ASSIGNMENT BOOKLET

M.Sc. in Chemistry/Analytical Chemistry Programme (MSCCHEM/MSCANCHEM)

MATHEMATICS FOR CHEMISTS
(Valid from 1st July 2025 to 30th June 2026**)**

It is compulsory to submit the assignment before filling in the examination form

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THE PEOPLE'S
UNIVERSITY

School of Sciences
Indira Gandhi National Open University
New Delhi-110068
(2026)

Dear Learner,

Please read the section on assignments in the Programme Guide for M.Sc. in Chemistry that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, which would consist of one tutor-marked assignment for this course. The assignment is in this booklet, and covers both the blocks of the course. The total marks of all the parts are 100, of which 40% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1. On top of the first page of your answer sheet, please write the details exactly in the following format:

<div align="right">

ENROLAMENT NO. :…..……….

NAME :…………………...

ADDRESS :……………………

</div>

COURSE CODE   :……………..

COURSE TITLE   :……………..

ASSIGNMENT NO :……………..

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. Submit the complete assignment answer sheets within the due date.
6. The assignment answer sheets are to be submitted to your Study centre within the due date. Answer sheets received after the due date shall not be accepted.
   We strongly suggest that you retain a copy of your answer sheets.
7. This assignment is valid from 1st July, 2025 to 30th June, 2026. If you have failed in this assignment or fail to submit it by June 2026, then you need to get the assignment for the year 2027, and submit it as per the instructions given in the Programme Guide.
8. You cannot fill the examination form for this course until you have submitted the assignment.

Wishing you good luck

Tutor Marked Assignment
MTMATHEMATICS FOR CHEMISTS (MCH-014)

Note: Attempt all questions. The marks for each question are indicated against it.

1. **(a)** Which of the following sets are finite, and which are infinite? **(2)**

   (i) The set of points on the circumference of a circle.

   (ii)]0, 1[

   (iii) [-1, 1]

   (iv) {1, 2, …, 100}

   (b) If A = {1, 2, 3}, B = {2, 3, 4, 5}, and C = {1}, determine $A \cup B \cup C$ and also verify

   $$A \cup B \cup C (A \cup B) \cup C = A \cup (B \cup C)$$ **(2)**

   (c) Define subjective, injective, and bijective functions with the examples. **(3)**

   (d) 1.50 mol of $PCl_5(g)$ is decomposes at room temperature to form $PCl_3(g)$ and $Cl_2(g)$. Determine their concentration at equilibrium, when $K_c = 1.80$. **(3)**

2. **(a)** Show that the set of following vectors form the sides of a right-angled triangle. **(3)**

   $$2\hat{i} - \hat{j} + \hat{k}$$

   $$\hat{i} - 3\hat{j} - 5\hat{k}$$

   $$3\hat{i} - 4\hat{j} - 4\hat{k}$$

   (b) Find the work done by the force, $F = 5\hat{i} + 2\hat{j} + 3\hat{k}$ when its point of application moves from $A(1, -2, -2)\ to\ B(3, 1, 1)$. **(3)**

   (c) Prove, with the help of vectors, that the diagonals of a parallelogram bisect each other. **(4)**

3. **(a)** Evaluate the following limit.

   $$\lim_{x \to \infty} \frac{\sqrt{1+x} - \sqrt{1-x}}{x}$$ **(3)**

   (b) If the law of motion of a particle is given as: $s = -t^3 + 3t^2 + 25$, then **(2+1)**

   i) find its velocity and acceleration.

   ii) find the distance covered by the particle in time t = 5 units

(c) Find the derivative of the following functions with respect to x: **(2+2)**

$$\text{(i)} \quad \frac{x^{-1/2} - x^{1/2}}{x^{-1/2} + x^{1/2}}$$

$$\text{(ii)} \quad \frac{3x}{\sqrt[3]{5 + 2x^2}}$$

4. **(a)** Find all the second order partial derivatives of the following function. **(2)**

$$f(x,y) = x^2 - 8xy + y^2$$

(b) Find the equation of tangent and normal to the curve $f(x) = x^3 - 3x^2 + 6x - 1$ at $x = 2$. **(2+2)**

