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Higher Secondary Examination

fo"k; & mPp xf.kr

**Subject Name – Higher Mathematics
(Hindi & English Versions)**

SOLUTION

1. **Sol.** (i) (B)

(ii) (A)

(iii) (D)

(iv) (A) $\sqrt{b^2 + c^2}$

(v) B

(vi) A

2. **Sol.** (i) T (ii) T (iii) T (iv) T (v) F (vi) T

3. **Sol.**

(i) $a^x \log a$

(ii) $\frac{3}{7}, \frac{-2}{7}, \frac{6}{7}$

(iii) e^x

(iv) $\frac{7}{3}$ sq unit

(v) equal

(vi) $\frac{5}{2}$

4. **Sol.** (i) (1,2) (ii) $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ (iii) $e^{\frac{1}{e}}$ (iv) 10π (vi) -3 (vi) -5
(vii) $3x - y = 2$

5. **Sol.**

(i) \rightarrow (c) (ii) \rightarrow (a) (iii) \rightarrow (d) (iv) \rightarrow (f)

(v) \rightarrow (g) (vi) \rightarrow (h) (vii) \rightarrow (i)

Two Marks Questions

6. **Sol.** $\vec{r} = 3\hat{i} - 4\hat{j} + 5\hat{k}$

Unit vector in the direction of $\vec{r} \Rightarrow \hat{r} = \frac{\vec{r}}{|\vec{r}|} = \frac{3\hat{i} - 4\hat{j} + 5\hat{k}}{\sqrt{50}}$

OR

Let

$$\overrightarrow{OA} = \vec{a} - 2\vec{b} + 3\vec{c}$$

$$\overrightarrow{OB} = -2\vec{a} + 3\vec{b} - 4\vec{c}$$

$$\overrightarrow{OC} = \vec{a} - 3\vec{b} + 5\vec{c}$$

For coplanar $[\overrightarrow{OA} \overrightarrow{OB} \overrightarrow{OC}] = 0$

$$\begin{vmatrix} 1 & -2 & 3 \\ -2 & 3 & -4 \\ 1 & -3 & 5 \end{vmatrix} = 0$$

$$1(15 - 12) + 2(-10 + 4) + 3(6 - 3) = 0$$

7. **Sol.** Let, in triangle ABC,

$$\overrightarrow{BC} = \vec{a}, \overrightarrow{CA} = \vec{b} \text{ and } \overrightarrow{AB} = \vec{c}$$

$$\text{To prove: } \vec{a} + \vec{b} + \vec{c} = \vec{0}$$

By the triangle law of vector addition,

$$\overrightarrow{BC} + \overrightarrow{CA} = \overrightarrow{BA}$$

$$\therefore \overrightarrow{BC} + \overrightarrow{CA} = -\overrightarrow{AB} \quad \dots\dots(1)$$

Adding vector \overrightarrow{AB} on both sides of equation (1),

$$\overrightarrow{BC} + \overrightarrow{CA} + \overrightarrow{AB} = -\overrightarrow{AB} + \overrightarrow{AB} = \vec{0}$$

$$\text{Hence, } \vec{a} + \vec{b} + \vec{c} = \vec{0} \quad (\text{zero vector})$$

OR

$$\vec{a} = 3\hat{i} - \hat{j} - 4\hat{k} \quad \text{and} \quad \vec{b} = -2\hat{i} + 4\hat{j} - 3\hat{k}$$

$$\therefore 3\vec{a} - 2\vec{b} = 3(3\hat{i} - \hat{j} - 4\hat{k}) - 2(-2\hat{i} + 4\hat{j} - 3\hat{k}) = 13\hat{i} - 11\hat{j} - 6\hat{k}$$

$$\Rightarrow |3\vec{a} - 2\vec{b}| = \sqrt{(13)^2 + (-11)^2 + (-6)^2} = \sqrt{326}$$

