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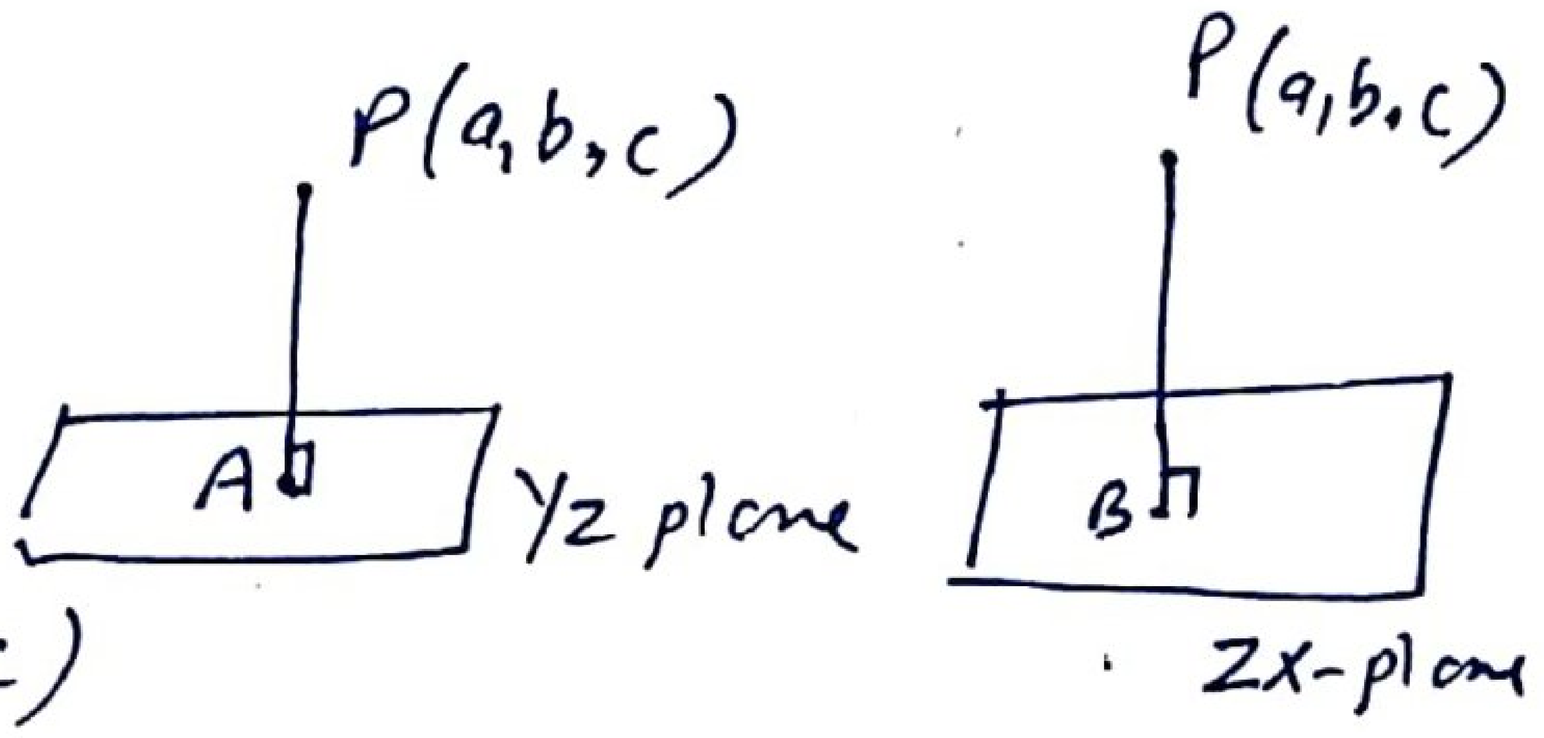
ULTIMATE MATHEMATICS: BY AJAY MITTAL

CHAPTER: 3-D

CLASS No: 4

Qn 1 → If from a point $P(a, b, c)$ perpendiculars PA and PB are drawn to YZ and ZX-planes. Find the equation of the plane OAB

Solution



Coordinate of A is $(0, b, c)$

and coordinate of B is $(a, 0, c)$

and origin $O(0, 0, 0)$

equation of plane OAB is given by

$$\begin{vmatrix} x-0 & y-0 & z-0 \\ 0-0 & b-0 & c-0 \\ a-0 & 0-0 & c-0 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} x & y & z \\ 0 & b & c \\ a & 0 & c \end{vmatrix} = 0$$

