3D COORDINATE GEOMETRY

1. The distance, of the point (7, –2, 11) from the line $\frac{x-6}{1}=\frac{y-4}{0}=\frac{z-8}{3}$ along the line $\frac{x-5}{2}=\frac{y-1}{-3}=\frac{z-5}{6}$, is :

(1) 12 (2) 14

(3) 18 (4) 21

2. If the shortest distance between the lines $\frac{x-4}{1}=\frac{y+1}{2}=\frac{z}{-3}$ and $\frac{x-\lambda}{2}=\frac{y+1}{4}=\frac{z-2}{-5}$ is $\frac{6}{\sqrt{5}}$, then the sum of all possible values of λ is :

(1) 5 (2) 8

(3) 7 (4) 10

3. Let the image of the point (1, 0, 7) in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$ be the point (α, β, γ). Then which one of the following points lies on the line passing through (α, β, γ) and making angles $\frac{2\pi}{3}$ and $\frac{3\pi}{4}$ with y-axis and z-axis respectively and an acute angle with x-axis ?

(1) $\left(1,-2,1+\sqrt{2}\right)$ (2) $\left(1,2,1-\sqrt{2}\right)$

(3) $\left(3,4,3-2\sqrt{2}\right)$ (4) $\left(3,-4,3+2\sqrt{2}\right)$

4. The lines $\frac{x-2}{2}=\frac{y}{-2}=\frac{z-7}{16}$ and $\frac{x+3}{4}=\frac{y+2}{3}=\frac{z+2}{1}$ intersect at the point P. If the distance of P from the line $\frac{x+1}{2}=\frac{y-1}{3}=\frac{z-1}{1}$ is l, then $14l^2$ is equal to……………..

5. Let PQR be a triangle with $R(-1, 4, 2)$. Suppose M(2, 1, 2) is the mid point of PQ. The distance of the centroid of ΔPQR from the point of intersection of the line $\frac{x-2}{0}=\frac{y}{2}=\frac{z+3}{-1}$ and $\frac{x-1}{1}=\frac{y+3}{-3}=\frac{z+1}{1}$ is

(1) 69 (2) 9 (3) $\sqrt{69}$ (4) $\sqrt{99}$

6. A line with direction ratios 2, 1, 2 meets the lines x = y +2 = z and x + 2 = 2y = 2z respectively at the point P and Q. if the length of the perpendicular from the point (1, 2, 12) to the line PQ is l, then l^2 is

7. Let P(3, 2, 3), Q (4, 6, 2) and R (7, 3, 2) be the vertices of ΔPQR. Then, the angle $\angle$QPR is

(1) $\frac{\pi}{6}$ (2) $\cos^{-1}\left(\frac{7}{18}\right)$

(3) $\cos^{-1}\left(\frac{1}{18}\right)$ (4) $\frac{\pi}{3}$

8. Let O be the origin, and M and N be the points on the lines $\frac{x-5}{4}=\frac{y-4}{1}=\frac{z-5}{3}$ and $\frac{x+8}{12}=\frac{y+2}{5}=\frac{z+11}{9}$ respectively such that MN is the shortest distance between the given lines. Then $OM \cdot ON$ is equal to _______.

9. Let (α, β, γ) be the foot of perpendicular from the point (1, 2, 3) on the line $\frac{x+3}{5}=\frac{y-1}{2}=\frac{z+4}{3}$. then $19(\alpha+\beta+\gamma)$ is equal to :

(1) 102 (2) 101

(3) 99 (4) 100

10. If d_1 is the shortest distance between the lines x + 1 = 2y = –12z, x = y + 2 = 6z – 6 and d_2 is the shortest distance between the lines $\frac{x-1}{2}=\frac{y+8}{-7}=\frac{z-4}{5}$, $\frac{x-1}{2}=\frac{y-2}{1}=\frac{z-6}{-3}$, then the value of $\frac{32\sqrt{3}d_1}{d_2}$ is :

11. Let a line passing through the point (–1, 2, 3) intersect the lines L_1: $\frac{x-1}{3}=\frac{y-2}{2}=\frac{z+1}{-2}$ at $M(\alpha, \beta, \gamma)$ and L_2: $\frac{x+2}{-3}=\frac{y-2}{-2}=\frac{z-1}{4}$ at N(a, b, c). Then the value of $\frac{(\alpha+\beta+\gamma)^2}{(a+b+c)^2}$ equals _____.

12. The distance of the point Q(0, 2, –2) from the line passing through the point P(5, –4, 3) and perpendicular to the lines

$\vec{r} = \left(-3\hat{i} + 2\hat{k}\right) + \lambda\left(2\hat{i} + 3\hat{j} + 5\hat{k}\right),\ \lambda \in \mathbb{R}$ and

$\vec{r} = \left(\hat{i} - 2\hat{j} + \hat{k}\right) + \mu\left(-\hat{i} + 3\hat{j} + 2\hat{k}\right),\ \mu \in \mathbb{R}$ is

(1) $\sqrt{86}$ (2) $\sqrt{20}$

(3) $\sqrt{54}$ (4) $\sqrt{74}$

13. Let Q and R be the feet of perpendiculars from the point P(a, a, a) on the lines x = y, z = 1 and x = –y, z = –1 respectively. If $\angle QPR$ is a right angle, then $12a^2$ is equal to ______

14. Let (α, β, γ) be mirror image of the point (2, 3, 5) in the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$.

Then $2\alpha + 3\beta + 4\gamma$ is equal to

(1) 32 (2) 33

(3) 31 (4) 34

15. The shortest distance between lines L_1 and L_2, where L_1: $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+4}{2}$ and L_2 is the line passing through the points $A(-4, 4, 3)$, $B(-1, 6, 3)$ and perpendicular to the line $\frac{x-3}{-2} = \frac{y}{3} = \frac{z-1}{1}$, is

(1) $\frac{121}{\sqrt{221}}$ (2) $\frac{24}{\sqrt{117}}$

(3) $\frac{141}{\sqrt{221}}$ (4) $\frac{42}{\sqrt{117}}$

16. A line passes through A(4, –6, –2) and B(16, –2,4). The point P(a, b, c) where a, b, c are non-negative integers, on the line AB lies at a distance of 21 units, from the point A. The distance between the points P(a, b, c) and Q(4, –12, 3) is equal to ______.

17. If the shortest distance between the lines $\frac{x-\lambda}{-2} = \frac{y-2}{1} = \frac{z-1}{1}$ and $\frac{x-\sqrt{3}}{1} = \frac{y-1}{-2} = \frac{z-2}{1}$ is 1, then the sum of all possible values of λ is :

(1) 0 (2) $2\sqrt{3}$

(3) $3\sqrt{3}$ (4) $-2\sqrt{3}$

18. Let P and Q be the points on the line $\frac{x+3}{8} = \frac{y-4}{2} = \frac{z+1}{2}$ which are at a distance of 6 units from the point R (1,2,3). If the centroid of the triangle PQR is (α, β, γ), then $\alpha^2 + \beta^2 + \gamma^2$ is:

(1) 26 (2) 36

(3) 18 (4) 24

19. If the mirror image of the point P(3,4,9) in the line $\frac{x-1}{3} = \frac{y+1}{2} = \frac{z-2}{1}$ is (α, β, γ), then $14(\alpha + \beta + \gamma)$ is :

(1) 102 (2) 138

(3) 108 (4) 132

20. If the shortest distance between the lines $\frac{x-\lambda}{2} = \frac{y-4}{3} = \frac{z-3}{4}$ and $\frac{x-2}{4} = \frac{y-4}{6} = \frac{z-7}{8}$ is $\frac{13}{\sqrt{29}}$, then a value of λ is :

(1) $-\frac{13}{25}$ (2) $\frac{13}{25}$

(3) 1 (4) –1

21. Let $P(\alpha, \beta, \gamma)$ be the image of the point Q(1, 6, 4) in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$. Then $2\alpha + \beta + \gamma$ is equal to _______.