8. **Sol.** Given,

Centre of sphere = $(-1, 0, 1)$ and radius = 2

We know that the standard form of sphere is :

$$(x - \alpha)^2 + (y - \beta)^2 + (z - \gamma)^2 = r^2$$

$$\Rightarrow (x + 1)^2 + (y - 0)^2 + (z - 1)^2 = 2^2$$

$$\Rightarrow (x + 1)^2 + y^2 + (z - 1)^2 = 4$$

$$\Rightarrow x^2 + y^2 + z^2 + 2x - 2z + 2 - 4 = 0$$

$$\Rightarrow x^2 + y^2 + z^2 + 2x - 2z - 2 = 0$$

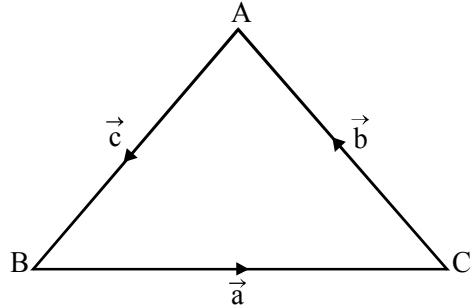
OR

The two given vectors are : $(2\hat{i} - 3\hat{j} + 5\hat{k})$ and $(-2\hat{i} + 2\hat{j} + 2\hat{k})$

If they are mutually perpendicular,

$$\text{Then } (2\hat{i} - 3\hat{j} + 5\hat{k}) \cdot (-2\hat{i} + 2\hat{j} + 2\hat{k}) = -4 - 6 + 10 = 0$$

Hence, the given vectors are mutually perpendicular.



9. **Sol.** $I = \int \sqrt{1+\cos x} dx = \int \sqrt{2\cos^2 \frac{x}{2}} dx$
 $= \sqrt{2} \int \cos \frac{x}{2} dx = \sqrt{2} \sin \left(\frac{x}{2} \right) + C = 2\sqrt{2} \sin \left(\frac{x}{2} \right) + C$

OR

$I = \int \frac{dx}{x^2 - 6x + 13}$

We have $x^2 - 6x + 13 = x^2 - 6x + 3^2 - 3^2 + 13 = (x - 3)^2 + 4$

$\text{So, } \int \frac{dx}{x^2 - 6x + 13} = \int \frac{1}{(x-3)^2 + 2^2} dx$

Let $x - 3 = t$. Then $dx = dt$

$\text{Therefore, } \int \frac{dx}{x^2 - 6x + 13} = \int \frac{dt}{t^2 + 2^2} = \frac{1}{2} \tan^{-1} \frac{t}{2} + C = \frac{1}{2} \tan^{-1} \frac{x-3}{2} + C$

10. **Sol.** Let $I = \int x \log x dx$

Taking $\log x$ as first function and x as second function and integrating by parts, we obtain

$I = \log x \int x dx - \int \left\{ \left(\frac{d}{dx} \log x \right) \int x dx \right\} dx = \log x \cdot \frac{x^2}{2} - \int \frac{1}{x} \cdot \frac{x^2}{2} dx$
 $= \frac{x^2 \log x}{2} - \frac{x^2}{4} + C$

OR

$I = \int \frac{e^{\cos^{-1} x}}{\sqrt{1-x^2}} dx$

Put $\cos^{-1} x = t$

$-\frac{dx}{\sqrt{1-x^2}} = dt$

$I = - \int e^t dt = -e^t + C$

$= -e^{\cos^{-1} x} + C$

11. **Sol.** If $A = \begin{bmatrix} 2 & 4 \\ 3 & 2 \end{bmatrix}, B = \begin{bmatrix} 1 & 3 \\ 2 & 5 \end{bmatrix}$

Given

$A \cdot B = \begin{bmatrix} 2 & 4 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} 1 & 3 \\ 2 & 5 \end{bmatrix} = \begin{bmatrix} 10 & 26 \\ 7 & 19 \end{bmatrix}$

OR

Given

$A = \begin{bmatrix} 1 & 5 & 6 \\ 6 & 7 & 0 \end{bmatrix}, B = \begin{bmatrix} 1 & -5 & 7 \\ 8 & -7 & 7 \end{bmatrix}$

$$A - B = \begin{bmatrix} 0 & 10 & -1 \\ -2 & 14 & -7 \end{bmatrix}$$

12. $f(x) = 2x + 3$ will be continuous at $x = 1$. If LHL at $(x=1) = f(1) = \text{RHL at } (x = 1)$

$$\lim_{h \rightarrow 0} f(1-h) = f(1) = \lim_{h \rightarrow 0} f(1+h)$$

$$\lim_{h \rightarrow 0} 2(1-h+3) = 5 = \lim_{h \rightarrow 0} 2(1+h)+3$$

$5 = 5 = 5$ (Hence $f(x)$ is continuous at $x=1$)

