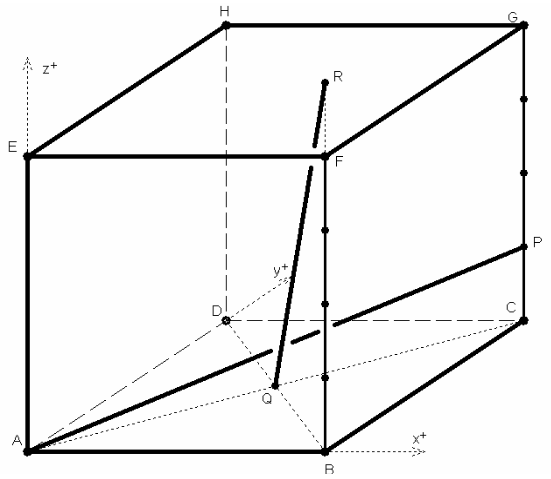
24)

A(0/0/0), P(12/12/3), Q(6/6/0), R(12/0/15)



a)

z. z.: $\overline{AP} = \overline{QR}$

$$\left|\overrightarrow{AP}\right| = \left|\begin{pmatrix}12\\12\\3\end{pmatrix}\right| = 3 \bullet \sqrt{4^2+4^2+1^2} = 3 \bullet \sqrt{33}$$

$$\left|\overrightarrow{QR}\right| = \left|\begin{pmatrix}6\\-6\\15\end{pmatrix}\right| = 3 \bullet \sqrt{2^2+2^2+5^2} = 3 \bullet \sqrt{33}$$

b)

$AP \to QR$
$A \to Q$
$P \to R$

$$\{d\} = \delta_{AQ} \cap \delta_{PR}$$

$$\delta_{AQ} : \overrightarrow{AQ} = \begin{pmatrix}6\\6\\0\end{pmatrix} \parallel \begin{pmatrix}1\\1\\0\end{pmatrix} => \delta_{AQ} : x + y = 6 \qquad M_{AQ}(3/3/0)$$

$$\delta_{PR} : \overrightarrow{PR} = \begin{pmatrix}0\\-12\\12\end{pmatrix} \parallel \begin{pmatrix}0\\-1\\1\end{pmatrix} \Rightarrow \delta_{PR} : -y + z = 3 \qquad M_{PR}(12/6/9)$$

$$\delta_{AQ} \cap \delta_{PR}$$

$$\vec{r}_d = \begin{pmatrix}1\\1\\0\end{pmatrix} \times \begin{pmatrix}0\\-1\\1\end{pmatrix} = \begin{pmatrix}1\\-1\\-1\end{pmatrix} \parallel \begin{pmatrix}-1\\1\\1\end{pmatrix}$$

Startpunkt: $y = 0 \Rightarrow x = 6 \Rightarrow z = 3$

$\Rightarrow S(6/0/3)$

$$d : \chi = \begin{pmatrix}6\\0\\3\end{pmatrix} + t \bullet \begin{pmatrix}-1\\1\\1\end{pmatrix} \qquad \left\{\begin{matrix}x = 6 - t\\y = t\\z = 3 + t\end{matrix}\right\}$$

$d \perp \gamma_1 \qquad A \in \gamma_1$

$Q \in \gamma_1$

$\Rightarrow \gamma_1 : -x + y + z = 0$

$\gamma_1 \cap d = \{Z_{AQ}\}$

$$-(6-t)+t+3+t=0$$
$$-3+3t=0$$
$$3t=3$$
$$t=1 \Rightarrow Z_{AQ}(5/1/4)$$

$$\overrightarrow{Z_{AQ}Q} = \begin{pmatrix}1\\5\\-4\end{pmatrix} \Bigg\| \begin{pmatrix}-1\\-5\\4\end{pmatrix}$$

$$\overrightarrow{Z_{AQ}A} = \begin{pmatrix}-5\\-1\\-4\end{pmatrix} \Bigg\| \begin{pmatrix}5\\1\\4\end{pmatrix}$$

$\varphi_1 = \angle AZ_{AQ}Q$

$$\cos\varphi_1 = \frac{\begin{pmatrix}5\\1\\4\end{pmatrix} \bullet \begin{pmatrix}-1\\-5\\4\end{pmatrix}}{\left|\begin{pmatrix}5\\1\\4\end{pmatrix}\right| \bullet \left|\begin{pmatrix}-1\\-5\\4\end{pmatrix}\right|} = \frac{6}{\sqrt{42} \bullet \sqrt{42}} = \frac{6}{42} = \frac{1}{7} \Rightarrow \varphi_1 \approx 81{,}8^\circ$$

$d \perp \gamma_2 \qquad P \in \gamma_2$

$R \in \gamma_2$

$\Rightarrow \gamma_2 : -x + y + z = 3$

$\gamma_2 \cap d = \{Z_{PR}\}$

$$-(6-t)+t+3+t=3$$
$$-3+3t=3$$
$$3t=6$$
$$t=2 \Rightarrow Z_{PR}(4/2/5)$$

$$\overrightarrow{Z_{PR}P} = \begin{pmatrix}8\\10\\-2\end{pmatrix}$$

$$\overrightarrow{Z_{PR}R} = \begin{pmatrix}8\\-2\\10\end{pmatrix}$$

$\varphi_2 = \angle PZ_{PR}R$

$$\cos\varphi_2 = \frac{\begin{pmatrix}8\\10\\-2\end{pmatrix} \bullet \begin{pmatrix}8\\-2\\10\end{pmatrix}}{\left|\begin{pmatrix}8\\10\\-2\end{pmatrix}\right| \bullet \left|\begin{pmatrix}8\\-2\\10\end{pmatrix}\right|} = \frac{24}{\sqrt{168} \bullet \sqrt{168}} = \frac{24}{168} = \frac{1}{7} \Rightarrow \varphi_2 \approx 81{,}8^\circ$$