

POST GRADUATE DIPLOMA IN
ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

June, 2023

MCH-001 : BASIC ANALYTICAL CHEMISTRY

Time : 3 Hours

Maximum Marks : 75

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

(ii) All questions carry equal marks.

1. Answer any *five* of the following :
- (a) An analyst obtained Mn content in a steel sample, 1.59% compared to actual value 1.43%. Calculate absolute error and % relative error. 3
- (b) State 4d rule and explain how an experimental data is rejected. 3

- (c) What is the colour code adopted for various hazardous materials ? 3
- (d) Define buffer solution. Explain its constituents. 3
- (e) Draw the structure of EDTA indicating hexadentate positions. Why is it tetrabasic in nature ? 3
- (f) Explain Mohr's titration and name the indicator used. 3
2. (a) List any *five* classical and modern separation methods explaining essential features of any *two* of these briefly. 5
- (b) Explain significant figures considering a suitable example. What are significant figures in the following numbers : 5
- 20.57, 0.478 and 0.0890

- (c) What are the main steps followed while analyzing a sample and explain any *two* steps in brief. 5
3. (a) Explain control chart with illustration and discuss its significance in quality control of analytical data. 5
- (b) Explain different types of water samples. 5
- (c) What are the characteristics of adsorbents ? Discuss the factors affecting adsorption. 5
4. (a) Explain all the classes of hazardous materials briefly. 5
- (b) Derive the rate law of first order reaction and its half-life. Draw the nature of rate curve for first order reaction. 5
- (c) What are enzyme catalyzed reactions ? Explain briefly how rate of such reaction is determined by steady state condition. 5

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5. (a) Explain the terms 'autoprotolysis' and 'levelling effect' considering the examples of C_2H_5OH , acetic acid and NH_3 for autoprotolysis and of HCl and HNO_3 in methanol for levelling effect. 5
- (b) Draw the structures of phenolphthalein and methyl orange in acid and base forms according to quinonoid theory. Also write their pH ranges along with colour in acidic and alkaline forms. 5
- (c) Describe the requirements of a primary standard with suitable examples of primary and secondary standard. Explain how a primary standard differs from a secondary standard. 5
6. (a) Define buffer capacity with mathematical expression. Draw the variation plot of buffer capacity with $\log \frac{C_{NaA}}{C_{HA}}$ and explain. 5

[5]

MCH-001

(b) What is Bronsted-Lowry concept of acids and bases ? In what respects, it is an improvement over Arrhenius theory ? Explain how it can be used for titration of non-aqueous solvents by considering any *two* non-aqueous solvents. 5

(c) Explain with a suitable example, how a redox reaction can be represented as two half reactions. Define redox potential. 5

7. (a) Define cell potential and develop a suitable Nernst equation. Calculate electrode potential of half cell containing an aqueous solution of 0.1 M KMnO_4 and 0.1 M MnCl_2 at pH = 1.00. Given that : 5



$$E^\circ = +1.52 \text{ V}$$

(b) Derive an expression for redox equilibrium constant considering number of electrons exchanged are same. 5

P. T. O.

[6]

MCH-001

(c) Write down chemical characteristics of EDTA and show its successive dissociation in four stages with equilibrium constants. 5

8. (a) Explain precipitation titration with difficulties encountered therein. Draw the curve for the precipitation titration of NaCl with AgNO_3 . 5

(b) How do coprecipitation and post-precipitation differ from each other ? Which one of Na^+ , Ca^{2+} and Cu^{2+} will be coprecipitated with BaSO_4 ppt. 5

(c) Explain the difference between colorimeter, photometer and spectrophotometer. In what respects these differ from flame photometer ? 5

MCH-001