OR

have to prove or

$f(x) = |x|$ is not differentiable at $x = 0$

$$\text{Now L.H.O. } \lim_{h \rightarrow 0} \frac{f(0-h) - f(0)}{-h}$$

$$\lim_{h \rightarrow 0} \frac{(0-h) - (0)}{-h} = -1$$

$$\text{and L.H.D. } \lim_{h \rightarrow 0} \frac{f(0+h) - f(0)}{h}$$

$$\lim_{h \rightarrow 0} \frac{|0+h| - 0}{h} = 1$$

L.H.D \neq R.H.D hence not differentiable at $x = 0$

13. **Sol.** $I = \int (x^{\frac{2}{3}} + 1) dx$

$$I = \frac{x^{\frac{2}{3}+1}}{\frac{2}{3}+1} + x + C$$

$$= \frac{3}{5} x^{\frac{5}{3}} + x + C$$

OR

$$I = \int \frac{1 - \sin x}{\cos^2 x} dx$$

$$= \int (\sec^2 x - \tan x \sec x) dx$$

$$= \tan x - \sec x + C$$

14. **Sol.** $\vec{a} = 2\hat{i} + 3\hat{j} + \hat{k}$

$$\text{unit vector } \vec{a} = \frac{\vec{a}}{|\vec{a}|} = \frac{2\hat{i} + 3\hat{j} + \hat{k}}{\sqrt{14}}$$

OR

$$\text{Given } \vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k} \text{ and } \vec{b} = \hat{i} + 2\hat{j} + \hat{k}$$

projection of \vec{a} on $\vec{b} = \hat{b} \cdot \vec{a}$

$$\hat{b} = \frac{\vec{b}}{|\vec{b}|} = \frac{\hat{i} + 2\hat{j} + \hat{k}}{\sqrt{6}}$$

$$\text{Now } \hat{b} \cdot \vec{a} = \frac{(\hat{i} + 2\hat{j} + \hat{k}) \cdot (2\hat{i} + 3\hat{j} + \hat{k})}{\sqrt{6}} = \frac{10}{\sqrt{6}}$$

15. **Sol.** We know intercept form of plane is

$$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1; \quad \text{Given } a = -4, b = 2, c = 3$$

$$\Rightarrow \frac{x}{-4} + \frac{y}{2} + \frac{z}{3} = 1$$

OR

$$\text{Given lines is } \frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$$

$$\text{Plane : } 3x + y + z = 7$$

$$\text{since angle between line \& plane be } \sin \theta = \left| \frac{\vec{n} \cdot \vec{b}}{|\vec{n}| |\vec{b}|} \right|$$

$$\text{where } \vec{n} = 3\hat{i} + \hat{j} + \hat{k} \quad \& \quad \vec{b} = 2\hat{i} + 3\hat{j} + 6\hat{k}$$

$$\sin \theta = \left| \frac{(3\hat{i} + \hat{j} + \hat{k}) \cdot (2\hat{i} + 3\hat{j} + 6\hat{k})}{\sqrt{9+1+1} \sqrt{4+9+36}} \right|$$

$$\sin \theta = \frac{6+3+6}{\sqrt{11} \sqrt{49}}$$

$$\sin \theta = \frac{15}{7\sqrt{11}}$$

$$\theta = \sin^{-1} \frac{15}{7\sqrt{11}}$$

Three Marks Questions

16. **Sol.** The given equation of line is : $\frac{x+1}{2} = \frac{y}{3} = \frac{z-3}{6}$... (i)

$$\text{and the equation of plane is : } 3x + y + z = 7 \quad \dots (\text{ii})$$

Let the angle between the line and the plane be θ .

