

[A-84] SARDAR PATEL UNIVERSITY

M.Sc. (Analytical Chemistry) Examination, IIIrd Semester (CBCS)

Friday, Date: 24.04.2015

Session: Evening, Time: 2.30 p.m. to 5.30 p.m.

Course Code: PS03CANC03

Subject: Basic and thermal methods of analysis,

Total marks: 70

N.B.: i) Figure to the right indicate marks.

ii) Assume the suitable data if necessary and indicate clearly.

- Q.1.** Answer by highlighting the right option [08]
- An event which makes a DTA peak endothermic is
 - Melting
 - Oxidation
 - Absorption
 - None
 - Grams of Fe_2O_3 correspond to 1.0 g of Fe_3O_4 (Fe=56, O=16) are
 - 0.97 g
 - 1.03 g
 - 0.46 g
 - 0.69 g
 - A solvent the autoprotolysis exists in is
 - Ethanol
 - Water
 - Ammonia
 - All
 - Factor(s) affecting an acid-base indicator pH range is/are
 - Temperature
 - Solvent type
 - Presence of electrolytes
 - All
 - Iodimetry is an example of
 - Redox titration
 - Complexometry
 - Acid-base titration
 - Precipitation titration
 - FAJAN method is a kind of
 - Volumetry
 - Titrimetry
 - Argentometry
 - All
 - A metallochromic indicator among the following is
 - Eriochrome black T
 - Calmagite
 - Murexide
 - All
 - EDTA is
 - An Arrhenius acid
 - A Brønsted base
 - A Lewis Acid
 - All
- Q.2.** Attempt any Seven [14]
- State the basic principle of TG analysis. List the optimum conditions required for its efficient results.
 - State the terms 'emulsoid' and 'suspensoid', with suitable examples.
 - Illustrate the term 'feasibility'. Show how it can be affected by titrand/titrant concentration in acid-base titration.
 - State the term 'buffer capacity'. Determine buffer capacity of a solution which is 0.1 F in HOAC and 0.1 F in NaOAC. HOAC is a weak acid and its $K_a = 1.75 \times 10^{-5}$.
 - What do you understand by argentometric titration? Draw and discuss 'pX Vs AgNO_3 ', as characteristic titration curves, where X = Cl or Br or I.
 - What is Nernst equation? Calculate the equilibrium constant of a redox reaction; $\text{Fe}^{2+} + \text{Ce}^{4+} \leftrightarrow \text{Fe}^{3+} + \text{Ce}^{3+}$
[$E^\circ_{\text{Fe}^{3+}} = +0.771$ Volt, $E^\circ_{\text{Ce}^{4+}} = +1.61$ Volt]

- vii) Illustrate 'effective stability constant (K_{eff})'. Calculate K_{eff} of Ca-EDTA complex at 10 pH [$K_f = 5.0 \times 10^{10}$ and $\alpha_4 = 0.35$].
- viii) State the basic principle of complexometric titration.
- ix) Identify principal conjugate acid/base pair in H_2S in water, and calculate value of the ratio between them, buffered at pH 9. [$K_{a1} = 9.6 \times 10^{-8}$, $K_{a2} = 1.3 \times 10^{-14}$]

- Q.3.** a) What do you understand by supersaturation? State its role in precipitation process. Discuss ways of controlling relative supersaturation 'Q-S/S', during precipitation. [06]
- b) Define 'specific surface area (SSA)'. A solid cube with 3.0 g weight was divided into 10^6 smaller cubes. If SSA of smaller cube is $200 \text{ cm}^2/\text{g}$, calculate SSA of the original solid cube. [06]

OR

- Q.4** b) Classify thermal analysis techniques. Write a note on DTA. [06]
- a) A 50.00 mL, 0.1M weak acid ($K_a = 1.0 \times 10^{-5}$), HA, solution was titrated against 0.1M NaOH solution. Construct the theoretical titration curve, considering and calculating pH at least at five increment additions of titrant before and after the equivalence point. Comment on shape of curve. [06]
- b) Derive the equation of pH for a dibasic acid monosodium salt, NaHA, in water. [06]

OR

- b) State the term 'indicator pH range'. Calculate the pH range, suppose 50 mL, 0.05 F formic acid is titrated against 0.1F KOH solution so that titration error remained $\pm 0.05 \text{ mL}$ [$K_a = 1.57 \times 10^{-4}$].
- Q.5.** a) Answer the following [06]
- i) Derive balanced chemical equation for a redox reaction $\text{MnO}_4^- + \text{VO}_2^- \leftrightarrow \text{Mn}^{2+} + \text{V}(\text{OH})_4^{1+}$ in acidic medium.
- ii) Define 'formal potential' and discuss its significance.
- b) Discuss in brief ways of detecting redox titration end point. Write a note on redox indicators. [06]

OR

- b) Describe in brief general principle of precipitation titration. Write a note on Mohr's method.
- Q.6** a) State masking and de-masking, in complexometry. Suggest systematic determination of metal ions presence in a mixture that contains Zn^{2+} , Pb^{2+} and Cu^{2+} , using this concept. [06]
- b) Discuss at least three different ligands, used as titrants in complexometric titration. [06]

OR

- b) Define titration error. A 50.00 mL, 0.100 M Mg^{2+} solution was titrated against 0.10 M EDTA solution, using EBT as an indicator, at pH=10. Calculate pMg value corresponding to color-shift range of indicator, and titration error [$\alpha_4 = 0.35$, $K_{f(\text{Metal-EDTA})} = 4.9 \times 10^8$, $K_{f(\text{Mg-Indicator})} = 1.0 \times 10^7$, $K_{a3(\text{Indicator})} = 2.5 \times 10^{-12}$].