22. Consider the line L passing through the points (1, 2, 3) and (2, 3, 5). The distance of the point $\left(\frac{11}{3}, \frac{11}{3}, \frac{19}{3}\right)$ from the line L along the line $\frac{3x-11}{2} = \frac{3y-11}{1} = \frac{3z-19}{2}$ is equal to :

(1) 3 (2) 5

(3) 4 (4) 6

23. The square of the distance of the image of the point (6, 1, 5) in the line $\frac{x-1}{3}=\frac{y}{2}=\frac{z-2}{4}$, from the origin is ______.

24. Let the line L intersect the lines
$x - 2 = -y = z - 1,\ 2(x + 1) = 2(y - 1) = z + 1$
and be parallel to the line $\frac{x-2}{3}=\frac{y-1}{1}=\frac{z-2}{2}$.
Then which of the following points lies on L ?

(1) $\left(-\frac{1}{3},1,1\right)$ (2) $\left(-\frac{1}{3},1,-1\right)$

(3) $\left(-\frac{1}{3},-1,-1\right)$ (4) $\left(-\frac{1}{3},-1,1\right)$

25. The shortest distance between the line
$\frac{x-3}{4}=\frac{y+7}{-11}=\frac{z-1}{5}$ and $\frac{x-5}{3}=\frac{y-9}{-6}=\frac{z+2}{1}$ is :

(1) $\frac{187}{\sqrt{563}}$ (2) $\frac{178}{\sqrt{563}}$

(3) $\frac{185}{\sqrt{563}}$ (4) $\frac{179}{\sqrt{563}}$

26. Let the point, on the line passing through the points P(1, –2, 3) and Q(5, –4, 7), farther from the origin and at a distance of 9 units from the point P, be (α, β, γ). Then $\alpha^2 + \beta^2 + \gamma^2$ is equal to :

(1) 155 (2) 150

(3) 160 (4) 165

27. If the shortest distance between the lines $\frac{x+2}{2}=\frac{y+3}{3}=\frac{z-5}{4}$ and $\frac{x-3}{1}=\frac{y-2}{-3}=\frac{z+4}{2}$ is $\frac{38}{3\sqrt{5}}k$ and $\int_0^k [x^2]dx = \alpha - \sqrt{\alpha}$, where [x] denotes the greatest integer function, then $6\alpha^3$ is equal to ______.

28. Let (α, β, γ) be the image of the point (8, 5, 7) in the line $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-2}{5}$. Then $\alpha + \beta + \gamma$ is equal to

(1) 16 (2) 18

(3) 14 (4) 20

29. Let the point $(-1, \alpha, \beta)$ lie on the line of the shortest distance between the lines $\frac{x+2}{-3}=\frac{y-2}{4}=\frac{z-5}{2}$ and $\frac{x+2}{-1}=\frac{y+6}{2}=\frac{z-1}{0}$.
Then $(\alpha-\beta)^2$ is equal to _____.

30. Let P the point of intersection of the lines $\frac{x-2}{1}=\frac{y-4}{5}=\frac{z-2}{1}$ and $\frac{x-3}{2}=\frac{y-2}{3}=\frac{z-3}{2}$.
Then, the shortest distance of P from the line $4x = 2y = z$ is

(1) $\frac{5\sqrt{14}}{7}$ (2) $\frac{\sqrt{14}}{7}$

(3) $\frac{3\sqrt{14}}{7}$ (4) $\frac{6\sqrt{14}}{7}$

31. Consider a line L passing through the points P(1,2,1) and Q(2,1,–1). If the mirror image of the point A(2,2,2) in the line L is (α,β,γ), then $\alpha + \beta + 6\gamma$ is equal to …..

32. Let d be the distance of the point of intersection of the lines $\frac{x+6}{3}=\frac{y}{2}=\frac{z+1}{1}$ and $\frac{x-7}{4}=\frac{y-9}{3}=\frac{z-4}{2}$ from the point (7, 8, 9). Then $d^2 + 6$ is equal to :

(1) 72 (2) 69

(3) 75 (4) 78

33. Let P (α, β, γ) be the image of the point Q(3, –3, 1) in the line $\frac{x-0}{1}=\frac{y-3}{1}=\frac{z-1}{-1}$ and R be the point (2, 5, –1). If the area of the triangle PQR is λ and $\lambda^2 = 14K$, then K is equal to:

(1) 36 (2) 72

(3) 18 (4) 81

34. If the shortest distance between the lines $\frac{x-\lambda}{3}=\frac{y-2}{-1}=\frac{z-1}{1}$ and $\frac{x+2}{-3}=\frac{y+5}{2}=\frac{z-4}{4}$ is $\frac{44}{\sqrt{30}}$, then the largest possible value of $|\lambda|$ is equal to _______.

35. If the line $\frac{2-x}{3}=\frac{3y-2}{4\lambda+1}=4-z$ makes a right angle with the line $\frac{x+3}{3\mu}=\frac{1-2y}{6}=\frac{5-z}{7}$, then $4\lambda+9\mu$ is equal to :

(1) 13 (2) 4
(3) 5 (4) 6

36. Let P(x, y, z) be a point in the first octant, whose projection in the xy-plane is the point Q. Let OP = γ; the angle between OQ and the positive x-axis be θ; and the angle between OP and the positive z-axis be φ, where O is the origin. Then the distance of P from the x-axis is :

(1) $\gamma\sqrt{1-\sin^2\varphi\cos^2\theta}$ (2) $\gamma\sqrt{1+\cos^2\theta\sin^2\varphi}$
(3) $\gamma\sqrt{1-\sin^2\theta\cos^2\varphi}$ (4) $\gamma\sqrt{1+\cos^2\varphi\sin^2\theta}$

37. If the shortest distance between the lines

$L_1: \vec{r}=(2+\lambda)\hat{i}+(1-3\lambda)\hat{j}+(3+4\lambda)\hat{k},\ \lambda\in\mathbb{R}$

$L_2: \vec{r}=2(1+\alpha)\hat{i}+3(1+\alpha)\hat{j}+(5+\alpha)\hat{k},\ \alpha\in\mathbb{R}$

is $\frac{m}{\sqrt{n}}$, where gcd (m, n) = 1, then the value of m + n equals.