$$\Rightarrow x(bc) - y(-ac) + z(-ab) = 0$$

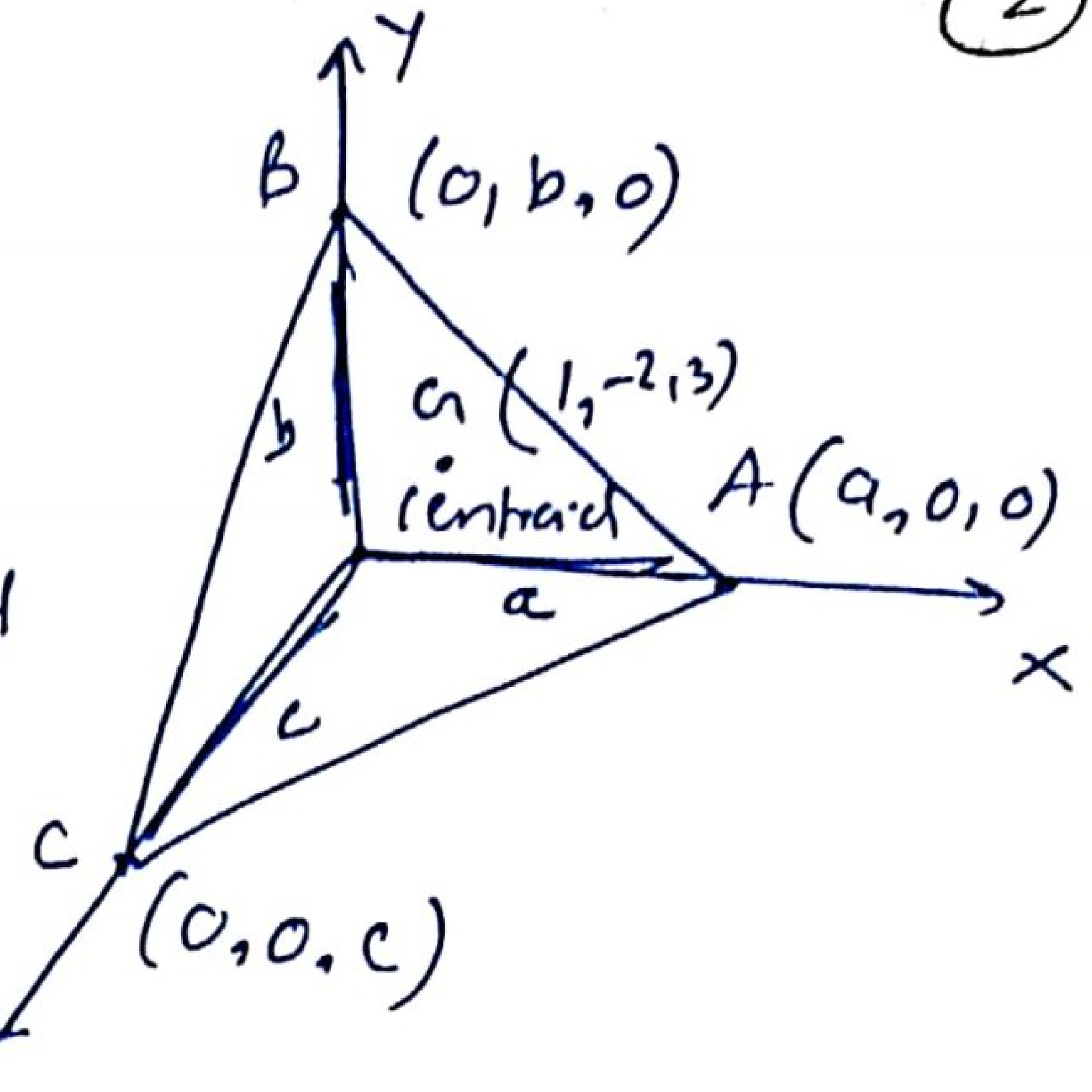
divide by abc

$$\Rightarrow \boxed{\frac{x}{a} + \frac{y}{b} - \frac{z}{c} = 0} \text{ Ans}$$

Qn 2 → A plane meets the coordinate axes at A, B and C respectively such that the centroid of triangle ABC is $(1, -2, 3)$. Find the equation of the plane

Solution

Let $A(a,0,0)$, $B(0,b,0)$ & $C(0,0,c)$



Now $G(1,-2,3)$ is the centroid

then $1 = \frac{a+0+0}{3} \Rightarrow a = 3$

$-2 = \frac{0+b+0}{3} \Rightarrow b = -6$

$3 = \frac{0+0+c}{3} \Rightarrow c = 9$

Now equation of plane in Intercept form

$$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$$

$$\Rightarrow \frac{x}{3} - \frac{y}{6} + \frac{z}{9} = 1$$

$$\Rightarrow \boxed{6x - 3y + 2z = 18} \quad \text{Ans}$$

Ques 3 → Let $\vec{n}$ be a vector of magnitude $2\sqrt{3}$ such that it makes equal acute angles with the coordinate axes. Find the vector and cartesian equation of the plane passing through the point $(1,-1,2)$ and normal to $\vec{n}$.

Solution given $\alpha = \beta = \gamma$

$\Rightarrow \cos\alpha \pm \cos\beta = \cos\gamma$

$\Rightarrow l = m = n$

we have $l^2 + m^2 + n^2 = 1$

$\Rightarrow 3l^2 = 1$

$\Rightarrow l = \frac{1}{\sqrt{3}}$ -- $\{ l \neq -\frac{1}{\sqrt{3}}$; since acute angles given$\}$

$\therefore l = m = n = \frac{1}{\sqrt{3}}$

Now $\hat{n} = l\hat{i} + m\hat{j} + n\hat{k}$

$\Rightarrow \hat{n} = \frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$

Given $|\vec{n}| = 2\sqrt{3}$

we know that $\vec{n} = |\vec{n}|\hat{n}$

$\vec{n} = 2\sqrt{3}\left(\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}\right)$

$\Rightarrow \boxed{\vec{n} = 2\hat{i} + 2\hat{j} + 2\hat{k}}$

let position vector of given point $(1, -1, 2)$ is

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

Vector equation of plane:

$(\vec{r} - \vec{a}) \cdot \vec{n} = 0$

$\Rightarrow \vec{r} \cdot \vec{n} = \vec{a} \cdot \vec{n}$

$\Rightarrow \vec{r} \cdot (2\hat{i} + 2\hat{j} + 2\hat{k}) = (\hat{i} - \hat{j} + 2\hat{k}) \cdot (2\hat{i} + 2\hat{j} + 2\hat{k})$