$$\Rightarrow \cos \theta = \frac{2 \times 3 + 3 \times 1 + 6 \times 1}{\sqrt{2^2 + 3^2 + 6^2} \cdot \sqrt{3^2 + 1^2 + 1^2}} = \frac{15}{\sqrt{49} \cdot \sqrt{11}}$$

$$\Rightarrow \theta = \cos^{-1} \left(\frac{15}{7\sqrt{11}} \right)$$

OR

The two given end-points of diameter are A(2, -3, 4) and B(-5, 6, 7)

Now, the equation of sphere with end-point of diameter as (x_1, y_1, z_1) and (x_2, y_2, z_2) is given by –

$$(x - x_1)(x - x_2) + (y - y_1)(y - y_2) + (z - z_1)(z - z_2) = 0$$

$$\Rightarrow (x - 2)(x + 5) + (y + 3)(y - 6) + (z - 4)(z - 7) = 0$$

$$\Rightarrow (x^2 + 3x - 10) + (y^2 - 3y - 18) + (z^2 - 11z + 28) = 0$$

$$\Rightarrow x^2 + y^2 + z^2 + 3x - 3y - 11z = 0$$

17. Sol. given function

$$y = x(5 - x) \dots\dots(1)$$

diff. wrto x

$$\frac{dy}{dx} = 5 - 2x \dots\dots(2)$$

$$\text{put } \frac{dy}{dx} = 0$$

$$5 - 2x = 0$$

$$x = \frac{5}{2}$$

again diff eq (2) wrto x.

$$\frac{d^2y}{dx^2} = -2$$

$$\therefore \frac{d^2y}{dx^2} < 0 \quad \forall x \in R.$$

so $x = \frac{5}{2}$ is point of maxima.

for maximum value of function

$$\text{put } x = \frac{5}{2} \text{ in eq ...}(1)$$

$$y = \frac{5}{2} \left(5 - \frac{5}{2} \right)$$

$$y = \frac{5}{2} \times \frac{5}{2}$$

$$y = \frac{25}{4}$$

OR

To find $\sqrt{49.5}$

$$\text{let } f(x) = \sqrt{x}$$

$$x + \Delta x = 49.5$$

$$\therefore x = 49 \text{ & } \Delta x = 0.5$$

$$\therefore \Delta y = f(x + \Delta x) - f(x)$$

$$\Delta y = f(49.5) - f(49)$$

$$\Delta y = \sqrt{49.5} - \sqrt{49}$$

$$\Delta y = \sqrt{49.5} - 7$$

$$\sqrt{49.5} = 7 + \Delta y \dots\dots(1)$$

$$\therefore \Delta y = f(x) . \Delta x$$

$$\therefore f(x) = \frac{1}{2\sqrt{x}}$$

$$\Delta y = \frac{1}{2\sqrt{x}} . \Delta x$$

put the value of x & Δx

$$\Delta y = \frac{1}{2\sqrt{49}} . (0.5)$$

$$\Delta y = \frac{0.5}{14} = \frac{1}{28}$$

put in eq (1)

$$\sqrt{49.5} = 7 + \frac{1}{28}$$

$$\sqrt{49.5} = \frac{196+1}{28} = \frac{197}{28}$$

$$\sqrt{49.5} = 7.03$$

18. Sol. To prove

$$\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$$

$$\text{given that } \vec{a} + \vec{b} + \vec{c} = \vec{0} \quad \dots\dots(1)$$

Eq (1) pre multiply by \vec{a} & \vec{b} respectively

$$\vec{a} \times (\vec{a} + \vec{b} + \vec{c}) = \vec{0}$$

$$\vec{a} \times \vec{a} + \vec{a} \times \vec{b} + \vec{a} \times \vec{c} = 0$$

$$\therefore \vec{a} \times \vec{a} = 0$$

$$\vec{a} \times \vec{b} + \vec{a} \times \vec{c} = 0$$

$$\vec{a} \times \vec{b} = -\vec{a} \times \vec{c}$$

$$\because \vec{a} \times \vec{c} = -\vec{c} \times \vec{a}$$

$$\therefore \vec{a} \times \vec{b} = \vec{c} \times \vec{a} \quad \dots\dots(2)$$

