7. (a) The position vectors of A, B, C and D are $\vec{a}, \vec{b}, 2\vec{a} + 3\vec{b}$ and $\vec{a} - \vec{b}$. Find the vector $\overrightarrow{AB}, \overrightarrow{BC}, \overrightarrow{CD}$ and $\overrightarrow{DA}$.

(b) Prove

$$\begin{vmatrix} x & y & z \\ x^2 & y^2 & x^2 \\ yz & zx & xy \end{vmatrix} = (y-z)\,(z-x)\,(x-y)\,(xy + yz + zx).$$

(6, 9)

Roll No. ..... Total Pages : 4

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January 2023

M.Sc. (Chemistry) Ist Semester

MATHEMATICS FOR CHEMISTS (CH-104XB)

Time : 3 Hours] [Max. Marks : 75

Instructions :

Attempt five questions in all. Question No. 1 is compulsory. Select four question from Part B. All the questions carry equal marks. Log Tables may be asked.

PART–A
(Compulsory Question)

1. (a) What does a dot product of two vectors? Is it scalar quantity?

(b) Why logarithm is important in Chemistry?

(c) What is two type of integrals used in Chemistry? Give Examples.

(d) A solution has pH of 9. Calculate hydrogen ion concentration.

(e) Is enthalpy an exact differential? Justify your answer.

(f) Define unit matrix and null matrix with suitable example.

(g) Sjmplify : ln 125 – ln 625.

(h) $ax + 5y = 8$ has slope of –4/3. What is the value of a?

(i) Find the equation of line that is perpendicular to the other line.

(j) What is Sterling's approximation? Calculate value of ln(5!). (1.5×10=15)

PART–B

2. (a) Prove that

$$\log_a \frac{mp}{n} = \log_a m + \log_a p - \log_a n.$$

(b) Log 0.000050 = $\bar{5}.6990$.

Find out log 0.5, log 0.005, log 50.

(c) If $10^x = 2.5$, find x = ? (6,6,3)

3. (a) Show that the line joining (6, –4) and (3, –2) is parallel to the line joining (1, 3) and (–2, 5).

(b) Find the equation of the line which is at a perpendicular distance of 5 units from the origin and the angle made by the perpendicular with the positive x-axis is 30°.

(c) Write the equation of line passing through A(–3, 4) and B(4, 5) in the form of $ax + by + c = 0$. (5, 5, 5)

4. (a) Differentiate w.r.t. x

(i) $y = \dfrac{1}{(x+5)(x+6)}$.

(ii) $x^2 + y^2 = 1$, then $\dfrac{dy}{dx}$ = ?

(iii) $y = \sqrt{\dfrac{1+x}{1-x}}$ find $\dfrac{dy}{dx}$ = ? (5, 5, 5)

5. (a) If $f(x, y) = \sin^2 x \cos y + \dfrac{x}{y^2}$

Evaluate $\left(\dfrac{\partial f}{\partial x}\right)_y$ and $\left(\dfrac{\partial f}{\partial y}\right)_x$.

(b) G = f(P, T)

Show that $\left(\dfrac{\partial G}{\partial T}\right)_V = \left(\dfrac{\partial G}{\partial T}\right)_P + \left(\dfrac{\partial G}{\partial P}\right)_T + \left(\dfrac{\partial P}{\partial T}\right)_V$.

(8, 7)

6. Integrate

(a) $\int e^{2x} \sin x \, dx$.

(b) $\int \dfrac{\sqrt{\tan x}}{\sin x \, dx} \, dx$.

(c) Evaluate I = $\int (6ax^4 + 5bx^3 + ax^2 + 6c)dx$. (6,6,3)