(1) 384
(2) 387
(3) 377
(4) 390

38. The shortest distance between the lines $\frac{x-3}{2}=\frac{y+15}{-7}=\frac{z-9}{5}$ and $\frac{x+1}{2}=\frac{y-1}{1}=\frac{z-9}{-3}$ is

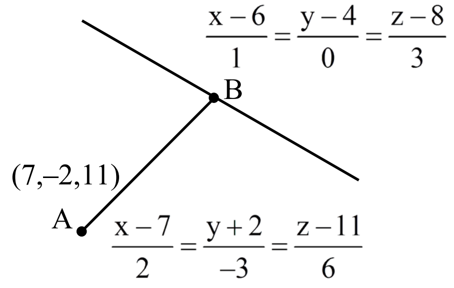
(1) $6\sqrt{3}$ (2) $4\sqrt{3}$
(3) $5\sqrt{3}$ (4) $8\sqrt{3}$

39. Let P be the point (10, –2, –1) and Q be the foot of the perpendicular drawn from the point R(1, 7, 6) on the line passing through the points (2, –5, 11) and (–6, 7, –5). Then the length of the line segment PQ is equal to ________.

SOLUTIONS

1. **Ans. (2)**

Sol. $B = (2\lambda + 7, -3\lambda - 2, 6\lambda + 11)$



Point B lies on $\frac{x-6}{1} = \frac{y-4}{0} = \frac{z-8}{3}$

$$\frac{2\lambda + 7 - 6}{1} = \frac{-3\lambda - 2 - 4}{0} = \frac{6\lambda + 11 - 8}{3}$$

$-3\lambda - 6 = 0$

$\lambda = -2$

$B \Rightarrow (3, 4, -1)$

$$AB = \sqrt{(7-3)^2 + (4+2)^2 + (11+1)^2}$$

$$= \sqrt{16 + 36 + 144}$$

$$= \sqrt{196} = 14$$

2. **Ans. (2)**

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

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

the shortest distance between the lines

$$= \left|\frac{(\vec{a}-\vec{b})\cdot(\vec{d}_1 \times \vec{d}_2)}{|\vec{d}_1 \times \vec{d}_2|}\right|$$

$$= \left|\frac{\begin{vmatrix} \lambda-4 & 0 & 2 \\ 1 & 2 & -3 \\ 2 & 4 & -5 \end{vmatrix}}{\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & -3 \\ 2 & 4 & -5 \end{vmatrix}}\right|$$

$$= \left|\frac{(\lambda-4)(-10+12) - 0 + 2(4-4)}{|2\hat{i} - 1\hat{j} + 0\hat{k}|}\right|$$

$$\frac{6}{\sqrt{5}} = \left|\frac{2(\lambda-4)}{\sqrt{5}}\right|$$

$3 = |\lambda - 4|$

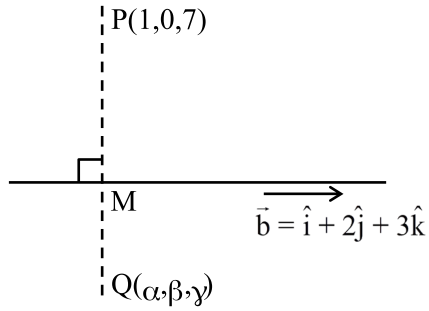
$\lambda - 4 = \pm 3$

$\lambda = 7, 1$

Sum of all possible values of λ is = 8

3. **Ans. (3)**

Sol. $L_1 = \frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3} = \lambda$



$M(\lambda, 1 + 2\lambda, 2 + 3\lambda)$

$\vec{PM} = (\lambda - 1)\hat{i} + (1 + 2\lambda)\hat{j} + (3\lambda - 5)\hat{k}$

$\vec{PM}$ is perpendicular to line L_1

$\vec{PM}\cdot\vec{b} = 0 \quad (\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k})$

$\Rightarrow \lambda - 1 + 4\lambda + 2 + 9\lambda - 15 = 0$

$14\lambda = 14 \Rightarrow \lambda = 1$

$\therefore M(1, 3, 5)$

$\vec{Q} = 2\vec{M} - \vec{P}$ [M is midpoint of P & Q]

$\vec{Q} = 2\hat{i} + 6\hat{j} + 10\hat{k} - \hat{i} - 7\hat{k}$

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

$\therefore (\alpha, \beta, \gamma) = (1, 6, 3)$

Required line having direction cosine (l, m, n)

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

$$\Rightarrow l^2 + \left(-\frac{1}{2}\right)^2 + \left(-\frac{1}{\sqrt{2}}\right)^2 = 1$$

$$l^2 = \frac{1}{4}$$

$\therefore l = \frac{1}{2}$ [Line make acute angle with x-axis]

Equation of line passing through (1, 6, 3) will be

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

Option (3) satisfying for $\alpha = 4$

4. Ans. (108)

Sol. $\frac{x-2}{1}=\frac{y}{-1}=\frac{z-7}{8}=\lambda$

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

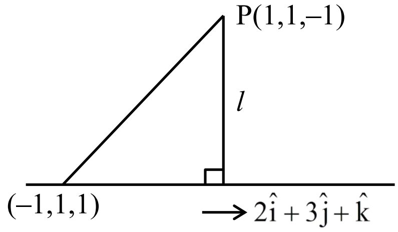
$\Rightarrow \lambda+2=4k-3$

$-\lambda=3k-2$

$\Rightarrow k=1, \lambda=-1$

$8\lambda+7=k-2$

$\therefore P\equiv(1,1,-1)$



Projection of $2\hat{i}-2\hat{k}$ on $2\hat{i}+3\hat{j}+\hat{k}$ is

$=\frac{4-2}{\sqrt{4+9+1}}=\frac{2}{\sqrt{14}}$

$\therefore l^2=8-\frac{4}{14}=\frac{108}{14}$

$\Rightarrow 14l^2=108$

5. Ans. (3)

Sol. Centroid G divides MR in 1 : 2

G(1, 2, 2)

Point of intersection A of given lines is (2,–6, 0)

$AG=\sqrt{69}$

6. Ans. (65)

Sol. Let $P(t, t-2, t)$ and $Q(2s-2, s, s)$

D.R's of PQ are 2, 1, 2

$\frac{2s-2-t}{2}=\frac{s-t+2}{1}=\frac{s-t}{2}$

$\Rightarrow t=6$ and $s=2$

$\Rightarrow$ P(6, 4, 6) and Q(2, 2, 2)

$PQ:\frac{x-2}{2}=\frac{y-2}{1}=\frac{z-2}{2}=\lambda$

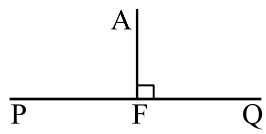
Let $F(2\lambda+2, \lambda+2, 2\lambda+2)$

A(1, 2,12)

$\vec{AF}\cdot\vec{PQ}=0$

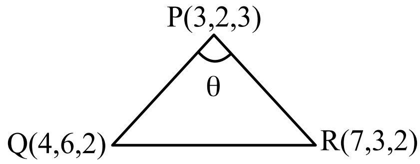
$\therefore\lambda=2$

So F(6,4, 6) and $AF=\sqrt{65}$



7. Ans. (4)

Sol.



