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NCERT Class 12- Mathematics: Chapter – 11 Three Dimensional Geometry Part 2

11.2 Solved Examples

Short Answer (S. A)

Question 1: If the direction ratios of a line are $1, 1, 2$, find the direction cosines of the line.

Answer:

The direction cosines are given by

$$l = \frac{a}{\sqrt{a^2 + b^2 + c^2}}, m = \frac{b}{\sqrt{a^2 + b^2 + c^2}}, n = \frac{c}{\sqrt{a^2 + b^2 + c^2}}$$

Here a, b, c are $1, 1, 2,$ respectively.

Therefore, $l = \frac{1}{\sqrt{1^2 + 1^2 + 2^2}}, m = \frac{1}{\sqrt{1^2 + 1^2 + 2^2}}, n = \frac{2}{\sqrt{1^2 + 1^2 + 2^2}}$

$i.e., l = \frac{1}{\sqrt{6}}, m = \frac{1}{\sqrt{6}}, n = \frac{2}{\sqrt{6}}$ $i.e. \pm \left(\frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}} \right)$ are D. C's of the line.

Question 2:

Find the direction cosines of the line passing through the points $P(2, 3, 5)$ and $Q(-1, 2, 4)$.

Answer:

The direction cosines of a line passing through the points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ are

$$\frac{x_2 - x_1}{PQ}, \frac{y_2 - y_1}{PQ}, \frac{z_2 - z_1}{PQ}.$$

Here $PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

$$= \sqrt{(-1-2)^2 + (2-3)^2 + (4-5)^2} = \sqrt{9+1+1} = \sqrt{11}$$

Hence D. C. s are

$$\pm\left(\frac{-3}{\sqrt{11}}, \frac{-1}{\sqrt{11}}, \frac{-1}{\sqrt{11}}\right) \text{or} \pm\left(\frac{3}{\sqrt{11}}, \frac{1}{\sqrt{11}}, \frac{1}{\sqrt{11}}\right).$$

Question 3: If a line makes an angle of $30°, 60°, 90°$ with the positive direction of $x, y, z - axes$, respectively, then find its direction cosines.

Answer:

The direction cosines of a line which makes an angle of α, β, γ with the $axes$, are $\cos\alpha, \cos\beta, \cos\gamma$

Therefore, D. C. s of the line are $\cos 30°, \cos 60°, \cos 90°$ i.e.. , $\pm\left(\frac{\sqrt{3}}{2}, \frac{1}{2}, 0\right)$

Question 4:

The $x-$ coordinate of a point on the line joining the points $Q(2, 2, 1)$ and $R(5, 1, -2)$ is . Find its $z-$ coordinate.

Answer:

Let the point P divide QR in the ratio $\lambda : 1$, then the co-ordinate of P are

$$\left(\frac{5\lambda+2}{\lambda+1}, \frac{\lambda+2}{\lambda+1}, \frac{-2\lambda+1}{\lambda+1}\right)$$

But $x-$ coordinate of P is . Therefore,

$$\frac{5\lambda+2}{\lambda+1} = 4 \Rightarrow \lambda = 2$$

Hence, the $z-$ coordinate of P is $\frac{-2\lambda+1}{\lambda+1} = -1$

Question 5: Find the distance of the point whose position vector is $\left(2\hat{\imath} + \hat{\jmath} - \hat{k}\right)$ from the plane $\vec{r}.\left(\hat{\imath} - 2\hat{\jmath} + 4\hat{k}\right) = 9$

Answer:

Here $\vec{a} = 2\hat{\imath} + \hat{\jmath} - \hat{k}, \vec{n} = \hat{\imath} - 2\hat{\jmath} + 4\hat{k} \text{and} d = 9$

So, the required distance is $\frac{\left|\left(2\hat{\imath} + \hat{\jmath} - \hat{k}\right).\left(\hat{\imath} - 2\hat{\jmath} + 4\hat{k}\right) - 9\right|}{\sqrt{1+4+16}}$

$$= \frac{|2-2-4-9|}{\sqrt{21}} = \frac{13}{\sqrt{21}}$$

Question 6:

Find the distance of the point $(-2, 4, -5)$ from the line $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$

Answer:

Here $P(-2, 4, -5)$ is the given point.

Any point Q on the line is given by $(3\lambda - 3, 5\lambda + 4, (6\lambda - 8))$,

$\overrightarrow{PQ} = (3\lambda - 1)\,\hat{i} + 5\lambda\hat{j} + (6\lambda - 3)\,\hat{k}$.

Since $\overrightarrow{PQ} \perp \left(3\hat{i} + 5\hat{j} + 6\hat{k}\right)$, we have

$$3(3\lambda - 1) + 5(5\lambda) + 6(6\lambda - 3) = 0$$

$$9\lambda + 25\lambda + 36\lambda = 21, i.e. \lambda = \frac{3}{10}$$

Thus $\overrightarrow{PQ} = \frac{1}{10}\hat{i} + \frac{15}{10}\hat{j} - \frac{12}{10}\hat{k}$

Hence $\left|\overrightarrow{PQ}\right| = \frac{1}{10}\sqrt{1 + 225 + 144} = \sqrt{\frac{37}{10}}$.