

NCERT/CBSE MATHEMATICS CLASS 12 textbook

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MISCELLANEOUS EXERCISES

Solutions to NCERT/CBSE MATH (Class XII) textbook

Chapter 11

THREE DIMENSIONAL GEOMETRY

19. Find the vector equation of the line passing through (1, 2, 3) and parallel to the planes $\vec{r} \cdot (\hat{i} - \hat{j} + 2\hat{k}) = 5$ and $\vec{r} \cdot (3\hat{i} + \hat{j} + \hat{k}) = 6$.

Answer:19

Let the direction of the line be $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$

∴ Equation of the line passing through (1,2,3) having direction \vec{b} is

$$\begin{aligned}\vec{r} &= \hat{i} + 2\hat{j} + 3\hat{k} + \lambda \vec{b} \\ &= \hat{i} + 2\hat{j} + 3\hat{k} + \lambda (b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) \dots (1)\end{aligned}$$

Line (1) and plane $\vec{r} \cdot (\hat{i} - 2\hat{j} + 2\hat{k}) = 5$ are parallel.

⇒ Normal of plane is perpendicular to the line (1)

$$\therefore (b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) \cdot (\hat{i} - 2\hat{j} + 2\hat{k}) = 0$$

$$\text{or } b_1 - b_2 + 2b_3 = 0 \dots (2)$$

Again line (1) and the plane $\vec{r} \cdot (3\hat{i} + \hat{j} + \hat{k}) = 6$ are parallel.

⇒ Normal of plane is perpendicular to the line (1)

$$\therefore (b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) \cdot (3\hat{i} + \hat{j} + \hat{k}) = 0$$

$$\text{or } 3b_1 + b_2 + b_3 = 0 \dots (3)$$

From (2) and (3)

$$\begin{aligned}\frac{b_1}{-1-2} &= \frac{b_2}{6-1} = \frac{b_3}{1+3} \\ \frac{b_1}{-3} &= \frac{b_2}{5} = \frac{b_3}{4} \quad \text{or} \quad \frac{b_1}{3} = \frac{b_2}{-5} = \frac{b_3}{-4}\end{aligned}$$

⇒ 3, -5, -4 are the direction ratios of the line b

∴ Equation of the line (1) may be written as

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

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