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MCH–001

POST GRADUATE DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

December, 2024

MCH-001 : BASIC ANALYTICAL CHEMISTRY

Time : 3 Hours *Maximum Marks : 75*

Note : *(i) Answer **five** questions in all. Question No. **1** is compulsory.*

(ii) All questions carry equal marks.

1. Answer any ***five*** of the following :

   (a) Define types of errors giving an example for each. 3

   (b) Define standard deviation, relative standard deviation and standard deviation of mean with mathematical formulations. 3

(c) Write down the equation for rate law of first order reaction and draw the plot for its rate curve. 1+2

(d) Draw structures of phenolphthalein or methyl orange indicator in benzenoid and quinoid forms. 3

(e) Explain the oxidizing nature of potassium permanganate ($KMnO_4$) and potassium dichromate ($K_2Cr_2O_7$) in acidic medium, giving chemical equation. 3

(f) Define coprecipitation and post-precipitation giving an example for each of the two. 3

(g) Differentiate between spectrophotometer and flame photometer and their role in chemical analysis. 3

2. (a) Classify nuclear analytical methods describing property measured. 5

(b) What are various modern methods of separation ? Explain any *one* of these briefly. 5

(c) Define significant figures and explain these with a suitable example. Why is rounding off important ? A student reported 2.367, 46.823 and 178.5, find the sum to one decimal place. 2+1+2

3. (a) What are criteria for the rejection of data ? Write 4d rules. In replicate analysis of Cu in bronze, its % was found to be 52.40, 52.47, 52.50, 52.51 and 52.46. Should any of data be rejected ? 1+2+2

(b) Explain control chart with illustration. Discuss its importance in the evaluation of analytical data. 2+1+2

(c) Define the terms Suspended Particulate Matter (SPM) and PM_{10} and types of suspended particulate matter and give their sources. 2+3

4. (a) Explain various possible ways in which chemical exposure can occur. What are the effects of following chemicals on our body– acids, alkalies, cyanides and mercury ? 3+2

(b) Enumerate any *four* reaction rate measurement methods. What are the advantages of differential methods ? 2+3

(c) What are various detection systems used in kinetic measurements ? Write down *three* basic components of the detection system used in kinetic measurements. 2+3

5. (a) Define polyprotic acids with examples for di and triprotic acids. Derive an expression for the determination of $[H_3O]^+$ for a typical diprotic acid. 2+3

(b) Write names of any *four* indicators commonly used in acid-base titrations. Derive an expression for pH using Ostwald's theory of indicators. 2+3

(c) Define equivalence point. Draw nature of titration curve for weak acid and strong base considering suitable example and explain. Name the indicator used. 1+3+1

6. (a) Discuss the role of solvents in acid-base reactions in terms of Bronsted-Lowry

concept considering suitable example. Name *two* indicators used. What will be conjugate acid-base pair for the reactions of HCl and H_2O ? 3+1+1

(b) What is Hammett's acidity function ? 5

(c) What are Redox indicators ? Write Nernst equation for the indicator half cell. Name the indicator used in titration of iron(II) with Ce(IV). 5

7. (a) What are metallochromic indicators ? Name the indicator used in complexometric determination of hardness of water and explain mechanism of its colour change in different pH ranges. 1+2+2

(b) Complete the following reactions : 3+2

(i) $Ag^+ + SCN^- \rightarrow$ .....

(ii) $AgCl + SSN^- \rightarrow$ ..... + ...

(iii) $Fe^{3+} + SCN^- \rightarrow$ .....

Explain the working of adsorption indicators with example.

(c) What is Mohr's titration ? Explain how end point equilibrium is calculated in Mohr's titration with complete chemical equations. 2+3

8. (a) Differentiate between coprecipitation and post-precipitation. Which one of the cations, Na^+, K^+, Ca^{2+} and Cu^{2+} is likely to be coprecipiated with $BaSO_4$ ppt ? 5

(b) Classify reactions identified with organic reagents used as precipitants. Write some advantages and disadvantages of organic precipitants. 3+2

(c) Write briefly about the development of Atomic Absorption Spectrophotometry (AAS) and its basic principle responsible for the determination of elements. 5

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