(c) Find the asymptotes of the following functions: **(2+2)**

$$\text{(i)} \quad \frac{3x - 4}{2x + 6}$$

$$\text{(ii)} \quad \frac{x^2 - 2x - 8}{x - 1}$$

5. **(a)** State the order and the degree of the following differential equations: **(4x1)**

$$\text{(i)} \quad \left(\frac{dy}{dx}\right)^2 = \frac{7x}{4y^2}$$

$$\text{(ii)} \quad \sqrt{\frac{d^3y}{dx^3}} = \frac{dy}{dx} + x^4$$

$$\text{(iii)} \quad \left(\frac{dy}{dx}\right)^3 = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}$$

$$\text{(iv)} \quad \left(\frac{d^2y}{dx^2}\right)^{1/5} = k\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{5/2}$$

(b) Evaluate the following integrals: **(3x2)**

$$\text{(i)} \quad \int \left(2e^x - 3\sqrt{x}\right) dx$$

$$\text{(ii)} \quad \int \frac{(1 + \ln x)^3}{x} dx$$

$$\text{(iii)} \quad \int_1^3 x^2 e^{x^3} dx$$

6. **(a)** Find the differential equation whose solution is given by

$$y = e^x(A \cos x + B \, Sin \, x)$$

where, A and B are arbitrary constants. **(2)**

(d) Using the ideal gas equation, estimate the change in the pressure of 1.0 mol of an ideal gas at 0°C when its volume is changed from 22.414 L to 21.414 L. **(2)**

(b) Solve the following differential equation: **(3)**

$$\frac{1}{y^2}\frac{dy}{dt} = 1 - e^{-3t}$$

(c) Show that the equation **(3)**

$$(y - 2x^3)dx = x(1 - xy)dy$$

becomes exact on multiplication by x^{-2} and solve it.

7. **(a)** If $A = \begin{bmatrix} 3 & 5 \\ -2 & 4 \end{bmatrix}$ then show that **(2)**

(i) $\frac{1}{2}(A + A')$ is symmetric, and

(ii) $\frac{1}{2}(A - A')$ is skew symmetric.

(b) Verify that the following matrix A is orthogonal **(3)**

$$A = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$$

(c) Solve the following system of equations using Cramer's rule. **(5)**

$$x + y - z = 6$$

$$3x - 2y + z = -5$$

$$x + 3y - 2z = 14$$

8. **(a)** Find eigenvectors for the matrix **(4)**

$$A = \begin{bmatrix} -5 & 2 \\ -7 & 4 \end{bmatrix}$$

(b) Find A^{-1}, where **(6)**

$$A = \begin{bmatrix} 4 & 3 & 8 \\ 6 & 2 & 5 \\ 1 & 5 & 9 \end{bmatrix}$$

9. **(a)** Two coins are tossed simultaneously then find probability of getting at least one head. **(2)**

 (b) A number is chosen at random from the first 40 natural numbers. Calculate the probability that the selected is divisible by 5 or 7. **(2)**

(c) A bag contains 8 red balls and 5 black balls. Two balls are drawn one by one without replacement. Find the probability that both balls are red. **(2)**

 (d) Define Binomial, Poisson and Normal distribution with appropriate equation and name their terms. **(4)**

10. **(a)** Define Error and their types in quantitative chemical analysis. **(5)**

(b) In an iron determination from the same amount of sample, the five replicate results were obtained: 20.1, 19.6, 20.0 and 19.9 and 20.4 mg iron.

Calculate the standard deviation, variance, standard deviation of mean, coefficient of variation and relative standard deviation in ppm of the given data. **(5)**