Direction ratio of PR = (4, 1, –1)

Direction ratio of PQ = (1, 4, –1)

Now, $\cos\theta=\left|\frac{4+4+1}{\sqrt{18}\cdot\sqrt{18}}\right|$

$\theta=\frac{\pi}{3}$

8. Ans. (9)

Sol. $L_1: \frac{x-5}{4}=\frac{y-4}{1}=\frac{z-5}{3}=\lambda$ drs (4,1,3) = b_1

M $(4\lambda+5, \lambda+4, 3\lambda+5)$

$L_2: \frac{x+8}{12}=\frac{y+2}{5}=\frac{z+11}{9}=\propto$

$N(12\propto-8, 5\propto-2, 9\propto-11)$

$\vec{MN}=(4\lambda-12\propto+13, \lambda-5\propto+6, 3\lambda-9\propto+16)$ ..(1)

Now

$$\vec{b_1}\times\vec{b_2}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 4 & 1 & 3\\ 12 & 5 & 9\end{vmatrix}=-6\hat{i}+8\hat{k} \quad \ldots(2)$$

Equation (1) and (2)

$\therefore \frac{4\lambda-12\propto+13}{-6}=\frac{\lambda-5\propto+6}{0}=\frac{3\lambda-9\propto+16}{8}$

I and II

$\lambda-5\propto+6=0$ ….(3)

I and III

$\lambda-3\propto+4=0$ ….(4)

Solve (3) and (4) we get

$\lambda=-1, \propto=1$

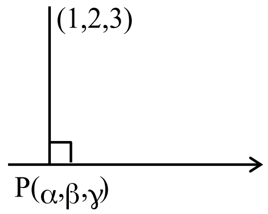
$\therefore$ M (1, 3, 2)

N (4, 3, –2)

$\therefore$ $\vec{OM}\cdot\vec{ON}=4+9-4=9$

9. Ans. (2)

Sol.



Let foot P (5k – 3, 2k + 1, 3k – 4)

DR 's → AP : 5 k – 4, 2 k – 1, 3 k – 7

DR 's → Line: 5, 2, 3

Condition of perpendicular lines

(25k–20) + (4k–2) + (9k – 21) = 0

Then $k = \frac{43}{38}$

Then $19(\alpha + \beta + \gamma) = 101$

10. Ans. (16)

Sol. $L_1 : \frac{x+1}{1} = \frac{y}{1/2} = \frac{z}{-1/12}$,

$L_2 : \frac{x}{1} = \frac{y+2}{1} = \frac{z-1}{\frac{1}{6}}$

d_1 = shortest distance between L_1 & L_2

$$= \left| \frac{(\vec{a}_2 - \vec{a}_1)\cdot(\vec{b}_1 \times \vec{b}_2)}{|\vec{b}_1 \times \vec{b}_2|} \right|$$

$d_1 = 2$

$L_3 : \frac{x-1}{2} = \frac{y+8}{-7} = \frac{z-4}{5}$, $L_4 : \frac{x-1}{2} = \frac{y-2}{1} = \frac{z-6}{-3}$

d_2 = shortest distance between L_3 & L_4

$d_2 = \frac{12}{\sqrt{3}}$ Hence

$$= \frac{32\sqrt{3}d_1}{d_2} = \frac{32\sqrt{3}\cdot 2}{\frac{12}{\sqrt{3}}} = 16$$

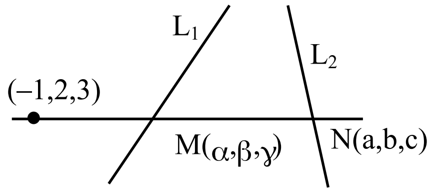
11. Ans. (196)

Sol. $M(3\lambda + 1, 2\lambda + 2, -2\lambda - 1)$

$\therefore \alpha + \beta + \gamma = 3\lambda + 2$

$N(-3\propto -2, -2\propto +2, 4\propto +1)$

$\therefore a + b + c = -\propto + 1$



$$\frac{3\lambda + 2}{-3\propto -1} = \frac{2\lambda}{-2\propto} = \frac{-2\lambda - 4}{4\propto - 2}$$

$3\lambda\propto + 2\propto = 3\lambda\propto + \lambda$

$2\propto = \lambda$

$2\lambda\propto - \lambda = \lambda\propto + 2\propto$

$\lambda\propto = \lambda + 2\propto$

$\Rightarrow \lambda\propto = 2\lambda$

$\Rightarrow \propto = 2 \quad (\lambda \neq 0)$

$\therefore \lambda = 4$

$\alpha + \beta + \gamma = 14$

$a + b + c = -1$

$$\frac{(\alpha + \beta + \gamma)^2}{(a + b + c)^2} = 196$$

12. Ans. (4)

Sol. A vector in the direction of the required line can be obtained by cross product of

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 5 \\ -1 & 3 & 2 \end{vmatrix}$$

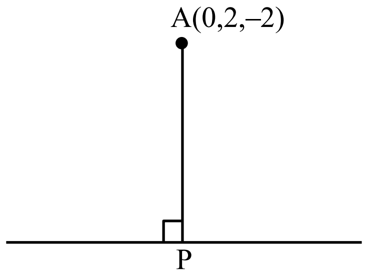
$= -9\hat{i} - 9\hat{j} + 9\hat{k}$

Required line,

$\vec{r} = (5\hat{i} - 4\hat{j} + 3\hat{k}) + \lambda'(-9\hat{i} - 9\hat{j} + 9\hat{k})$

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

Now distance of (0, 2, –2)



P.V. of P $\equiv (5+\lambda)\hat{i} + (\lambda - 4)\hat{j} + (3-\lambda)\hat{k}$

$\overrightarrow{AP} = (5+\lambda)\hat{i} + (\lambda - 6)\hat{j} + (5-\lambda)\hat{k}$

$\overrightarrow{AP} \cdot (\hat{i} + \hat{j} - \hat{k}) = 0$

$5 + \lambda + \lambda - 6 - 5 + \lambda = 0$

$\lambda = 2$

$|\overrightarrow{AP}| = \sqrt{49 + 16 + 9}$

$|\overrightarrow{AP}| = \sqrt{74}$

13. Ans. (12)

Sol. $\frac{x}{1} = \frac{y}{1} = \frac{z-1}{0} = r \rightarrow Q(r, r, 1)$

$\frac{x}{1} = \frac{y}{-1} = \frac{z+1}{0} = k \rightarrow R(k, -k, -1)$

$\overline{PQ} = (a-r)\hat{i} + (a-r)\hat{j} + (a-1)\hat{k}$

a = r + a – r = 0.

2a = 2r → a = r

$\overrightarrow{PR} = (a-k)\hat{i} + (a+k)\hat{j} + (a+1)\hat{k}$

a – k – a – k = 0 ⇒ k = 0

As, $PQ \perp PR$

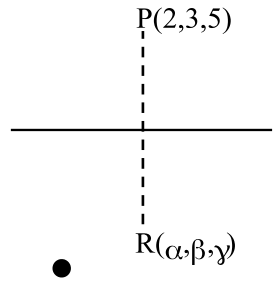
$(a-r)(a-k) + (a-r)(a+k) + (a-1)(a+1) = 0$ a

= 1 or –1

$12a^2 = 12$

14. Ans. (2)

Sol.



