ASSIGNMENT BOOKLET

Post Graduate Diploma in Analytical Chemistry (PGDAC)

Basic Analytical Chemistry	**(MCH – 001)**
Separation Methods	**(MCH – 002)**
Spectroscopic Methods	**(MCH – 003)**
Electroanalytical & Other Methods	**(MCH – 004)**

(Valid from January 1, 2020 to December 31, 2020)

It is compulsory to submit the assignments before filling in the examination form.

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2020)

Dear Learner,

This assignment booklet consists of the tutor marked assignments (TMAs) of MCH-001, MCH-002, MCH–003 and MCH–004 courses of the Post Graduate Diploma in Analytical Chemistry (PGDAC) programme.

We hope, you are familiar with the system of evaluation to be followed for this programme. You may probably like to re-read the section on assignments in the Programme Guide that was sent to you earlier. As you are aware, a weightage of 30 percent has been earmarked for continuous evaluation component. For this you have to submit the responses of the enclosed tutor marked assignments to the Study Centre Coordinator. The assignments are based on the content of all the blocks of all the courses.

Before attempting the assignment, please read the following instructions carefully.

1 On top of the first page of your assignment response, please write the details exactly in the following format; write your answers from second page onwards.

ENROLMENT NO. : ……...

NAME **:** ……

ADDRESS **:** ……...

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COURSE CODE **:** …….

COURSE TITLE **: ……..**

STUDY CENTRE **: ……..…** **DATE : ……...**

(NAME AND CODE)

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2 Use only foolscap size paper (but not of very thin variety) for writing your answers.

3 Leave about 4 cm margin on the left, top and bottom of your assignment response sheet.

4 Your answers should be precise.

5 While writing answers, clearly indicate the Question No. and part of the question being solved.

6 Though the validity of assignment is for one year, we advise you to submit the assignment response within 12 weeks after receiving it.

7 **We strongly suggest that you should retain a copy of your assignment responses.**

Wishing you good luck.

TUTOR MARKED ASSIGNMENT
MCH-001: Basic Analytical Chemistry

Course Code: MCH-001
Assignment Code: MCH -001/TMA/2020
Maximum Marks: 100

Note: Answer all the questions given below.

1. Derive the rate law for a second order reaction. Also derive the rate law for a pseudo first order reaction. (5)

2. Calculate the $[OH^-]$ of 0.20 M Na_2CO_3 (K_w = 1. X 10^{-14}), K_1 = 2.1 x 10^{-7} and K_2 = 2.4 x 10^{-11} for H_2CO_3. (5)

3. Draw the pH titration curve of a weak acid and a strong base and explain it. (5)

4. What are non-aqueous titrations? Give two examples. (5)

5. What is error? Explain the sources of determinate error. (5)

6. What is the difference between accuracy and precision? Explain with suitable examples. (5)

7. Explain the following terms in 2-3 lines: (5)

   i) Mean ii) Mode iii) Deviation iv) Average deviation v) Probable deviation

8. Give brief introduction of different electrical methods of analysis. (5)

9. Describe the applications of precipitation titrations. (5)

10. How would you minimize the co-precipitation? Explain. (5)

11. Describe the advantages and the disadvantages of organic precipitants. (5)

12. Discuss the role of computer in analytical instruments. (5)

13. What is a hazardous substance? Outline the precautions to be observed while transporting larger amounts of hazardous chemicals in the laboratory. (5)

14. Discuss the safety measures to be followed for effective running of a Chemistry laboratory. (5)

15. Show that the potential range of the colour change for a redox indicator can be given as $E^0_{ox/red} \pm 0.059/n\ V$. (5)

16. A half cell containing nickel metal in contact with 0.08 M solution of Ni^{++} ions is coupled with another half cell having silver metal in contact with 0.001 M solution of Ag^+ ions. (5)

    i) Write the cell equation ii) Represent the cell so obtained

    iii) Calculate E^0_{cell} for the cell. Given: $E^0(Ag^+/Ag) = 0.80\ V$; $E^0(Ni^{++}/Ni) = -0.25\ V$

