

## EXERCISE 28.1

**Q1.**

**Solution:**

We know that the vector equation of a line is given as

$$\vec{r} = \vec{a} + \lambda\vec{b}$$

So, the Cartesian equation of a line is given as

$$\frac{x-x_1}{a_1} = \frac{y-y_1}{a_2} = \frac{z-z_3}{a_3}$$

By using the above formulas,

Hence,

The vector equation of the line is

$$\vec{r} = (5\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(3\hat{i} + 2\hat{j} - 8\hat{k})$$

The Cartesian equation of a line is

$$\frac{x-5}{3} = \frac{y-2}{2} = \frac{z+4}{-8}$$

**Q2.**

**Solution:**

It is given that,

The direction ratios of the line are:  $(3+1, 4-0, 6-2) = (4, 4, 4)$

Since the given line passes through  $(-1, 0, 2)$

We know that the vector equation of a line is given as

$$\vec{r} = \vec{a} + \lambda\vec{b}$$

So let us substitute the values, we get

$$\vec{r} = \vec{a} + \lambda\vec{b}$$

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

Hence,

The vector equation of the line is

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

**Q3.**

**Solution:**

Let us consider,

Vector equation of line passing through a fixed point vector  $\vec{a}$  and parallel to vector  $\vec{b}$  is given as

$$\vec{r} = \vec{a} + \lambda\vec{b} \quad \text{Where, } \lambda \text{ is scalar.}$$

So here,

$$\vec{b} = 2\hat{i} - \hat{j} + 3\hat{k} \quad \text{and} \quad \vec{a} = 5\hat{i} - 2\hat{j} + 4\hat{k}$$

The equation of the required line is

$$\vec{r} = \vec{a} + \lambda \vec{b}$$

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

Let us substitute the value of r as

$$:\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

So we get,

$$(x\hat{i} + y\hat{j} + z\hat{k}) = (5 + 2\lambda)\hat{i} + (-2 - \lambda)\hat{j} + (4 + 3\lambda)\hat{k}$$

Now, let us compare the coefficients of vector i, j, R

$$x = 5 + 2\lambda, y = -2 - \lambda, z = 4 + 3\lambda$$

By equating to  $\lambda$  we get,

$$\frac{x-5}{2} = \lambda, \frac{y+2}{-1} = \lambda, \frac{z-4}{3} = \lambda$$

Hence,

The Cartesian form of equation of the line is

$$\frac{x-5}{2} = \frac{y+2}{-1} = \frac{z-4}{3}$$

**Q4.**

**Solution:**

Let us consider,

Vector equation of line passing through a fixed point vector a and parallel to vector b is given as

$$\vec{r} = \vec{a} + \lambda \vec{b} \quad \text{Where, } \lambda \text{ is scalar.}$$

So here,

$$\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k} \quad \text{and} \quad \vec{b} = 3\hat{i} + 4\hat{j} - 5\hat{k}$$

The equation of the required line is

$$\vec{r} = \vec{a} + \lambda \vec{b}$$

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

Let us substitute the value of r as

$$:\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

So we get,

$$x\hat{i} + y\hat{j} + z\hat{k} = (2 + 3\lambda)\hat{i} + (-3 + 4\lambda)\hat{j} + (4 - 5\lambda)\hat{k}$$

Now, let us compare the coefficients of vector i, j, R

$$x = 2 + 3\lambda, y = -3 + 4\lambda, z = 4 - 5\lambda$$

By equating to  $\lambda$  we get,

$$\frac{x-2}{3} = \lambda, \frac{y+3}{4} = \lambda, \frac{z-4}{-5} = \lambda$$

Hence,

The Cartesian form of equation of the line is

$$\frac{x-2}{3} = \frac{y+3}{4} = \frac{z-4}{-5}$$

**Q5.**

**Solution:**

It is given that, ABCD is a parallelogram.

Let us consider, AC and BD bisects each other at point O.

So,

$$\begin{aligned} \text{Position vector of point O} &= \frac{\vec{a} + \vec{c}}{2} \\ &= \frac{(4\hat{i} + 5\hat{j} - 10\hat{k}) + (-\hat{i} + 2\hat{j} + \hat{k})}{2} \\ &= \frac{3\hat{i} + 7\hat{j} - 9\hat{k}}{2} \end{aligned}$$

Let us consider position vector of point O and B are represented by  $\vec{o}$  and  $\vec{b}$ .

So,

Equation of the line BD is the line passing through O and B is given by

$$\vec{r} = \vec{a} + \lambda(\vec{b} - \vec{a}) \quad \left[ \text{Since equation of the line passing through} \right]$$

two points  $\vec{a}$  and  $\vec{b}$

$$\vec{r} = \vec{b} + \lambda(\vec{o} - \vec{b})$$

$$= (2\hat{i} - 3\hat{j} + 4\hat{k}) + \lambda \left( \frac{3\hat{i} + 7\hat{j} - 9\hat{k}}{2} - 2\hat{i} - 3\hat{j} + 4\hat{k} \right)$$

$$\vec{r} = (2\hat{i} - 3\hat{j} + 4\hat{k}) + \lambda(3\hat{i} + 7\hat{j} - 9\hat{k} - 4\hat{i} + 6\hat{j} - 8\hat{k})$$

$$\vec{r} = (2\hat{i} - 3\hat{j} + 4\hat{k}) + \lambda(-\hat{i} + 13\hat{j} - 17\hat{k})$$

Now let us substitute the value r as

$$: \vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

So we get,

$$(x\hat{i} + y\hat{j} + z\hat{k}) = (2 - \lambda)\hat{i} + (-3 + 13\lambda)\hat{j} + (4 - 17\lambda)\hat{k}$$

Now, let us compare the coefficients of vector i, j, R

$$x = 2 - \lambda, y = -3 - 13\lambda, z = 4 - 17\lambda$$

By equating to  $\lambda$  we get,

$$\frac{x-2}{-1} = \lambda, \frac{y+3}{13} = \lambda, \frac{z-4}{-17} = \lambda$$

Hence,

The Cartesian form of equation of the line BD is

$$\frac{x-2}{-1} = \frac{y+3}{13} = \frac{z-4}{-17}$$



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