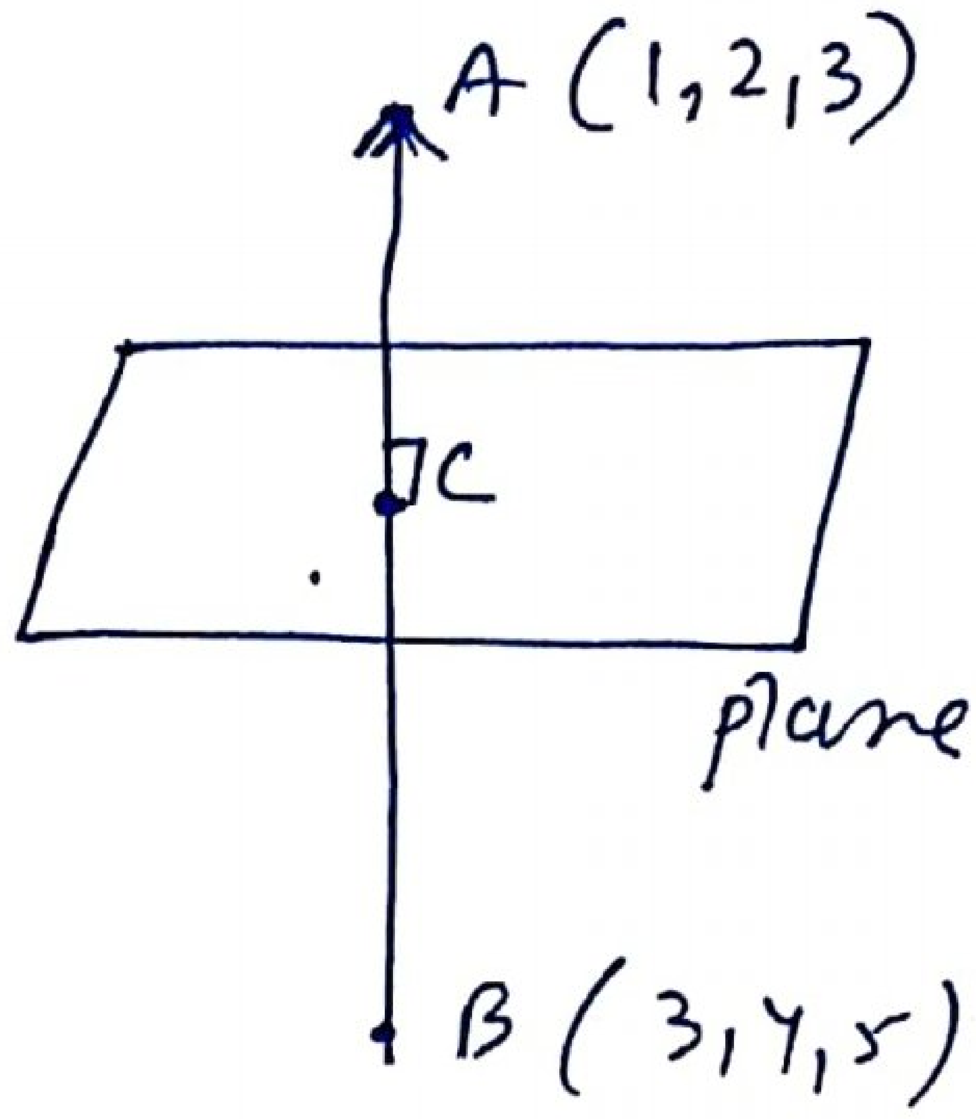
$\Rightarrow \vec{r} \cdot (2\hat{i} + 2\hat{j} + 2\hat{k}) = \cancel{2} - \cancel{2} + 4$

$\Rightarrow \boxed{\vec{r} \cdot (\hat{i} + \hat{j} + \hat{k}) = 2}$

$(x\hat{i} + y\hat{j} + z\hat{k}) \cdot (\hat{i} + \hat{j} + \hat{k}) = 2$

$\Rightarrow \boxed{x + y + z = 2}$ Cartesian equation of plane Ans.

Ques 4 → Find the equation of the plane that bisects the line segment joining the points (1, 2, 3) and (3, 4, 5) and is right angle to it.



Soln Let the given points are

A(1, 2, 3) & B(3, 4, 5)

Let C be the Mid point of AB

∴ Coordinate of C is (2, 3, 4)

given AB ⊥r plane

∴ $\vec{BA}$ is normal to the plane

$\Rightarrow \vec{BA} = \vec{n}$ { You can take also $\vec{AB} = \vec{n}$ }

$\Rightarrow \vec{n} = -2\hat{i} - 2\hat{j} - 2\hat{k}$

point C is on the plane

let its position vector is . $\vec{a} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

Now equation of plane is

$(\vec{r} - \vec{a}) \cdot \vec{n} = 0$

$\Rightarrow \vec{r} \cdot \vec{n} = \vec{a} \cdot \vec{n}$

$\Rightarrow \vec{r} \cdot (-2\hat{i} - 2\hat{j} - 2\hat{k}) = (2\hat{i} + 3\hat{j} + 4\hat{k}) \cdot (-2\hat{i} - 2\hat{j} - 2\hat{k})$

$\Rightarrow \vec{r} \cdot (-2\hat{i} - 2\hat{j} - 2\hat{k}) = -4 - 6 - 8$

$\Rightarrow \vec{r} \cdot (-2\hat{i} - 2\hat{j} - 2\hat{k}) = -18$

$\Rightarrow \boxed{\vec{r} \cdot (\hat{i} + \hat{j} + \hat{k}) = 9}$ vector form

(or) $(x\hat{i} + y\hat{j} + z\hat{k}) \cdot (\hat{i} + \hat{j} + \hat{k}) = 9 \Rightarrow \boxed{x + y + z = 9}$ cartesian form Ans

Ans 5 → Reduce the equation $\vec{r}\cdot(-3\hat{i}+4\hat{j}-12\hat{k})+5=0$ to normal form and hence find the length of perpendicular from the origin to the plane

Solution given equation :

$$\vec{r}\cdot\left(-3\hat{i}+4\hat{j}-12\hat{k}\right)+5=0$$

$$\Rightarrow \vec{r}\cdot\left(-3\hat{i}+4\hat{j}-12\hat{k}\right)=-5$$

$$\Rightarrow \vec{r}\cdot\left(3\hat{i}-4\hat{j}+12\hat{k}\right)=5$$

Divide by $\sqrt{9+16+144}=13$

$$\Rightarrow \boxed{\vec{r}\cdot\left(\frac{3}{13}\hat{i}-\frac{4}{13}\hat{j}+\frac{12}{13}\hat{k}\right)=\frac{5}{13}}$$ normal form

Comparing with $\vec{r}\cdot\hat{n}=d$

here $d=\frac{5}{13}$

$\therefore$ $\boxed{\perp^r \text{ distance of the plane from the origin } = \frac{5}{13}}$ Ans

Ans 6 → Find the equation of a plane which is at a distance $3\sqrt{3}$ from the origin and the normal to which is equally inclined with the coordinate axes.