$\because \overrightarrow{PR} \perp (2,3,4)$

$\therefore \overrightarrow{PR} \cdot (2,3,4) = 0$

$(\alpha - 2, \beta - 3, \gamma - 5) \cdot (2,3,4) = 0$

$\Rightarrow 2\alpha + 3\beta + 4\gamma = 4 + 9 + 20 = 33$

15. Ans. (3)

Sol. $L_2 = \frac{x+4}{3} = \frac{y-4}{2} = \frac{z-3}{0}$

$$\therefore S.D = \frac{\begin{vmatrix} x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ 2 & -3 & 2 \\ 3 & 2 & 0 \end{vmatrix}}{|\vec{n}_1 \times \vec{n}_2|}$$

$$= \frac{\begin{vmatrix} 5 & -5 & -7 \\ 2 & -3 & 2 \\ 3 & 2 & 0 \end{vmatrix}}{|\vec{n}_1 \times \vec{n}_2|}$$

$$= \frac{141}{|-4\hat{i} + 6\hat{j} + 13\hat{k}|}$$

$$= \frac{141}{\sqrt{16 + 36 + 169}}$$

$$= \frac{141}{\sqrt{221}}$$

16. Ans. (22)

Sol. $\frac{x-4}{12} = \frac{x+6}{4} = \frac{z+2}{6}$

$\frac{x-4}{\frac{6}{7}} = \frac{y+6}{\frac{2}{7}} = \frac{z+2}{\frac{3}{7}} = 21$

$\left(21 \cdot \frac{6}{7} + 4, \frac{2}{7} \cdot 21 - 6, \frac{3}{7} \cdot 21 - 2\right)$

$= (22, 0, 7) = (a, b, c)$

$\therefore \sqrt{324 + 144 + 16} = 22$

17. Ans. (2)

Sol. Passing points of lines L_1 & L_2 are

$(\lambda, 2, 1)$ & $(\sqrt{3}, 1, 2)$

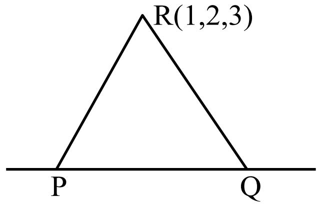
$$S.D. = \frac{\begin{vmatrix} \sqrt{3}-\lambda & -1 & 1 \\ -2 & 1 & 1 \\ 1 & -2 & 1 \end{vmatrix}}{\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -2 & 1 & 1 \\ 1 & -2 & 1 \end{vmatrix}}$$

$$1 = \left|\frac{\sqrt{3}-\lambda}{\sqrt{3}}\right|$$

$\lambda = 0, \lambda = 2\sqrt{3}$

18. Ans. (3)

Sol.



$P(8\lambda - 3, 2\lambda + 4, 2\lambda - 1)$

$PR = 6$

$(8\lambda - 4)^2 + (2\lambda + 2)^2 + (2\lambda - 4)^2 = 36$

$\lambda = 0, 1$

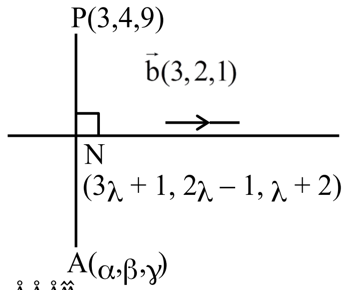
Hence $P(-3, 4, -1)$ & $Q(5, 6, 1)$

Centroid of $\Delta PQR = (1, 4, 1) \equiv (\alpha, \beta, \gamma)$

$\alpha^2 + \beta^2 + \gamma^2 = 18$

19. Ans. (3)

Sol.



$\vec{PN}.\vec{b} = 0$?

$3(3\lambda - 2) + 2(2\lambda - 5) + (\lambda - 7) = 0$

$14\lambda = 23 \Rightarrow \lambda = \frac{23}{14}$

$N\left(\frac{83}{14}, \frac{32}{14}, \frac{51}{14}\right)$

$\therefore \frac{\alpha+3}{2} = \frac{83}{14} \Rightarrow \alpha = \frac{62}{7}$

$\frac{\beta+4}{2} = \frac{32}{14} \Rightarrow \beta = \frac{4}{7}$

$\frac{\gamma+9}{2} = \frac{51}{14} \Rightarrow \gamma = \frac{-12}{7}$

Ans. $14(\alpha + \beta + \gamma) = 108$

20. Ans. (3)

Sol. $\left.\begin{array}{l} \vec{r}_1 = (\lambda\hat{i} + 4\hat{j} + 3\hat{k}) + \alpha(2\hat{i} + 3\hat{j} + 4\hat{k}) \\ \vec{r}_2 = (2\hat{i} + 4\hat{j} + 7\hat{k}) + \beta(2\hat{i} + 3\hat{j} + 4\hat{k}) \end{array}\right\} \begin{array}{l} \vec{b} = 2\hat{i} + 3\hat{j} + 4\hat{k} \\ \vec{a}_1 = \lambda\hat{i} + 4\hat{j} + 3\hat{k} \\ \vec{a}_2 = 2\hat{i} + 4\hat{j} + 7\hat{k} \end{array}$

Shortest dist. $= \frac{|\vec{b} \times (\vec{a}_2 - \vec{a}_1)|}{|\vec{b}|} = \frac{13}{\sqrt{29}}$

$$\frac{\left|(2\hat{i} + 3\hat{j} + 4\hat{k}) \times ((2-\lambda)\hat{i} + 4\hat{k})\right|}{\sqrt{29}} = \frac{13}{\sqrt{29}}$$

$|-8\hat{j} - 3(2-\lambda)\hat{k} + 12\hat{i} + 4(2-\lambda)\hat{j}| = 13$

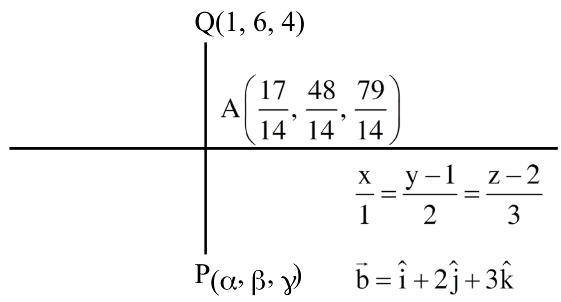
$|12\hat{i} - 4\lambda\hat{j} + (3\lambda - 6)\hat{k}| = 13$

$144 + 16\lambda^2 + (3\lambda - 6)^2 = 169$

$16\lambda^2 + (3\lambda - 6)^2 = 25 \Rightarrow \lambda = 1$

21. Ans. (11)

Sol.



