

Roll No. 1900 / 10/30/20

January 2018
M. Sc 1st Semester Examination

CHEMISTRY

Paper V (a) Mathematics for Chemists (MCH-405)

Time 3 Hours

(Max Marks Regular 85 / Private 100)

(Min Marks Regular 28 / Private 33)

Note : This question paper is meant for all Regular and Private students. Answer all five questions. All questions carry equal marks. The blind candidates will be given 80 minutes extra time.

1. (a) Explain properties of Scalar Triple Product
(b) Define and explain Gradient and Divergence with example

OR

(a) If $A = \begin{bmatrix} 2 & -1 \\ 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ -1 & -1 \end{bmatrix}$ show that $(A + B)^2 = A^2 + AB + BA + B^2$

(b) If $A = \begin{bmatrix} 1 & 3 \\ 3 & 10 \end{bmatrix}$ and $B = \begin{bmatrix} 10 & -3 \\ -3 & 1 \end{bmatrix}$ then prove that $AB = BA + I$.

2. Differentiate the following with respect to x

(a) $y = (\cos x)^{\sin x}$

(b) $y = (3x - 7)^{-2}$

(c) If $x = at^3$ and $y = a(1 + t^2)$ then find $\frac{dy}{dx}$

OR

The probability density function of an electron existed at a distance r from the centre of the nucleus of hydrogen atom is $P(r) = \frac{4r^2}{a_0^3} e^{-\frac{2r}{a_0}}$. Apply the condition of maxima and minima and prove that the Bohr's radius r is equal to a_0 at which $P(r)$ has its maximum value

3. Integrate the following with respect to x :

(a) $\int \frac{2x + 5}{x^2 + 5x + 9} dx$

(b) $\int \frac{(x-1)}{(x-3)(x-2)} dx$

OR

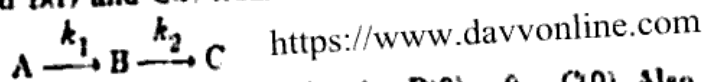
(a) Evaluate the Integral $\int \frac{e^x(1+x \log x)}{x} dx$

(b) If $\left(P + \frac{a}{V^2}\right)V = RT$ then prove that $\frac{\partial^2 P}{\partial V \partial T} = \frac{\partial^2 P}{\partial T \partial V}$

4. (a) Write working procedure and method of solution of Homogeneous differential equation taking a suitable example.
(b) What is exact differential equation? Give working procedure for its determination. Solve $(ax + by + g) dx + (hx + by + f) dy = 0$.

OR

Find $B(t)$ and $C(t)$ from the consecutive first order chemical reactions :



with initial conditions $A(0) = A_0, B(0) = 0 = C(0)$. Also show that $A + B + C = \text{Constant} = A_0$.

5. (a) If ${}^n C_r = {}^n C_{r-1}$ and ${}^n P_r = {}^n P_{r+1}$ then find out the value of n .

- (b) Define Probability and explain Multiplication Theorem of Probability.

OR

Given the following observations of x and y :

X	1	2	3	4	5	6	7	8
Y	1.7	2.3	3.2	3.8	4.5	5.3	6.0	6.5

Compute the least squares line $y = a + bx$. Also estimate y at $x = 4.5$