Solution given $d=3\sqrt{3}$

given $\alpha=\beta=\gamma$

$\Rightarrow \cos\alpha=\cos\beta=\cos\gamma$

$\Rightarrow l=m=n$

we have $l^2+m^2+n^2=1$

$\Rightarrow 3l^2=1$

$\Rightarrow l = \pm \frac{1}{\sqrt{3}}$

$\therefore l = m = n = \pm \frac{1}{\sqrt{3}}$

now $\hat{n} = l\hat{i} + m\hat{j} + n\hat{k}$

$\Rightarrow \hat{n} = \pm \frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$

Equation of plane (normal form)

$\vec{r}\cdot\hat{n} = d$

$\Rightarrow \vec{r}\cdot\left(\pm\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}+\hat{k})\right) = 3\sqrt{3}$

$\Rightarrow \boxed{\vec{r}\cdot(\hat{i}+\hat{j}+\hat{k}) = \pm 9}$ vector form

(or) $(x\hat{i}+y\hat{j}+z\hat{k})\cdot(\hat{i}+\hat{j}+\hat{k}) = \pm 9$

$\Rightarrow \boxed{x+y+z = \pm 9}$ Cartesian form Ans

Ques 7 ⋆ Find the equation of the plane passing through the point $(1, 1, -1)$ and perpendicular to the planes $x+2y+3z=7$ and $2x-3y+4z=0$

Solution given planes $x+2y+3z=7$ (or) $\vec{r}\cdot(\hat{i}+2\hat{j}+3\hat{k})=7$

and $2x-3y+4z=0$ (or) $\vec{r}\cdot(2\hat{i}-3\hat{j}+4\hat{k})=0$

here $\vec{n_1} = \hat{i}+2\hat{j}+3\hat{k}$

$\vec{n_2} = 2\hat{i}-3\hat{j}+4\hat{k}$

let $\vec{n}$ be the normal vector to the required plane

Since, Required plane is $\perp^r$ to the given planes

$\because \vec{n} \perp \vec{n_1}$ & $\vec{n} \perp \vec{n_2}$

$\Rightarrow \vec{n} = \lambda(\vec{n_1} \times \vec{n_2})$

$$\Rightarrow \vec{n} = \lambda \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 2 & -3 & 4 \end{vmatrix}.$$

$\Rightarrow \vec{n} = \lambda(17\hat{i} + 2\hat{j} - 7\hat{k})$

let position vector of given point $(1, 1, -1)$ is
$\vec{a} = \hat{i} + \hat{j} - \hat{k}$

Now, equation of plane is

$(\vec{r} - \vec{a}) \cdot \vec{n} = 0$

$\Rightarrow \vec{r} \cdot \vec{n} = \vec{a} \cdot \vec{n}$

$\Rightarrow \vec{r} \cdot \cancel{\lambda}(17\hat{i} + 2\hat{j} - 7\hat{k}) = (\hat{i} + \hat{j} - \hat{k}) \cdot \cancel{\lambda}(17\hat{i} + 2\hat{j} - 7\hat{k})$

$\Rightarrow \vec{r} \cdot (17\hat{i} + 2\hat{j} - 7\hat{k}) = 17 + 2 + 7$

$\Rightarrow \vec{r} \cdot (17\hat{i} + 2\hat{j} - 7\hat{k}) = 26$

$\Rightarrow (x\hat{i} + y\hat{j} + z\hat{k}) \cdot (17\hat{i} + 2\hat{j} - 7\hat{k}) = 26$

$\Rightarrow \boxed{17x + 2y - 7z = 26}$ Ans

Alternate Method (Cartesian Method)

given planes $x + 2y + 3z = 7$
and $2x - 3y + 4z = 0$

D.R's of normal vector to I^{st} plane $= 1, 2, 3$
D.R's of normal vector to 2^{nd} plane $= 2, -3, 4$

Let DR's of the normal vector to required plane = a, b, c

Since required plane is perpendicular to the given planes

$\therefore$ $a + 2b + 3c = 0$

$2a - 3b + 4c = 0$

$\Rightarrow \dfrac{a}{8+9} = \dfrac{-b}{4-6} = \dfrac{c}{-3-4} = \lambda$

$\Rightarrow a = 17\lambda$; $b = 2\lambda$; $c = -7\lambda$

Point on plane is $(1, 1, -1)$

here $x_1 = 1$, $y_1 = 1$, $z_1 = -1$

Cartesian equation of plane is

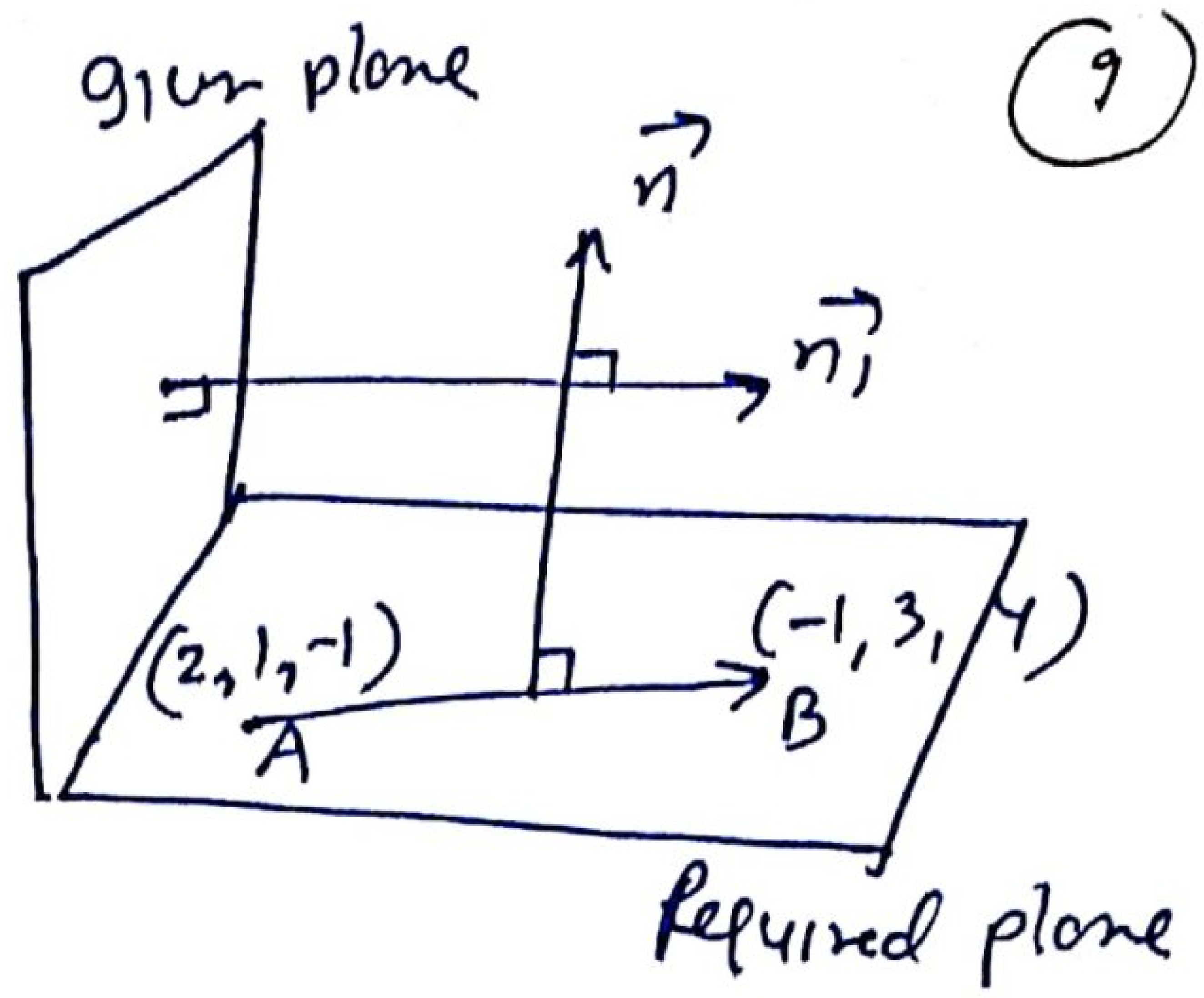
$(x - x_1)a + (y - y_1)b + (z - z_1)c = 0$

