SEAT No._____

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[35]

SARDAR PATEL UNIVERSITY

M.Sc. Semester-III: Analytical Chemistry **Examination** (CBCS)

JAN-**2021, Date:** 04.01.2021

Mon**day, Time:** 10.00 a.m. to 12 Noon

Paper Code: PS03CANC23

Subject: Classical 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(a) Attempt MCQs below highlighting correct option [08]

i) To what weight of Cl the 0.204 g of AgCl(s) would correspond? [FW of AgCl = 143, AW of Cl = 35.5]
a) 0.0506 g **b)** 50.6 mg
c) Both a) and b) **d)** 500 µg

ii) Melting is an endothermic process, one can detect through
a) DSC **b)** DTA
c) Both a) and b) **d)** TG

iii) The pH value of 0.04 M H_2SO_4 solution will be around..
a) 1.33 **b)** 1.40
c) 1.10 **d)** 2.00

iv) Which of the following is known to form Zwitter ions in water
a) Glycine **b)** Ascorbic acid
c) Glucose **d)** Pyridine

v) Acid-base indicators are..
a) Weak electrolytes **b)** Strong electrolytes
c) Both a) and b) **d)** Not electrolytes

vi) Identify redox-indicator(s)
a) Ferroin **b)** Diphenyl amine
c) Diphenylbenzidine **d)** All

vii) EDTA (H_4Y) at pH 10 dissociates in water dominantly into
a) H_4Y **b)** H_2Y^{2-}
c) Y^{4-} **d)** H_3Y^{-}

viii) Identify the indicator used in Volhard method
a) Fe^{3+} ions **b)** CrO_4^{2-} ions
c) $Cr_2O_7^{2-}$ ions **d)** None

Q.1(b) Answer [16]

i) Colloids are charged particles! True or False?
ii) Surface adsorption is endothermic process! True or False?
iii) Lower degree of RSS promotes high nucleation rate! True or False?
iv) Occlusion is a non-equilibrium process! True or False?
v) Calculate the pH of water at 100 ° C (Kw = $4.9X10^{-13}$, 100 ° C)
vi) Calculate theoretical pH range of an indicator having pKa value 6.
vii) Name the indicator used to monitor diazotization titrimetry
viii) Show the structural rearrangement of phenolphthalein indicator responsible for its color change
ix) Name the property to be monitored in the redox titrimetry.
x) Name the enzyme in starch forming unstable blue color complex with I_3^-

[P.T.O.]

xi) $KMnO_4$ and $K_2Cr_2O_7$ are colored substances due to common K^+ ion is present in both! True or False?
xii) Name at least two reducing agents used in redox titrations.
viii) Give indicator reaction associated to Mohr's method
xiv) Give the chemical reaction associated with Lie-big method.
xv) Name the masking agent for Zn^{2+} ion in complexometry.
xvi) FAJAN indicator works through the principle of _____

Q.2 Answer in brief, ***any seven*** [14]

i) Draw characteristic shapes of the TG curve, with their correct interpretations
ii) State gravimetric factor giving suitable example
iii) State the terms autoprotolysis and autoprotolysis constant
iv) If a weak base is titrated against strong acid, draw the shape of the theoretical titration curve 'pH Vs volume of the titrant'
v) Calculate isoelectic point of glycine in water [pKa, pKb and pKw are 9.69, 11.69 and 14 respectively]
vi) Distinguish between the terms 'iodometry' and 'iodimetry'
vii) If Ka_1, Ka_2, Ka_3 and Ka_4 are step-wise dissociation constants of EDTA, then arrange them in increasing order of their values
viii) Ammonia is a best auxiliary reagent for EDTA titration of metal ions at higher pH! Explain
ix) XM $AgNO_3$ and XM NaCl solutions were mixed together in equal volumes. Calculate pCl considering Ksp(AgCl(s)) is equal to $1x10^{-10}$

Q.3 Answer the following

a) Define the specific surface area (SSA). A solid cube weighing 2.0 g is 1.0 cm^3 in the volume. If the cube is divided into 1000 small cubes, calculate SSA of original and smaller cubes both. Comment on values of SSA of these cubes. [08]

b) List varied types of co-precipitation process, and describe any of them in detail.

OR

Q.3 How will you analyze a mixture containing $CaC_2O_4H_2O$, $SrC_2O_4H_2O$ and $BaC_2O_4H_2O$ thermogravimetrically? Explain

Q.4 Answer the following

a) State the Pearson rule for hard acid-base substances. Comments on the feasibility of the reactions below [08]
I. $LiI + CsF \leftrightarrow LiF + CsI$, II. $Ag^+ + 2F^- \leftrightarrow AgF_2^-$ and
III. $CuI_2 + 2CuF \leftrightarrow CuF_2 + 2CuI$

b) Write self ionization reactions occurring in pure ethanol. Show the reactions involved in the dissociation of benzoic acid and sodium ethoxide in pure ethanol

OR

Q.4 Derive simple and quadratic equations of $[H_3O^+]$ for the weak acid HA solution in water. Calculate pH of 0.001 M solution of this acid (Ka = $1X10^{-4}$) in water using these equations. Comment on the results.

Q.5

a) Derive the balanced chemical reaction if a pair of two half redox reactions; $Fe^{2+} \rightarrow Fe^{3+}$, and $MnO_4^- \rightarrow MnO_2$ exists in the basic medium. [08]

b) Calculate 2nd equivalence point pH of the titration where 50

mL 0.1M acid H_2A solution is titrated against 0.1M NaOH soln. [Ka_1=1.2X10^{-2}, Ka_2= 6X10^{-7}, Kw = 1X10^{-14}]

OR

Q.5 State Nearnst equation and its significance. 50 mL of 0.1F Fe^{2+} solution was mixed well with 50 mL of 0.1M Ce^{4+} solution. Calculate the electrode potential E of the resulting mixture [E^o_{Ce4+} = 1.44 V, E^o_{Fe3+} = 0.77 V].

Q.6 Answer the following [08]

a) State effective stability constant with a suitable example. The formation constant Kf of Ca-EDTA complex is 5.0X10^{10}. The α_4 value of EDTA is 0.35 at pH 10. Calculate K_{eff} of this complex.

b) Write a note on metallochromeic indicators.

OR

Q.6 Calculate the pMg range for the color-shift of EBT (H_3In) indicator at pH 10, if 50 mL of 0.1 M Mg^{2+} solution is titrated against 50 mL of 0.1M EDTA (H_4Y) solution.
[Use $K_3(H_3In)$ = 2.5X10^{-12} and $Kf(MgIn^-)$ = 1.0X10^7 at pH 10].

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