)

4. (a) How can you minimize the determinate error? (2)
   (b) Write difference between accuracy and precision. (3)
   (c) Write short notes on any *two* of the following: (2.5×2=5)
   (i) Method error (ii) Instrument error (iii) Gross error

5. (a) What do you mean by a standard solution? Explain with example what is a primary standard and what is a secondary standard solution? (3)
   (b) Calculate the number of mmoles contained in 200 mg of LiCl (at. mass of Li =6.94, Cl =35.46 g/mol) (2)
   (c) Calculate the molar concentration of of Na^+ ion in a solution prepared by mixing 250 mL of 0.15 M $NaNO_3$ and 350 mL of 0.25 M Na_2SO_4 solution. (3)
   (d) What is the pc weight of Ag in 5.0g sample of Ag Cl of 90% purity? (2) (at. mass of Ag=108 g/mol)

6. (a) (i) Draw and explain the Differential thermal curve for manganese carbonate. (3)
   (ii) Give two applications of Atomic Absorption Spectroscopy. (2)
   (b) (i) What is Thermogravimetric Analysis (TGA). Explain in detail the overall working principles and the instrumentation involved in TGA. (2+3=5)

7. (a) Discuss the effect of pressure and catalyst for getting maximum yield for the following reactions – (5)
   (i) $2\ SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$; $K_c = 1.7 \times 10^{26}$
   (ii) $N_2\ (g) + 3H_2\ (g) \rightleftharpoons 2\ NH_3\ (g)$
   (iii) $H_2\ (g) + I_2\ (g) \rightleftharpoons 2\ HI\ (g)$
   (b) (i) In the reaction equilibrium, $A + B \rightleftharpoons C + D$, what will happen to the concentration of A, B and D if the concentration of C is increased? (2)
   (ii) How does the magnitude of equilibrium constant give an idea of the relative amounts of the reactants and products? The following concentrations were obtained for the formation of NH_3 from N_2 and H_2 at equilibrium at 500K. $[N_2] = 1.5 \times 10^{-2}$ M. $[H_2] = 3.0 \times 10^{-2}$ M and $[NH_3] = 1.2 \times 10^{-2}$ M. Calculate equilibrium constant. (3)

8. Explain the complete working principle involved in inductively coupled plasma atomic emission spectroscopy. Give one applications of ICP-AES. (8+2=10)

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Duration: 20 minutes **Marks – 20**

(PART A- Objective Type)

I. Choose the correct answer: **1×20=20**

1. Le-Chatelier principle is not applicable to-
   (a) $H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g)$
   (b) $N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_3(g)$
   (c) $2SO_2(g)(g) + O_2 \rightleftharpoons 2\,SO_3(g)$
   (d) $H_2(g) + Cl_2(g) \rightleftharpoons 2\,HCl(g)$

2. Inert gas has been added to the following equilibrium system at constant volume
   $SO_2(g) + \frac{1}{2}\,O_2(g) \rightleftharpoons SO_3(g)$
   To which direction will the equilibrium will shift-
   (a) Forward (b) Backward
   (c) No effect (d) Unpredictable

3. The catalytic system used for the manufacture of ammonia in Haber process is
   (a) Fe/Co (b) Fe/ Mo (c) V_2O_5 (d) Fe

4. The correct relation between Kp and Kc for the following reaction is-
   $CH_4 + H_2O \rightleftharpoons CO + 3\,H_2$
   (a) $K_p=K_c\,(RT)$ (b) $K_p=K_c\,(RT)^2$
   (c) $K_p=K_c/RT$ (d) $K_p=K_c/(RT)^2$

5. Tarring 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.

6. A typical analytical balance with a capacity of 10 g to 30 g and precision of 0.01 mg is called:
   (a) Macroanalytical balance (c) Microanalytical balances
   (b) Semi-microanalytical balance (d) None above

7. Which one of the following falls in the category of TD (To deliver) volumetric glassware's?
   (a) Volumetric flask (b) Beaker
   (c) Pipette (d) Burette

8. Number of mmol in 5.85mg of NaCl is
(a) 0.01 (b) 0.10 (c) 0.20 (d) 0.02

9. Normality of 1.06g/200mL of Na_2CO_3 is
(a) 0.1(N) (b) 0.01(N) (c) 0.125 (N) (d) 1.0 (N)

10. Number of grams required to prepare 250 mL of 0.1 (M) NaOH
(a) 0.1 (b) 1.0 (c) 10.0 (d) 4.0

11. The ppm concentration of 2.50×10^{-4} (M) Ca^{2+} is
(a) 1.5 (b) 100.0 (c) 10.0 (d) 1.0

12. For getting equivalent mass of $KMnO_4$ in acidic medium, its molar mass is to be divided by
(a) 2 (b) 3 (c) 5 (d) 6

13. In error distribution curve, more precise curve is one in whose
(a) Spread is more & height is less (c) Spread and height is more
(b) Spread is less & height is more (d) None of the above

14. Accuracy is
(a) Degree of agreement between measured value and true value.
(b) Degree of agreement between replicate measurements.
(c) Both a & b.
(d) None.

15. The median of the following:- 8, 7, 4, 9, 11, 14 is
(a) 8.5 (b) 10 (c) 11 (d) None of the above

16. The total number of significant figures in 6.023×10^{23} is
(a) 3 (b) 4 (c) 5 (d) 6

17. Which of the following is used for flame aspiration in AAS?
(a) Acetylene/ethylene (c) Ethylene/dinitrogen oxide
(b) Ethylene/argon (d) Ethylene/krypton

18. In ICP-AES the gas used to create the plasma
(a) Hydrogen (b) Argon
(c) Krypton (d) Neon

19. The ionisation of gas in AAS occurs at a potential of
(a) 200 – 300 V (b) 250 -350 V
(c) 300 -400 (d) 450 – 550V

20. Thermal stability of a catalyst can be studied with the help of –
(a) SEM (b) TGA (c) UV (d) FT-IR

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