$\Rightarrow (x-1)(17\lambda) + (y-1)(2\lambda) + (z+1)(-7\lambda) = 0$

$\Rightarrow 17x - 17 + 2y - 2 - 7z - 7 = 0$

$\Rightarrow \boxed{17x + 2y - 7z = 26}$ Ans

Que 8 → Find the equation of the plane passing through the points $(2, 1, -1)$ & $(-1, 3, 4)$ and perpendicular to the plane $x - 2y + 4z = 10$



Solution

given plane

$x-2y+4z=10$

(or) $\vec{r}\cdot(\hat{i}-2\hat{j}+4\hat{k})=10$

here $\vec{n_1}=\hat{i}-2\hat{j}+4\hat{k}$

let $\vec{n}$ = normal vector to the required plane

Since planes are $\perp^r$

$\therefore\ \vec{n}\perp\vec{n_1}$

Now $\vec{AB}=(-1-2)\hat{i}+(3-1)\hat{j}+(4+1)\hat{k}$

$\vec{AB}=-3\hat{i}+2\hat{j}+5\hat{k}$

$\vec{n}$ also $\perp^r$ to $\vec{AB}$

$\Rightarrow\ \vec{n}=\lambda(\vec{n_1}\times\vec{AB})$

$\Rightarrow\ \vec{n}=\lambda\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 1 & -2 & 4\\ -3 & 2 & 5\end{vmatrix}$

$\vec{n}=\lambda(-18\hat{i}-17\hat{j}-4\hat{k})$

let position vector of point A (2,1,-1) is

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

equation of plane is

$(\vec{r}-\vec{a})\cdot\vec{n}=0$

$\Rightarrow\ \vec{r}\cdot\vec{n}=\vec{a}\cdot\vec{n}$

$\Rightarrow\ \vec{r}\cdot\cancel{\lambda}(-18\hat{i}-17\hat{j}-4\hat{k})=(2\hat{i}+\hat{j}-\hat{k})\cdot(\cancel{\lambda}(-18\hat{i}-17\hat{j}-4\hat{k}))$

$$\Rightarrow \vec{r}\cdot(-18\hat{i}-17\hat{j}-4\hat{k}) = -36-17+4$$

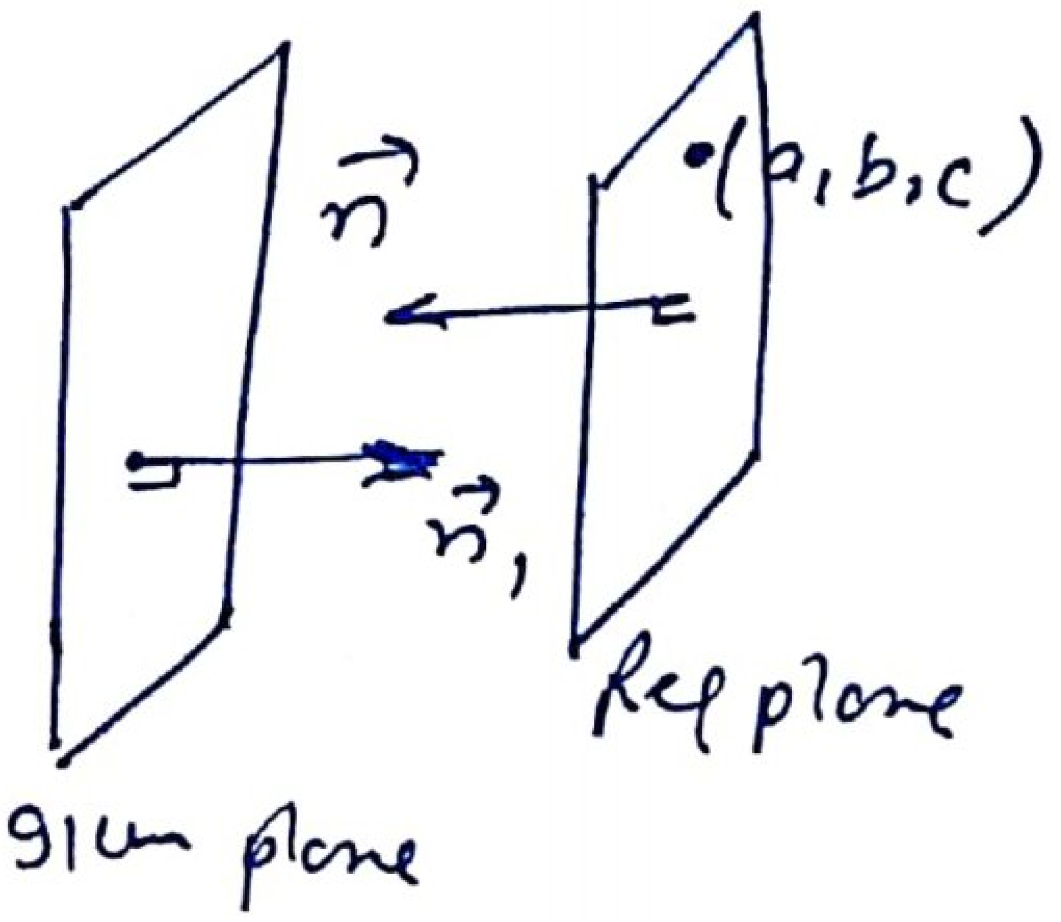
$$\Rightarrow \vec{r}\cdot(-18\hat{i}-17\hat{j}-4\hat{k}) = -49$$

$$\Rightarrow \boxed{\vec{r}\cdot(18\hat{i}+17\hat{j}+4\hat{k}) = 49}$$

$$\Rightarrow (x\hat{i}+y\hat{j}+z\hat{k})\cdot(18\hat{i}+17\hat{j}+4\hat{k}) = 49$$

$$\Rightarrow \boxed{18x+17y+4z = 49}$$ Ans

Ques 9 → Find the equation of the plane passing through the point (a,b,c) and parallel to the plane $\vec{r}\cdot(\hat{i}+\hat{j}+\hat{k}) = 2$



