$$\vec{V}_1 = \vec{u}_x(5) + \vec{u}_y(-2) + u_z(1)$$

$$\vec{V}_2 = \vec{u}_x(-3) + \vec{u}_y(1) + \vec{u}_z(-7)$$

$$\vec{V}_3 = \vec{u}_x(4) + \vec{u}_y(7) + \vec{u}_z(6)$$

X, Y

Z

$$\vec{V}_1 = \vec{u}_x(5) + \vec{u}_y(-2) + u_z(1), \qquad \vec{V}_2 = \vec{u}_x(-3) + \vec{u}_y(1) + \vec{u}_z(-7), \qquad \vec{V}_3 = \vec{u}_x(4) + \vec{u}_y(7) + \vec{u}_z(6).$$

$$\vec{R} = \vec{V}_1 + \vec{V}_2 + \vec{V}_3.$$

$$\vec{R} = (5 - 3 + 4)\vec{u}_x + (-2 + 1 + 7)\vec{u}_y + (1 - 7 + 6)\vec{u}_z = 6\vec{u}_x + 6\vec{u}_y + 0\vec{u}_z.$$

$$\vec{R}$$

$$\left\|\vec{R}\right\| = \sqrt{6^2 + 6^2 + 0^2} = \sqrt{72} = 6\sqrt{2}.$$

α, β, γ

$$\vec{R}$$

X, Y, Z

$$\cos(\alpha) = \frac{R_x}{\left\|\vec{R}\right\|}, \qquad \cos(\beta) = \frac{R_y}{\left\|\vec{R}\right\|}, \qquad \cos(\gamma) = \frac{R_z}{\left\|\vec{R}\right\|}.$$

$$\cos(\alpha) = \frac{6}{6\sqrt{2}} = \frac{1}{\sqrt{2}}, \qquad \cos(\beta) = \frac{6}{6\sqrt{2}} = \frac{1}{\sqrt{2}}, \qquad \cos(\gamma) = \frac{0}{6\sqrt{2}} = 0.$$

$$\alpha = \frac{\pi}{4}, \qquad \beta = \frac{\pi}{4}, \qquad \gamma = \frac{\pi}{2}.$$

$P(4, 5, -7)$

$Q(-3, 6, 12)$

$$\vec{V} = \vec{u}_x(4) - \vec{u}_y(1) + \vec{u}_z(3)$$

P

Q

$\vec{V}$

Q

$\vec{V}$

P

Q

$\vec{V}$

$$d(P,\ell) = \frac{\left\|(P-Q)\times\vec{V}\right\|}{\left\|\vec{V}\right\|}.$$

$$P - Q = (4 + 3, 5 - 6, -7 - 12) = (7, -1, -19).$$

$$(P-Q)\times\vec{V}=\begin{vmatrix}\vec{u}_x & \vec{u}_y & \vec{u}_z\\ 7 & -1 & -19\\ 4 & -1 & 3\end{vmatrix}=(-22,-97,-3).$$

$$\left\|(P-Q)\times\vec{V}\right\|=\sqrt{(-22)^2+(-97)^2+(-3)^2}=\sqrt{9902},\qquad \left\|\vec{V}\right\|=\sqrt{4^2+(-1)^2+3^2}=\sqrt{26}.$$

P

$$d(P, \ell) = \frac{\sqrt{9902}}{\sqrt{26}} = \sqrt{381}.$$

Q

$\vec{V}$

$$\vec{V}$$

P

$$d(P, \mathcal{P}) = \frac{\left|(P - Q) \cdot \vec{V}\right|}{\left\|\vec{V}\right\|}.$$

$$(P - Q) \cdot \vec{V} = (7, -1, -19) \cdot (4, -1, 3) = 28 + 1 - 57 = -28.$$

$$d(P, \mathcal{P}) = \frac{|-28|}{\sqrt{26}} = \frac{28}{\sqrt{26}}.$$

P

$$\sqrt{381}$$

P

$$\frac{28}{\sqrt{26}}$$

$\vec{a}_1, \vec{a}_2, \vec{a}_3$

$$\vec{a}^1 = \frac{\vec{a}_2 \times \vec{a}_3}{\vec{a}_1 \cdot \vec{a}_2 \times \vec{a}_3},$$
$$\vec{a}^2 = \frac{\vec{a}_3 \times \vec{a}_1}{\vec{a}_1 \cdot \vec{a}_2 \times \vec{a}_3},$$
$$\vec{a}^3 = \frac{\vec{a}_1 \times \vec{a}_2}{\vec{a}_1 \cdot \vec{a}_2 \times \vec{a}_3}$$

$$\vec{a}^i \cdot \vec{a}_i = 1$$

$$a^i \cdot a_j = 0$$

i

j

$\vec{a}^1, \vec{a}^2, \vec{a}^3$

$$\vec{a}_1, \vec{a}_2, \vec{a}_3$$

$$\vec{a}^i \cdot \vec{a}_j = 0$$

$$i \neq j$$

$$i = j$$

$$\vec{a}^1 \cdot \vec{a}_1 = \frac{(\vec{a}_2 \times \vec{a}_3) \cdot \vec{a}_1}{\vec{a}_1 \cdot (a_2 \times \vec{a}_3)}$$

$$\vec{a}^1 \cdot \vec{a}_1 = \frac{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)}{\vec{a}_1 \cdot (a_2 \times \vec{a}_3)}.$$

$$\vec{a}^1 \cdot \vec{a}_1 = 1$$

$$\vec{a}^2 \cdot \vec{a}_2 = 1, \qquad \vec{a}^3 \cdot \vec{a}_3 = 1.$$

$i \neq j$

$$\vec{a}^1 \cdot \vec{a}_2 = \frac{(\vec{a}_2 \times \vec{a}_3) \cdot \vec{a}_2}{\vec{a}_1 \cdot (\vec{a}_2 \times \vec{a}_3)}.$$

$$\vec{a}_2 \times \vec{a}_3$$

$$\vec{a}_2$$

$$(\vec{a}_2 \times \vec{a}_3) \cdot \vec{a}_2 = 0.$$

$$\vec{a}^1 \cdot \vec{a}_2 = 0.$$

$$\vec{a}^1 \cdot \vec{a}_3 = 0, \quad \vec{a}^2 \cdot \vec{a}_1 = 0 \quad \vec{a}^2 \cdot \vec{a}_3 = 0 \quad \vec{a}^3 \cdot \vec{a}_1 = 0 \quad \vec{a}^3 \cdot \vec{a}_2 = 0.$$