Question
The vectors OP and OQ are given respectively by the quantities $2\mathbf{i}+2\mathbf{j}-5\mathbf{k}$ and $4\mathbf{i}-3\mathbf{j}+2\mathbf{k}$. Find PQ, and determine its length and direction cosines.

Answer
$\vec{OP} = 2\mathbf{i}+2\mathbf{j}-5\mathbf{k}$ and $\vec{OQ} = 4\mathbf{i}-3\mathbf{j}+2\mathbf{k}$
$\vec{PQ} = \vec{OQ} - \vec{OP} = (4\mathbf{i}-3\mathbf{j}+2\mathbf{k}) - (2\mathbf{i}+2\mathbf{j}-5\mathbf{k}) = 2\mathbf{i}-5\mathbf{j}+7\mathbf{k}$
length of $\vec{PQ} = |\vec{PQ}| = \sqrt{2^2+5^2+7^2} = \sqrt{78}$

$$\cos\alpha = \tfrac{x}{r} \qquad \cos\beta = \tfrac{y}{r} \qquad \cos\gamma = \tfrac{z}{r}$$

$$\Rightarrow \quad \cos\alpha = \tfrac{2}{\sqrt{78}} \quad \cos\beta = \tfrac{-5}{\sqrt{78}} \quad \cos\gamma = \tfrac{7}{\sqrt{78}}$$