$$\vec{b} \times (\vec{a} + \vec{b} + \vec{c}) = \vec{0}$$

$$\vec{b} \times \vec{a} + \vec{b} \times \vec{b} + \vec{b} \times \vec{c} = 0$$

$$\therefore \vec{b} \times \vec{b} = 0$$

$$\vec{b} \times \vec{a} + \vec{b} \times \vec{c} = 0$$

$$\vec{b} \times \vec{c} = -\vec{b} \times \vec{a}$$

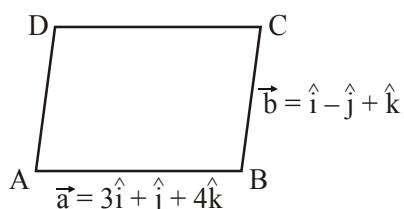
$$\therefore \vec{b} \times \vec{a} = -\vec{a} \times \vec{b}$$

$$\therefore \vec{b} \times \vec{c} = \vec{a} \times \vec{b} \quad \dots\dots(3)$$

from Eq (2) & (3)

$$\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$$

OR



Area of parallelogram ABCD is $|\vec{a} \times \vec{b}|$

$$\therefore \vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & 4 \\ 1 & -1 & 1 \end{vmatrix}$$

$$\vec{a} \times \vec{b} = \hat{i}(1+4) - \hat{j}(3-4) + \hat{k}(-3-1)$$

$$\vec{a} \times \vec{b} = 5\hat{i} + \hat{j} - 4\hat{k}$$

$$|\vec{a} \times \vec{b}| = \sqrt{25+1+16} = \sqrt{42}$$

so Area of parallelogram is $\sqrt{42}$ sq. unit

19. Sol. $\ell_1 \vec{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$

$$\ell_2 \vec{r} = 3\hat{i} + 3\hat{j} - 5\hat{k} + \mu(2\hat{i} + 3\hat{j} + 6\hat{k})$$

$$\vec{a}_1 = \hat{i} + 2\hat{j} - 4\hat{k}, \quad \vec{a}_2 = 3\hat{i} + 3\hat{j} - 5\hat{k}$$

$$\vec{b} = 2\hat{i} + 3\hat{j} + 6\hat{k}$$

$\therefore \ell_1$ & ℓ_2 are parallel.

$$\therefore D = \frac{\|(\vec{a}_2 - \vec{a}_1) \times \vec{b}\|}{|\vec{b}|} \dots\dots(1)$$

$$\vec{a}_2 - \vec{a}_1 = 2\hat{i} + \hat{j} - \hat{k}$$

$$|\vec{b}| = \sqrt{4+9+36} = 7$$

$$D = \frac{|(2\hat{i} + \hat{j} - \hat{k}) \times (2\hat{i} + 3\hat{j} + 6\hat{k})|}{7}$$

$$\therefore (2\hat{i} + \hat{j} - \hat{k}) \times (2\hat{i} + 3\hat{j} + 6\hat{k}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -1 \\ 2 & 3 & 6 \end{vmatrix}$$

$$= \hat{i}(6+3) - \hat{j}(12+2) + \hat{k}(6-2)$$

$$= 9\hat{i} - 14\hat{j} + 4\hat{k}$$

$$D = \frac{|9\hat{i} - 14\hat{j} + 4\hat{k}|}{7}$$

$$D = \frac{\sqrt{81+196+16}}{7}$$

$$D = \frac{\sqrt{293}}{7}$$

OR

given plane $2x - 3y + 4z - 6 = 0$

point is $(0, 0, 0)$

\therefore Distance of point from plane is

$$D = \frac{|Ax_1 + By_1 + Cz_1 - d|}{\sqrt{A^2 + B^2 + C^2}}$$

$$D = \frac{|0+0+0-6|}{\sqrt{4+9+16}}$$

$$D = \frac{6}{\sqrt{29}}$$

Four Marks Questions

$(7 \times 4 = 28)$

20. Sol. The given fraction is an improper fraction. Therefore dividing numerator by denominator, we get,

$$\frac{x^2 + 7x}{x^2 + 2x - 8} = 1 + \frac{5x + 8}{x^2 + 2x - 8} = 1 + \frac{5x + 8}{(x+4)(x-2)} = 1 + \frac{A}{(x+4)} + \frac{B}{(x-2)}$$