17. Discuss different factors affecting stability of metal-ligand complexes. (5)

18. Explain the effect of the presence of other complexing species on the complexometric titrations. (5)

19. With the help of an example describe Null Hypothesis. (5)

20. Describe the preservation of nutrient and organic groups for the analysis of water samples. (5)

TUTOR MARKED ASSIGNMENT
MCH-002: Separation Methods

Course Code: MCH-002
Assignment Code: MCH -002/TMA/2020
Maximum Marks: 100

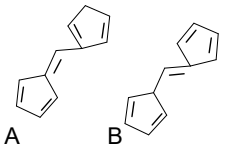
Note: Answer all the questions given below.

1. Briefly explain various methods of separation which are based on partition. (5)
2. What is the basis of classification of separation methods involving rate processes? List various methods classified under these separations. (5)
3. State distribution law and discuss its limitations. (5)
4. Discuss important aspects of extractions involving carboxylic and sulphonic acids. (5)
5. How does the presence of salting out agents affect the solvent extraction? Illustrate with suitable example. (5)
6. Define chromatography. Briefly explain the basis on which various chromatographic techniques can be classified. (5)
7. Explain van Deemter plot. How can zone broadening be reduced? (5)
8. What type of stationary phases can be used in liquid-solid column chromatography? Explain giving suitable examples. (5)
9. Define R_f. What factors influence the R_f values? Explain. (5)
10. Briefly explain the interaction forces which can aid in GC separations. (5)
11. Discuss the application of gas chromatography in environmental analysis. (5)
12. List the advantages of HPLC. (5)
13. What is meant by the selectivity of a resin? How do the valence and nature of exchanging ions affect the exchange process? (5)
14. Briefly explain the separation of actinide elements using ion exchange chromatography. (5)
15. Discuss the salient features of agrose gels giving their advantages and disadvantages. (5)
16. Discuss the application of size exclusion chromatography in the determination of molecular masses of proteins. (5)
17. What is Knudsen flow? Give its one important use. (5)
18. How are osmosis and reverse osmosis different? Briefly explain the parameters on which reverse osmosis process is evaluated. (5)
19. What are the instruments and reagents used in DNA gel electrophoresis? (5)
20. Briefly explain capillary electro-chromatography (CEC). Also discuss its advantages. (5)

TUTOR MARKED ASSIGNMENT
MCH-003: Spectroscopic Methods

Course Code: MCH-003
Assignment Code: MCH-003/TMA/2020
Maximum Marks: 100

Note: Answer all the questions given below.