Solution given plane $\vec{r}\cdot(\hat{i}+\hat{j}+\hat{k}) = 2$

here $\vec{n}_1 = \hat{i}+\hat{j}+\hat{k}$

let $\vec{n}$ = normal vector to the plane

Since planes are parallel

$$\therefore \vec{n} \parallel \vec{n}_1$$

$$\Rightarrow \vec{n} = \lambda \vec{n}_1$$

$$\Rightarrow \vec{n} = \lambda(\hat{i}+\hat{j}+\hat{k})$$

let position vector of given point (a,b,c) is

$$\vec{a} = a\hat{i}+b\hat{j}+c\hat{k}$$

vector equation of plane is

$$(\vec{r}-\vec{a})\cdot\vec{n} = 0$$

$\Rightarrow \vec{r}\cdot\vec{n} = \vec{a}\cdot\vec{n}$

$\Rightarrow$ ~~[illegible]~~

$\Rightarrow \vec{r}\cdot(\lambda(\hat{i}+\hat{j}+\hat{k})) = (a\hat{i}+b\hat{j}+c\hat{k})\cdot\cancel{\lambda}(\hat{i}+\hat{j}+\hat{k})$

$\Rightarrow \boxed{\vec{r}\cdot(\hat{i}+\hat{j}+\hat{k}) = a+b+c}$

(or) $\boxed{x+y+z = a+b+c}$ Ans

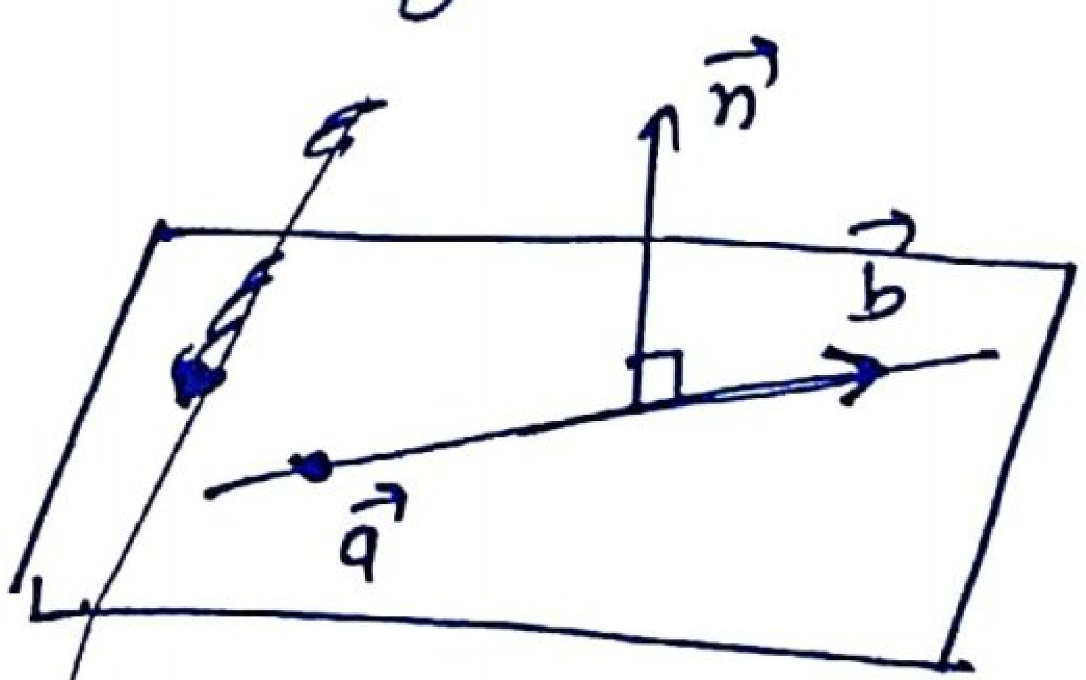
Ques 10 → Show that the plane $18x+17y+4z = 49$ contains the line $\vec{r} = -\hat{i}+3\hat{j}+4\hat{k} + \lambda(3\hat{i}-2\hat{j}-5\hat{k})$

Soln To prove: plane contains the line

we have to prove two conditions:

(1) Point (fixed point) on the line must satisfy the equation of plane

(2) $\vec{b}$ of line must be $\perp^r$ to $\vec{n}$ of plane



Plane: $18x+17y+4z = 19$

here $\vec{n} = 18\hat{i}+17\hat{j}+4\hat{k}$

line $\vec{r} = -\hat{i}+3\hat{j}+4\hat{k} + \lambda(3\hat{i}-2\hat{j}-5\hat{k})$