$$\Rightarrow (5x + 8) = A(x-2) + B(x+4) \Rightarrow \boxed{x=2}$$

$$5 \times 2 + 8 = B \times 6 \Rightarrow B = \frac{18}{6} = 3 \Rightarrow \boxed{x=-4}$$

$$5 \times (-4) + 8 = A \times (-6) \Rightarrow A = \frac{(-12)}{(-6)} = 2$$

$$\Rightarrow \frac{x^2 + 7x}{x^2 + 2x - 8} = 1 + \frac{2}{(x+4)} + \frac{3}{(x-2)}$$

OR

$$\text{Suppose that } \frac{2x+1}{(x-1)(x^2+1)} = \frac{A}{(x-1)} + \frac{Bx+C}{(x^2+1)}$$

$$\Rightarrow 2x+1 = A(x^2+1) + (Bx+C)(x-1)$$

$$\Rightarrow 2x+1 = A(x^2+1) + Bx(x-1) + C(x-1)$$

$$\boxed{x=1}$$

$$2 \times 1 + 1 = A(1+1) \Rightarrow A = 3/2$$

Comparing coefficients of 'x²' we get :

$$0 = A + B \Rightarrow B = -3/2$$

Comparing coefficients of 'x' we get, C - B = 2

$$\Rightarrow C = 2 + B = 2 - \frac{3}{2} = \frac{1}{2}$$

Hence,

$$\frac{(2x+1)}{(x-1)(x^2+1)} = \frac{3}{2(x-1)} - \frac{3x-1}{2(x^2+1)}$$

21. Sol. We know

$$\begin{aligned} \tan^{-1}x + \tan^{-1}y + \tan^{-1}z &= \tan^{-1}\left(\frac{x+y+z-xyz}{1-xy-yz-zx}\right) \\ \text{LHL } \tan^{-1}\frac{1}{2} + \tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{8} &= \tan^{-1}\left(\frac{\frac{1}{2} + \frac{1}{5} + \frac{1}{8} - \frac{1}{2} \times \frac{1}{5} \times \frac{1}{8}}{1 - \frac{1}{2} \times \frac{1}{5} - \frac{1}{5} \times \frac{1}{8} - \frac{1}{8} \times \frac{1}{2}}\right) \\ &= \tan^{-1}\left(\frac{\frac{40+16+10-1}{80}}{\frac{80-8-2-5}{80}}\right) = \tan^{-1}\left(\frac{65}{65}\right) \\ &= \tan^{-1}(1) = \frac{\pi}{4} = \text{RHS} \end{aligned}$$

OR

$$\text{LHL } \frac{1}{2} \cos^{-1} \frac{1-x}{1+x}$$

$$= \frac{1}{2} \cos^{-1} \left(\frac{1 - (\sqrt{x})^2}{1 + (\sqrt{x})^2} \right) = \frac{1}{2} \cos^{-1} \left(\frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} \right) \quad \begin{cases} \text{Put } (\sqrt{x} = \tan \theta) \\ \Rightarrow \theta = \tan^{-1} \sqrt{x} \end{cases}$$

$$= \frac{1}{2} \cos^{-1}(\cos 2\theta) = \theta = \tan^{-1} \sqrt{x} = \text{RHS}$$

22. Sol. $\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix} = 4abc$

L.H.S

$$\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$$

apply $R_1 \rightarrow R_1 + R_2 + R_3$

$$\begin{vmatrix} 2(b+c) & 2(a+c) & 2(a+b) \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$$

R_1 से 2 बाहर लेने पर

$$2 \begin{vmatrix} b+c & a+c & a+b \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$$

$R_1 \rightarrow R_1 - R_2$

$$2 \begin{vmatrix} c & 0 & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$$

R_1 के सापेक्ष विस्तार करने पर

$$\begin{aligned} & 2[c\{(c+a)(a+b) - bc\} + a\{bc - c(c+a)\}] \\ & \Rightarrow 2[c(ac + bc + a^2 + ab - bc) + abc - ac^2 - a^2c] \\ & \Rightarrow 2[ac^2 + a^2c + abc + abc - ac^2 - a^2c] \\ & \Rightarrow 4abc = R.H.S \end{aligned}$$

