**MCH-001**

# POST GRADUATE DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

## Term-End Examination

## December, 2020

### MCH-001 : BASIC ANALYTICAL CHEMISTRY

*Time : 3 Hours*                *Maximum Marks : 75*

**Note** : *(i)  Answer any **five** questions.*

   *(ii)  All questions carry equal marks.*

1.  (a)  What are thermal methods of analysis ? How are these classified ? Explain any ***one*** of these briefly.        5

   (b)  What are the various types of errors ? Explain their sources and minimization of errors.        5

(c)   Define accuracy and precision. How would you differentiate between these ? Explain with the help of a suitable example.          5

2.   (a)   Define standard deviation ($\sigma$) and relative standard deviation. Consider a set of data 31.2, 30.7, 32.5, 31.9, 33.5 and 32.7. Calculate $\sigma$ and RSD.          5

(b)   What do you understand by control chart ? Explain with the help of a plot.          5

(c)   Discuss the various types of samples and sampling facilities including containers used for collecting water sample for analysis.          5

3.   (a)   Describe the methods used for air sampling briefly with emphasis on gaseous pollutants.          5

(b)   What are hazardous materials ? How are these classified ? Write the colour codes used for identification for these materials.

5

(c) Write briefly about various emergency procedures followed in a chemical laboratory with emphasis on chemical and thermal burns.                    5

4. (a) Explain Student's $t$-test. If the mean conc. of Mn in a sample is 112.8 ppm compared to its accepted value of 113.5 ppm and $t_{Tab} = 4.60$ for 5 determinantions, then calculate $t$ value and compare it with $t_{Tab}$.

5

(b) Derive an equation for rate law of first order reaction and draw the plot between concentration of analyte [A] and time $t$. If rate constant $k = 0.038$ s$^{-1}$, then calculate $t_{1/2}$ of the reaction.                    5

(c) Explain logarithmic extrapolation method with the help of a typical plot and discuss its advantages.                    5

5. (a) How are solvents classified on the basis of their proton donor-acceptor properties ? Explain with suitable examples for each and define leveling effect.                    5

(b) Define buffer solution and buffer capacity. Calculate buffer capacity of 0.1 M $CH_3COOH$ and 0.1 M $CH_3COONa$. Given that pKa for $CH_3COOH$ is 4.75.      5

(c) Draw the titration curve for the titration between $CH_3COOH$ and NaOH. Explain equivalence point on the curve and show how pH at this point is calculated.      5

6. (a) Define indicators and explain modern Quinoid theory by considering the examples of methyl orange and phenolphthalein showing their structures in acids and bases. Mention the colour changes in both the cases.      5

(b) Write down the Nernst equation for the reaction :

$$Cr_2O_7^{2-} \rightarrow 2\,Cr^{3+} \quad E° = +1.33$$

Explain all the terms and also why does potential depend on pH of solution.      5

(c) What are metallochromic indicators ? What is the principle of their action ?      5

7. (a) Explain Fajan's method for the determination of $Cl^-$ ions. In what way is it different from Volhard's method ?        5

   (b) Explain the importance of digestion of precipitate with the mother liquor. Indicate if digestion of $PbSO_4$ precipitate with the mother liquor will improve its quality. Explain your answer.        5

   (c) Briefly describe various methods of electro-analytical analysis. What are the various types of electrodes used in each case.        5

8. Write brief notes on any *five* of the following :                    3 each

   (a) NMR spectroscopy

   (b) Radioactive substances

   (c) Ostwald's theory

   (d) Electrochemical cell

   (e) Organic precipitant

   (f) Role of computers in analytical chemistry

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