$A(t, 2t + 1, 3t + 2)$

$\vec{QA} = (t-1)\hat{i} + (2t-5)\hat{j} + (3t-2)\hat{k}$

$\vec{QA}.\vec{b} = 0$

$(t - 1) + 2(2t - 5) + 3(3t - 2) = 0$

$14t = 17$

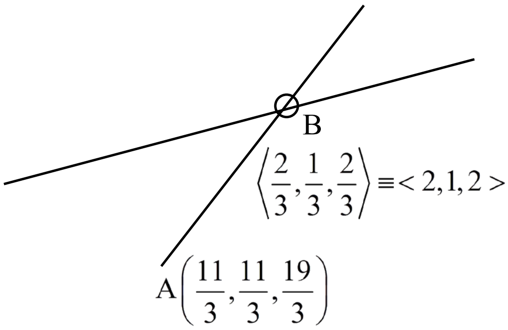
$\alpha = \frac{20}{14} \qquad \beta = \frac{12}{14} \qquad \gamma = \frac{102}{14}$

$2\alpha + \beta + \gamma = \frac{154}{14} = 11$

22. Ans. (1)

Sol. $\frac{x-1}{2-1} = \frac{y-2}{3-2} = \frac{z-3}{5-3}$

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



$B(1+\lambda, 2+\lambda, 3+2\lambda)$

D.R. of AB = $< \frac{3\lambda-8}{3}, \frac{3\lambda-5}{3}, \frac{6\lambda-10}{3} >$

$B\left(\frac{5}{3}, \frac{8}{3}, \frac{13}{3}\right)$ $\frac{3\lambda-8}{3\lambda-5} = \frac{2}{1} \Rightarrow 3\lambda - 8 = 6\lambda - 10$

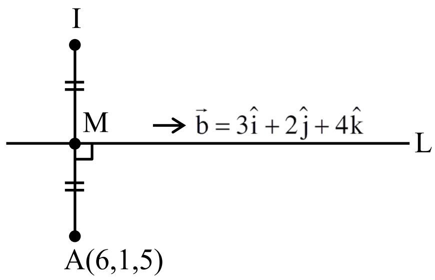
$3\lambda = 2$

$\lambda = \frac{2}{3}$

$AB = \frac{\sqrt{36+9+36}}{3} = \frac{9}{3} = 3$

23. Ans. (62)

Sol.



Let $M(3\lambda+1, 2\lambda, 4\lambda+2)$

$\overrightarrow{AM} \cdot \vec{b} = 0$

$\Rightarrow 9\lambda - 15 + 4\lambda - 2 + 16\lambda - 12 = 0$

$\Rightarrow 29\lambda = 29$

$\Rightarrow \lambda = 1$

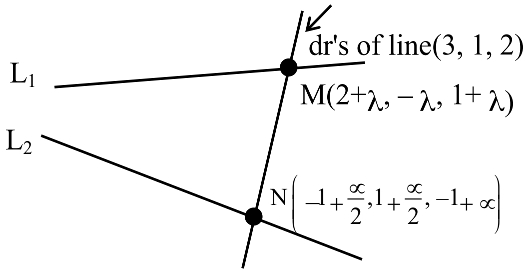
M (4, 2, 6), I = (2, 3, 7)

Required Distance = $\sqrt{4+9+49} = \sqrt{62}$

Ans. 62

24. Ans. (2)

Sol.



$L_1: \frac{x-2}{1} = \frac{y}{-1} = \frac{z-1}{1} = \lambda$

$L_2: \frac{x+1}{\frac{1}{2}} = \frac{y-1}{\frac{1}{2}} = \frac{z+1}{1} = \propto$

dr of line MN will be

$< 3+\lambda-\frac{\propto}{2}, -1-\lambda-\frac{\propto}{2}, 2+\lambda-\propto >$ & it will be proportional to <3, 1, 2>

$\therefore \frac{3+\lambda-\frac{\propto}{2}}{3} = \frac{-1-\lambda-\frac{\propto}{2}}{1} = \frac{2+\lambda-\propto}{2}$

$4\lambda + \propto = -6$ $\qquad$ $4 + 3\lambda = 0$

$\Rightarrow \lambda = -\frac{4}{3} \;\&\; \propto = -\frac{2}{3}$

$\therefore$ Coordinate of M will be $< \left(\frac{2}{3}, \frac{4}{3}, -\frac{1}{3}\right)$

and equation of required line will be.

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

So any point on this line will be

$\left(\frac{2}{3}+3k, \frac{4}{3}+k, -\frac{1}{3}+2k\right)$

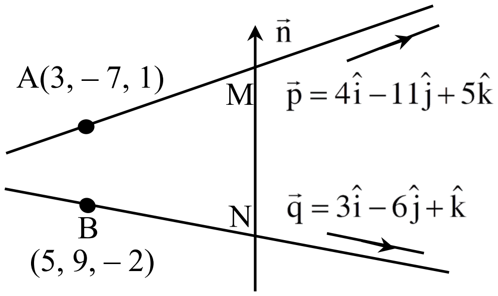
$\because \frac{2}{3}+3k = -\frac{1}{3} \Rightarrow k = -\frac{1}{3}$

$\therefore$ Point lie on the line for

$k = -\frac{1}{3}$ is $\left(-\frac{1}{3}, 1, -1\right)$

25. Ans. (1)

Sol.



$\vec n = \vec p \times \vec q$

$\vec n = \begin{vmatrix} \hat i & \hat j & \hat k \\ 4 & -11 & 5 \\ 3 & -6 & 1 \end{vmatrix} = 19\hat i + 11\hat j + 9\hat k$

S.d. = projection of $\vec{AB}$ on $\vec n$

$= \left|\dfrac{\vec{AB}\cdot\vec n}{|\vec n|}\right| = \left|\dfrac{(2\hat i + 16\hat j - 3\hat k)\cdot(19\hat i + 11\hat j + 9\hat k)}{\sqrt{361 + 121 + 81}}\right|$

$= \dfrac{38 + 176 - 27}{\sqrt{563}}$

S.d. $= \dfrac{187}{\sqrt{563}}$

26. Ans. (1)

Sol. PQ line

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

pt (4t + 1, –2t – 2, 4t + 3)

distance^2 = $16t^2 + 4t^2 + 16t^2 = 81$

$t = \pm\dfrac{3}{2}$

pt (7, –5, 9)

$\alpha^2 + \beta^2 + \gamma^2 = 155$

option (1)

27. Ans. (48)

Sol. $\dfrac{38}{3\sqrt5}\hat k = \dfrac{(5\hat i + 5\hat j - 9\hat k)}{\sqrt5} \cdot \begin{vmatrix} \hat i & \hat j & \hat k \\ 2 & 3 & 4 \\ 1 & -3 & 2 \end{vmatrix}$

$\dfrac{38}{3\sqrt5}\hat k = \dfrac{19}{\sqrt5}$

$k = \dfrac{19}{\sqrt5}$

$k = \dfrac{3}{2}$

$\int_0^{3/2}[x^2] = \int_0^1 0 + \int_1^{\sqrt2} 1 + \int_{\sqrt2}^{3/2} 2$

$= \sqrt2 - 1 + 2\left(\dfrac{3}{2} - \sqrt2\right)$

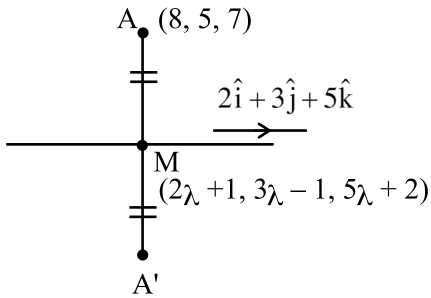
$= 2 - \sqrt2$

$\alpha = 2$

$\Rightarrow 6\alpha^3 = 48$

28. Ans. (3)

Sol.