here fixed point is $(-1,3,4)$ & $\vec{b} = 3\hat{i}-2\hat{j}-5\hat{k}$

$-18+51+16$

$= 19$

$=$ RHS $\therefore$ fixed point satisfy equation of plane

Now $\vec{b}\cdot\vec{n}$

$= (3\hat{i}-2\hat{j}-5\hat{k})\cdot(18\hat{i}+17\hat{j}+4\hat{k})$

$= 54-34-20$

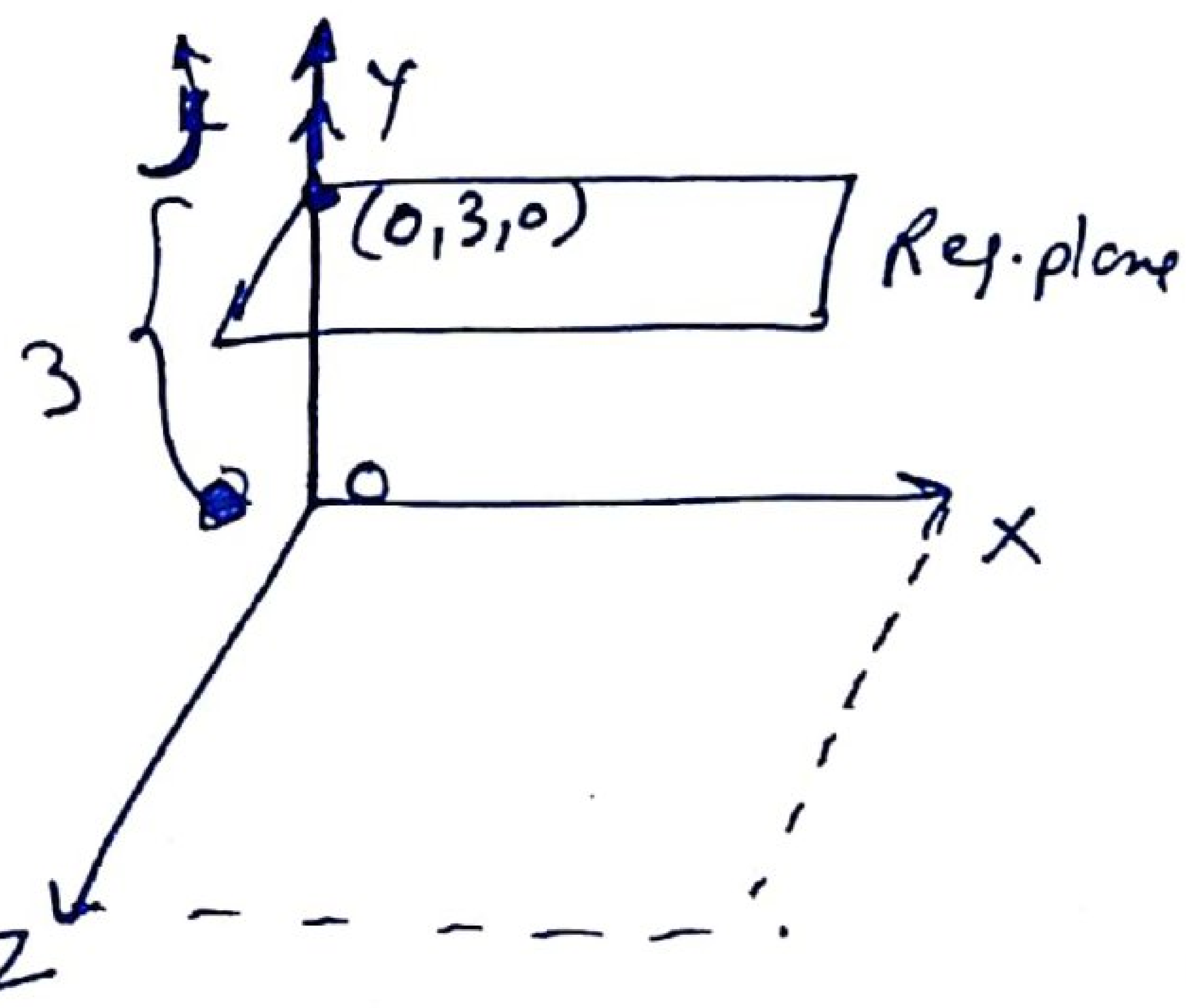
$= 0$

$\Rightarrow \vec{b}\perp\vec{n}$

$\therefore$ plane contains the line. Ans

Que 11 → Find the equation of the plane with Intercept 3 on the Y-axis and parallel to ZOX plane

Sol: when plane is parallel to ZOX plane
then Y-axis is $\perp^r$ to the plane



Hence, here $\vec{n} = \hat{j}$

Point on the plane $= (0,3,0)$ -- {given Y-int = 3}

let p.v of this point $\vec{a} = 0\hat{i}+3\hat{j}+0\hat{k} = 3\hat{j}$

equation of plane $(\vec{r}-\vec{a})\cdot\vec{n}=0$

$\Rightarrow \vec{r}\cdot\vec{n} = \vec{a}\cdot\vec{n}$

$\Rightarrow \vec{r}\cdot\hat{j} = (3\hat{j})\cdot\hat{j}$

$\Rightarrow \boxed{\vec{r}\cdot\hat{j} = 3}$

(or) $(x\hat{i}+y\hat{j}+z\hat{k})\cdot\hat{j}=3$

$\Rightarrow \boxed{y=3}$ Ans

{we can write directly Ans $\boxed{y=3}$ for one marks}

Qn 12 → Find the equation of a plane passing through the line of Intersection of the planes $\vec{r}\cdot(\hat{i}+3\hat{j}-\hat{k})=5$ and $\vec{r}\cdot(2\hat{i}-\hat{j}+\hat{k})-3=0$ and passing through the point $(2,1,-2)$

Soln given planes $\vec{r}\cdot(\hat{i}+3\hat{j}-\hat{k})=5$ and

$\vec{r}\cdot(2\hat{i}-\hat{j}+\hat{k})=3$

here $\vec{n_1}=\hat{i}+3\hat{j}-\hat{k}$; $d_1=5$

$\vec{n_2}=2\hat{i}-\hat{j}+\hat{k}$; $d_2=3$

equation of Required plane.

$\vec{r}\cdot(\vec{n_1}+\lambda\vec{n_2})=d_1+\lambda d_2$

$\Rightarrow \vec{r}\cdot(\hat{i}+3\hat{j}-\hat{k}+2\lambda\hat{i}-\lambda\hat{j}+\lambda\hat{k})=5+3\lambda$

$\Rightarrow \vec{r}\cdot\left(\hat{i}(1+2\lambda)+\hat{j}(3-\lambda)+\hat{k}(-1+\lambda)\right)=5+3\lambda$ ---- (i)

$\Rightarrow (x\hat{i}+y\hat{j}+z\hat{k})\cdot\left(\hat{i}(1+2\lambda)+\hat{j}(3-\lambda)+\hat{k}(-1+\lambda)\right)=5+3\lambda$

$\Rightarrow x(1+2\lambda)+y(3-\lambda)+z(-1+\lambda)=5+3\lambda$

Now given $(2,1,-2)$ lies on it

$2+4\lambda+3-\lambda+2-2\lambda=5+3\lambda$

$-2\lambda=-2 \Rightarrow \lambda=1$

$$\boxed{\vec{r}\cdot(3\hat{i}+2\hat{j}+0\hat{k})=8}$$ Ans

Qn. 13 → Find the equation of plane which contains the line of intersection of the planes $x+2y+3z-4=0$ and $2x+y-z+5=0$ and perpendicular to the plane $5x+3y+6z+8=0$

