

STEP II, 2004, Q6 MS

Q6 From the data it follows that the component of \mathbf{b} in the direction of \mathbf{a} is $3\mathbf{a}$.

Hence $\mathbf{p} = 4\mathbf{a}$ and $\mathbf{q} = \mathbf{b} - 3\mathbf{a}$.

• Again from the data, it follows that $(\mathbf{c} \cdot \mathbf{a})\mathbf{a} = -2\mathbf{a}$ and

$|\mathbf{q}|^2 = \mathbf{b} \cdot \mathbf{b} - 6\mathbf{a} \cdot \mathbf{b} + 9\mathbf{a} \cdot \mathbf{a} = 25 - 18 + 9 = 16 \Rightarrow |\mathbf{q}| = 4$, so that

$\left[\frac{(\mathbf{c} \cdot \mathbf{q})}{|\mathbf{q}|^2} \right] \mathbf{q} = \left(\frac{1}{2} \right) \mathbf{b} - \left(\frac{3}{2} \right) \mathbf{a}$.

Thus $\mathbf{P} = 2\mathbf{a}$, $\mathbf{Q} = -\left(\frac{9}{2} \right) \mathbf{a} + \left(\frac{3}{2} \right) \mathbf{b}$, $\mathbf{R} = \left(\frac{7}{2} \right) \mathbf{a} - \left(\frac{1}{2} \right) \mathbf{b} + \mathbf{c}$.



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