$\vec{AM}\cdot(2\hat i + 3\hat j + 5\hat k) = 0$

$(2\lambda - 7)(2) + (3\lambda - 6)(3) + (5\lambda - 5)(5) = 0$

$38\lambda = 57$

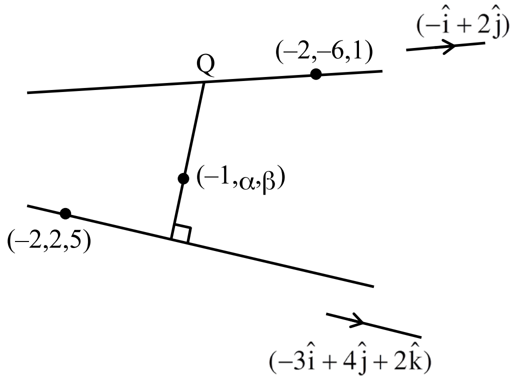
$\lambda = \dfrac{3}{2}$

$M\left(4, \dfrac{7}{2}, \dfrac{19}{2}\right)$

A'(0,2,12)

29. Ans. (25)

Sol.



$P(-3\lambda - 2, 4\lambda + 2, 2\lambda + 5)$

$Q(-\propto - 2, 2\propto - 6, 1)$

DRS of PQ = $(3\lambda - \propto, 2\propto - 4\lambda - 8, -2\lambda - 4)$

DRS of PQ = $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 2 & 0 \\ -3 & 4 & 2 \end{vmatrix}$

$= \left(4\hat{i} + 2\hat{j} + 2\hat{k}\right)$

OR

(2, 1, 1)

$\frac{3\lambda - \propto}{2} = \frac{2\propto - 4\lambda - 8}{1} = \frac{-2\lambda - 4}{1}$

$\Rightarrow \propto = \lambda + 2$ & $7\lambda = \propto - 8$

$\boxed{\lambda = -1}$ $\boxed{\propto = 1}$

Q : (–3, –4, 1)

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

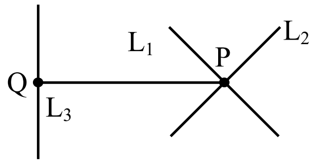
$(-1, \alpha, \beta) \Rightarrow 1 = \frac{\alpha+4}{1} = \frac{\beta-1}{1}$

$\Rightarrow \alpha = -3, \beta = 2$

$(\alpha - \beta)^2 = 25$

30. Ans. (3)

Sol.



$L_1 \equiv \frac{x-2}{1} = \frac{y-4}{5} = \frac{z-2}{1} = \lambda$

$P(\lambda + 2, 5\lambda + 4, \lambda + 2)$

$L_2 \equiv \frac{x-3}{2} = \frac{y-2}{3} = \frac{z-3}{2}$

$P(2\propto + 3, 3\propto + 2, 2\propto + 3)$

$\lambda + 2 = 2\propto + 3$ $\quad$ $3\propto + 2 = 5\lambda + 4$

$\lambda = 2\propto + 1$ $\quad$ $3\propto = 5\lambda + 2$

$3\propto = 5(2\propto + 1) + 2$

$3\propto = 10\propto + 7$

$\propto = -1 \quad \lambda = -1$

Both satisfies (P)

P(1,–1,1)

$L_3 \equiv \frac{x}{1/4} = \frac{y}{1/2} = \frac{z}{1}$

$L_3 = \frac{x}{1} = \frac{y}{2} = \frac{z}{4} = k$

Coordinates of Q(k,2k,4k)

DR's of PQ = <k–1, 2k + 1, 4k – 1>

PQ $\perp$ to L_3

(k – 1) + 2(2k + 1) + 4(4k – 1) = 0

k – 1 + 4k + 2 + 16k – 4 = 0

$k = \frac{1}{7}$

$Q\left(\frac{1}{7}, \frac{2}{7}, \frac{4}{7}\right)$

$PQ = \sqrt{\left(1 - \frac{1}{7}\right)^2 + \left(-1 - \frac{2}{7}\right)^2 + \left(1 - \frac{4}{7}\right)^2}$

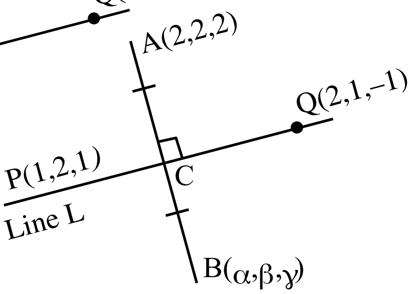
$= \sqrt{\frac{36}{49} + \frac{81}{49} + \frac{9}{49}} = \frac{\sqrt{126}}{7}$

$PQ = \frac{3\sqrt{14}}{7}$

Option-3 will satisfy

31. Ans. (6)

Sol.



DR's of Line L $\equiv -1 : 1 : 2$

DR's of AB $\equiv \alpha - 2 : \beta - 2 : \gamma - 2$

AB $\perp_{ar}$ L $\Rightarrow 2 - \alpha + \beta - 2 + 2\gamma - 4 = 0$

$2\gamma + \beta - \alpha = 4$ ...(1)

Let C is mid-point of AB

$C\left(\frac{\alpha+2}{2}, \frac{\beta+2}{2}, \frac{\gamma+2}{2}\right)$

DR's of PC = $\frac{\alpha}{2} : \frac{\beta-2}{2} : \frac{\gamma}{2}$

line L | | PC $\Rightarrow \frac{-\alpha}{2} = \frac{\beta-2}{2} = \frac{\gamma}{4} = K(\text{let})$

$\alpha = -2K$

$\beta = 2K + 2$

$\gamma = 4K$

use in (1) $\Rightarrow K = \frac{1}{6}$

value of $\alpha + \beta + 6\gamma = 24K + 2 = 6$

32. Ans. (3)

Sol. $\frac{x+6}{3} = \frac{y}{2} = \frac{z+1}{1} = \lambda$ …(1)

$x = 3\lambda - 6,\ y = 2\lambda,\ z = \lambda - 1$

$\frac{x-7}{4} = \frac{y-9}{3} = \frac{z-4}{2} = \mu$ …(2)

$x = 4\mu + 7,\ y = 3\mu + 9,\ z = 2\mu + 4$

$3\lambda - 6 = 4\mu + 7 \Rightarrow 3\lambda - 4\mu = 13$ …(3) × 2

$2\lambda = 3\mu + 9 \Rightarrow 2\lambda - 3\mu = 9$ …(4) × 3

$6\lambda - 8\mu = 26$

$6\lambda - 9\mu = 27$

$-\quad + \quad -$

$\mu = -1$

$\Rightarrow 3\lambda - 4(-1) = 13$

$3\lambda = 9$

$\lambda = 3$

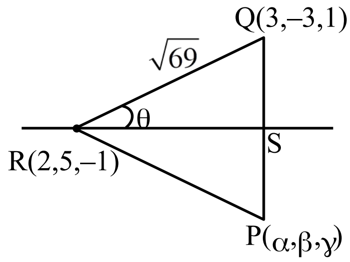
int. point (3, 6, 2) ; (7, 8, 9)

$d^2 = 16 + 4 + 49 = 69$

Ans. $d^2 + 6 = 69 + 6 = 75$

33. Ans. (4)

Sol.