1	a) Describe in brief the observations that led to the quantum model of electromagnetic radiation.	(5)
	b) What is Boltzmann statistical distribution? Calculate the population of an energy level having energy of 5 kJ moL^{-1} relative to the energy at ground state at 290°C .	(5)
2	a) Describe the origin of a UV-VIS spectrum.  Which out of A and B is expected to absorb at higher wavelength in a UV visible spectrum? Also give the type of transition shown by these molecules.	(5)
	b) What is the purpose of monochromators in UV-VIS spectrometers? Describe in brief the two types of monochromators used in these instruments.	(5)
3.	a) Why IR spectroscopy is called vibrational spectroscopy? Explain the harmonic and anharmonic oscillators.	(5)
	b) Compare the dispersive and Fourier transform infrared spectrophotometers.	(5)
4	a) Explain how the Raman spectral intensities be enhanced.	(5)
	b) What is the significance of Frank- Condon principle? Explain.	(5)
5.	a) How does the structure of molecules affect photoluminescence? Explain with the help of examples.	(5)
	b) Compare the direct and indirect methods of analysis by fluorescence.	(5)
6.	a) Describe the method of determination of blood glucose by fluorimetry.	(5)
	b) List the parameters characteristic of an atomic spectrum. Explain the effect of any one.	(5)
7.	a) What is a nebuliser in flame photometry? Enlist nebulisation methods and describe one of these.	(5)
	b) Describe in brief the excitations sources used in atomic fluorescence.	(5)
8.	a) Name the burners used in atomic absorption spectrophotometry and give their advantages and disadvantages.	(5)
	b) Explain the role of ICP torch in atomization-excitation process in atomic emission spectrometry.	(5)
9.	a) Write the process of determining lead as environmental contaminant and mercury as a pollutant in water using atomic absorption spectrophotometry.	(5)
	b) Write the theory of NMR spectroscopy and explain the concept of anisotropy of chemical bonds.	(5)
10.	a) Describe the gas phase sources of ionisation in mass spectrometry. Illustrate your answer.	(5)
	b) Predict the structures of the compounds on the basis of the molecular formula and ^{1}HNMR spectral data given below:	(5)
	i) Molecular formula $C_9H_{18}O$, ^{1}HNMR peaks: only a singlet at 1.25 ppm	
	ii) Molecular formula $C_9H_{10}O_2$ ^{1}HNMR peaks: singlet, δ =2.3 ppm, 6H, doublet, δ=7.0 ppm, 2H, triplet, δ =7.2 ppm, 1H, v. broad singlet, δ =12.9 ppm, 1H	

TUTOR MARKED ASSIGNMENT
MCH-004: Electroanalytical and Other Methods

Course Code: MCH-004
Assignment Code: MCH-004/TMA/2020
Maximum Marks: 100

Note: Answer all the questions given below.

1. a) Briefly describe following: (10)
   i) Electrode potential
   ii) Standard electrode potential
   iii) Liquid-junction potential
   iv) Polarography
   v) Coulometry
2. Calculate the potential of following electrodes: (10)
   i) A copper electrode immersed in 0.022 M Cu $(NO_3)_2$
   ii) A zinc electrode immersed in 0.030 M Zn $(NO_3)_2$.
3. What is direct potentiometry? Drive an expression for E_{cell} for both cation and anion indicator electrode. (10)
4. a) Describe a typical design of a solid state membrane electrode. List some applications of ion selective electrodes. (5)
   b) Distinguish between molar conductivity and limiting molar conductivity. Explain why limiting ionic mobilities of H^+ and OH^- ions are exceptionally high. (5)
5. a) At 298 K, the conductivity of pure water in 2.9×10^{-6} S m^{-1} and limiting molar conductivities of the H^+ and OH^- ions are 0.03498 and 0.01976 S m^2 mol^{-1}, respectively. Calculate the ionic product of pure water at 298 K. (5)
   b) A constant current of 0.400 A is used to deposit copper at the cathode and oxygen at the anode of an electrolytic cell. Calculate the number of grams of each product formed in 30.4 min, assuming no other redox reaction. (5)
6. Distinguish between: (10)
   i) Concentration polarization and kinetic polarization.
   ii) Constant current electrolysis and constant potential electrolysis.
7. a) Describe the design and principle of hydrogen oxygen coulometer. Write advantages of coulometric titrations. (5)
   b) What are the different types of pulse methods in voltammetry? Discuss any one method in some detail. (5)
8. a) What is dropping mercury electrode? Give its advantages. (5)
   b) Derive the polarographic equation. (5)
9. a) List the factors affecting TG curve. Taking a suitable example, explain the effect of furnace atmosphere on TG curve. (5)
   b) A mixture of $CaCO_3$ and CaO is analysed using TGA technique. TG curve of the sample indicates that there is a mass change from 584.2 mg to 374.5 mg between 500-900°C. Calculate the percentage of $CaCO_3$ in the sample. (5)
10. a) Give advantages and limitations of IDA technique. (5)
    b) Draw typical enthalpograms for both exothermic and endothermic reactions. Discuss the type of information you may get from these enthalpograms. (5)