OR

त्रिभुज के शीर्ष

A (3, 8), B (-4, 2) & C (5, 1)

$$\Delta ABC \text{ का क्षेत्रफल} = \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

$$\Rightarrow \frac{1}{2} \begin{vmatrix} 3 & 8 & 1 \\ -4 & 2 & 1 \\ 5 & 1 & 1 \end{vmatrix}$$

$$\Rightarrow \frac{1}{2} [3(2-1) - 8(-4-5) + 1(-4-10)]$$

$$= \frac{1}{2} [3 + 72 - 14]$$

$$\Rightarrow \frac{61}{2} \text{ वर्ग इकाई}$$

$\Rightarrow \cos^{-1} x = L.H.S$

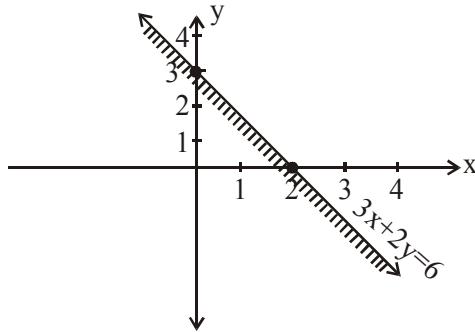
23. Sol. given inequation

$$3x + 2y \leq 6$$

$$3x + 2y = 6 \Rightarrow 3x + 2y - 6 = 0$$

$$\text{Put } x = 0, y = 3 \quad (0, 3)$$

$$\text{Put } y = 0, x = 2 \quad (2, 0)$$



$$\therefore 3x + 2y \leq 6$$

put $x = 0$ & $y = 0$

$$0 \leq 6$$

This is true so shaded region towards the origin

OR

given that

$$\text{Minimise } P = 2x + 4y$$

sub. to constraints :

$$4x + 3y \leq 12, x + 2y \geq 4, x, y \geq 0$$

$$\therefore 4x + 3y \leq 12$$

$$4x + 3y = 12 \dots(1)$$

$$4x + 3y - 12 = 0$$

$$\text{put } x = 0, y = 4 \quad A(0, 4)$$

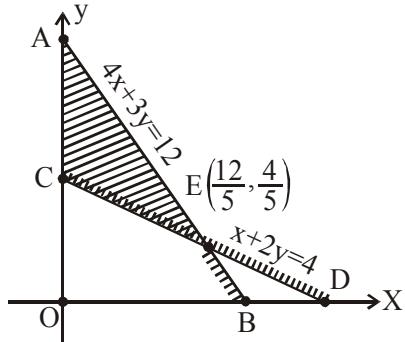
$$\text{put } y = 0, x = 3 \quad B(3, 0)$$

$$\therefore x + 2y \geq 4$$

$$x + 2y = 4 \Rightarrow x + 2y - 4 = 0 \dots(2)$$

$$\text{put } x = 0, y = 2 \quad C(0, 2)$$

$$\text{put } y = 0, x = 4 \quad D(4, 0)$$



from Eqn (1) and (2)

$$4x + 3y = 12$$

$$4(x + 2y = 4)$$

$$\underline{\underline{-5y = -4}}$$

$$y = \frac{4}{5} \text{ and } x = \frac{12}{5}$$

Intersection point is $E\left(\frac{12}{5}, \frac{4}{5}\right)$

$$\therefore 4x + 3y \leq 12$$

put $x = 0$ & $y = 0$

$$0 \leq 12$$

This is true so shaded region towards the origin

$$\therefore x + 2y \geq 4$$

put $x = 0$ & $y = 0$

$$0 \geq 4$$

This is false so shaded region away from the origin

Corner Points	$P = 2x + 4y$
(0, 2)	$P = 8$ min
(0, 4)	$P = 16$
$\left(\frac{12}{5}, \frac{4}{5}\right)$	$P = 8$

Min $P = 8$ at Every point of line segment joining A (0, 2) and E $\left(\frac{12}{5}, \frac{4}{5}\right)$