$RQ = \sqrt{1 + 64 + 4} = \sqrt{69}$

$\vec{RQ} = \hat{i} - 8\hat{j} + 2\hat{k}$

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

$\cos\theta = \frac{\vec{RQ}\cdot\vec{RS}}{|\vec{RQ}||\vec{RS}|} = \left|\frac{1 - 8 - 2}{\sqrt{69}\sqrt{3}}\right| = \frac{9}{3\sqrt{23}}$

$\cos\theta = \frac{3}{\sqrt{23}} = \frac{RS}{RQ} = \frac{RS}{\sqrt{69}}$

$RS = 3\sqrt{3}$

$\sin\theta = \frac{\sqrt{14}}{\sqrt{23}} = \frac{QS}{\sqrt{69}}$

$QS = \sqrt{42}$

area = $\frac{1}{2}$ .2QS RS $= \sqrt{42}\ 3\sqrt{3}$

$\lambda = 9\sqrt{14}$

$\lambda^2 = 81.14 = 14k$

k = 81

34. Ans. (43)

Sol. $\bar{a}_1 = \lambda\hat{i} + 2\hat{j} + \hat{k}$

$\bar{a}_2 = -2\hat{i} - 5\hat{j} + 4\hat{k}$

$\vec{p} = 3\hat{i} - \hat{j} + \hat{k}$

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

$(\lambda + 2)\hat{i} + 7\hat{j} - 3\hat{k} = \bar{a}_1 - \bar{a}_2$

$\vec{p} \times \vec{q} = -6\hat{i} - 15\hat{j} + 3\hat{k}$

$\frac{44}{\sqrt{30}} = \frac{|-6\lambda - 12 - 105 - 9|}{\sqrt{(-6)^2 + (-15)^2 + 3^2}}$

$\frac{44}{\sqrt{30}} = \frac{|6\lambda + 126|}{3\sqrt{30}}$

$132 = |6\lambda + 126|$

$\lambda = 1, \lambda = -43$

$|\lambda| = 43$

35. Ans. (4)

Sol. $\frac{2-x}{3}=\frac{3y-2}{4\lambda+1}=4-z \quad \ldots(1)$

$\frac{x-2}{(-3)}=\frac{y-\frac{2}{3}}{\left(\frac{4\lambda+1}{3}\right)}=\frac{z-4}{(-1)}$

$\frac{x+3}{3\mu}=\frac{1-2y}{6}=\frac{5-z}{7} \quad \ldots(2)$

$\frac{x+3}{3\mu}=\frac{y-\frac{1}{2}}{(-3)}=\frac{z-5}{(-7)}$

Right angle $\Rightarrow$

$(-3)(3\mu)+\left(\frac{4\lambda+1}{3}\right)(-3)+(-1)(-7)=0$

$-9\mu-4\lambda-1+7=0$

$4\lambda+9\mu=6$

36. Ans. (1)

Sol. P(x, y, z), Q(x, y, O) ; $x^2+y^2+z^2=\gamma^2$

$\overline{OQ}=x\hat{i}+y\hat{j}$

$\cos\theta=\frac{x}{\sqrt{x^2+y^2}}$

$\cos\varphi=\frac{z}{\sqrt{x^2+y^2+z^2}}$

$\Rightarrow \sin^2\varphi=\frac{x^2+y^2}{x^2+y^2+z^2}$

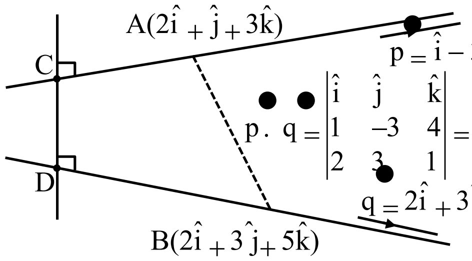
distance of P from x-axis $\sqrt{y^2+z^2}$

$\Rightarrow \sqrt{\gamma^2-x^2} \quad \Rightarrow \quad \gamma\sqrt{1-\frac{x^2}{\gamma^2}}$

$=\gamma\sqrt{1-\cos^2\theta\sin^2\varphi}$

37. Ans. (2)

Sol.



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

$\vec{p}\cdot\vec{q}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 1 & -3 & 4\\ 2 & 3 & 1\end{vmatrix}=-15\hat{i}+7\hat{k}$

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

Shortes distance (CD) = $\left|\frac{\overline{AB}\,\vec{p}\cdot\vec{q}}{|\vec{p}\cdot\vec{q}|}\right|$

$=\left|\frac{(0\hat{i}+2\hat{j}+2\hat{k}).(-15\hat{i}+7\hat{j}+9\hat{k})}{\sqrt{355}}\right|$

$=\frac{0+14+18}{\sqrt{355}}=\frac{32}{\sqrt{355}}$

$\therefore$ m + n = 32 + 355 = 387

38. Ans. (2)

Sol. $\frac{x-3}{2}=\frac{y+15}{-7}=\frac{z-9}{5}$ & $\frac{x+1}{2}=\frac{y-1}{1}=\frac{z-9}{-3}$

S.D = $\frac{\left|(\overline{a}_2.\overline{a}_1)\cdot(\overline{b}_1.\overline{b}_2)\right|}{\left|\overline{b}_1\,.\,\overline{b}_2\right|}$

a_1 = 3, –15, 9 $\qquad$ b_1 = 2, –7, 5

a_2 = –1, 1, 9 $\qquad$ b_2 = 2, 1, –3

a_2-a_1 = –4, 16, 0

$\overline{b}_1\,.\,\overline{b}_2=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & -7 & 5\\ 2 & 1 & -3\end{vmatrix}=\hat{i}(16)-\hat{j}(-16)+\hat{k}(16)$

$16(\hat{i}+\hat{j}+\hat{k})$

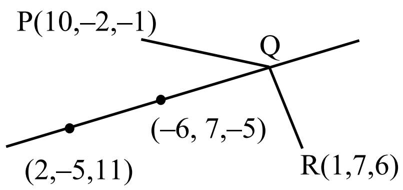
$\left|\overline{b}_1\,.\,\overline{b}_2\right|=16\sqrt{3}$

$\therefore (\overline{a}_2-\overline{a}_1)\cdot(\overline{b}_1-\overline{b}_2)=16[-4+16]=(16)(12)$

S.D. = $\frac{(16)(12)}{16\sqrt{3}}=4\sqrt{3}$

39. Ans. (13)

Sol.



Line : $\frac{x+6}{-8} = \frac{y-7}{12} = \frac{z+5}{-16}$

$\frac{x+6}{2} = \frac{y-7}{-3} = \frac{z+5}{4} = \lambda$

$Q(2\lambda - 6, 7 - 3\lambda, 4\lambda - 5)$

$\overline{QR}(2\lambda - 7, -3\lambda\ 4\lambda - 11)$

$\overline{QR} \cdot$ dr's of line = 0

$4\lambda - 14 + 9\lambda + 16\lambda - 44 = 0$

$29\lambda = 58 \Rightarrow \lambda = 2$

$Q(-2, 1, 3)$

$PQ = \sqrt{144 + 9 + 16} = \sqrt{169} = 13$