Sol: Converting given equation of planes in to vector form

$$\vec{r}\cdot(\hat{i}+2\hat{j}+3\hat{k})=4 \quad \text{--- (1)}$$

$$\vec{r}\cdot(2\hat{i}+\hat{j}-\hat{k})=-5 \quad \text{--- (2)}$$

$$\vec{r}\cdot(5\hat{i}+3\hat{j}+6\hat{k})=-8 \quad \text{--- (3)}$$

here $\vec{n_1}=\hat{i}+2\hat{j}+3\hat{k}$; $d_1=4$

$\vec{n_2}=2\hat{i}+\hat{j}+\hat{k}$; $d_2=-5$

$\vec{n_3}=5\hat{i}+3\hat{j}+6\hat{k}$

equation of required plane

$$\vec{r}\cdot(\vec{n_1}+\lambda\vec{n_2})=d_1+\lambda d_2$$

$$\Rightarrow \vec{r}\cdot(\hat{i}+2\hat{j}+3\hat{k}+2\lambda\hat{i}+\lambda\hat{j}-\lambda\hat{k})=4-5\lambda$$

$$\Rightarrow \vec{r}\cdot(\hat{i}(1+2\lambda)+\hat{j}(2+\lambda)+\hat{k}(3-\lambda))=4-5\lambda \text{ -- (i)}$$

here $\vec{n}=\hat{i}(1+2\lambda)+\hat{j}(2+\lambda)+\hat{k}(3-\lambda)$

Since required plane is $\perp^r$ to the 3^{rd} plane

$\therefore \vec{n} \perp \vec{n_3}$.

$\Rightarrow \vec{n} \cdot \vec{n_3} = 0$

$\Rightarrow \left(\hat{i}(1+2\lambda) + \hat{j}(2+\lambda) + \hat{k}(3-\lambda)\right) \cdot (5\hat{i} + 3\hat{j} + 6\hat{k}) = 0$

$\Rightarrow 5 + 10\lambda + 6 + 3\lambda + 18 - 6\lambda = 0$

$\Rightarrow 7\lambda = -29$

$\Rightarrow \lambda = \frac{-29}{7}$ put in eq (i)

$\Rightarrow \vec{r} \cdot \left(\hat{i}\left(1 - \frac{58}{7}\right) + \hat{j}\left(2 - \frac{29}{7}\right) + \hat{k}\left(3 + \frac{29}{7}\right)\right) = 4 + \frac{145}{7}$

$\Rightarrow \vec{r} \cdot \left(\hat{i}(-51) + \hat{j}(-15) + \hat{k}(50)\right) = 173$

$\Rightarrow (x\hat{i} + y\hat{j} + z\hat{k}) \cdot (-51\hat{i} - 15\hat{j} + 50\hat{k}) = 173$

$\Rightarrow \boxed{-51x - 15y + 50z = 173}$ Ans

WORKSHEET NO: 4 | Chapter = 3-D

Qns 1 Find the equation of the plane containing the line of intersection of the plane $x+y+z=6$ and $2x+3y+4z+5=0$ and passing through the point $(1,1,1)$

ANS $20x+23y+26z-69=0$

Qns 2 → Find the equation of the plane through the line of intersection of $\vec{r}\cdot(2\hat{i}-3\hat{j}+4\hat{k})=1$ and $\vec{r}\cdot(\hat{i}-\hat{j})+4=0$ and perpendicular to $\vec{r}\cdot(2\hat{i}-\hat{j}+\hat{k})+8=0$

ANS $\vec{r}\cdot(-5\hat{i}+2\hat{j}+12\hat{k})=47$

Qn. 3 → Find the equation of the plane passing through the point $2\hat{i}+\hat{j}-\hat{k}$ and passing through the line of Intersection of the planes $\vec{r}\cdot(\hat{i}+3\hat{j}-\hat{k})=0$ and $\vec{r}\cdot(\hat{j}+2\hat{k})=0$

ANS $\vec{r}\cdot(\hat{i}+9\hat{j}+11\hat{k})=0$

Qns 4 → Find the equation of the plane which is perpendicular to the plane $5x+3y-6z+8=0$ and passing through the line of intersection of the planes $x+2y+3z-4=0$ and $2x+y-z+5=0$

ANS $33x+45y+50z-41=0$

Qns 5 → Find the vector equation of the plane passing through the points $(2,1,-1)$ and $(-1,3,4)$ and perpendicular to the plane $x-2y+4z=10$

ANS $18x+17y+4z-49=0$

Qns 6 → Find the equation of the plane passing through the point $(-1, 3, 2)$ and perpendicular to each of the planes $x + 2y + 3z = 5$ and $3x + 3y + z = 0$

Ans $7x - 8y + 3z + 25 = 0$

Qn. 7 → Find the equation of the plane passing through the points $\hat{i} - \hat{j} + 2\hat{k}$ and $2\hat{i} - 2\hat{j} + 2\hat{k}$ and which is perpendicular to the plane $\vec{r} \cdot (6\hat{i} - 2\hat{j} + 2\hat{k}) = 9$

Ans $\vec{r} \cdot (\hat{i} + \hat{j} - 2\hat{k}) + 4 = 0$

Qn. 8 → Find the value of λ so that the planes $3x - 6y - 2z = 7$ and $2x + y - \lambda z = 5$ are $\perp^r$ to each other

Ans $\lambda = 0$

Qn. 9 → Find the vector equation of a plane which is at a distance of 6 units from the origin and has $2, -1, 2$ as the direction ratios of a normal to it

Ans $\vec{r} \cdot \left(\frac{2}{3}\hat{i} - \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}\right) = 6$

Qn. 10 → Find the equation of the plane which bisects the line segment joining the points $(-1, 2, 3)$ and $(3, -5, 6)$ at right angles

Ans $4x - 7y + 3z - 28 = 0$

Qn. 11 → Find the Intercepts made on the coordinate axis by the plane $2x + y - 2z = 3$ and also find the direction cosines of the normal to the plane

Ans $\frac{3}{2}, 3, -\frac{3}{2}$; $\frac{2}{3}, \frac{1}{3}, \frac{-2}{3}$

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