The Scalar Product

Specification: AQA 7366/7367: F3, F4 · Edexcel 9FM0: Core Pure 6.3, 6.4

HOMEWORK Consolidation

1 Find $\begin{pmatrix}5\\-3\\2\end{pmatrix}\cdot\begin{pmatrix}1\\4\\-6\end{pmatrix}$.

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2 Find $(\mathbf{i}+6\mathbf{j}-2\mathbf{k})\cdot(3\mathbf{i}-\mathbf{k})$.

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3 Find the angle between $\mathbf{a}=\begin{pmatrix}6\\2\\-3\end{pmatrix}$ and $\mathbf{b}=\begin{pmatrix}2\\-1\\2\end{pmatrix}$, to the nearest $0.1°$.

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4 Find the angle between $\mathbf{a}=2\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{b}=-3\mathbf{i}+6\mathbf{j}+2\mathbf{k}$.

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5 Show that $\begin{pmatrix}7\\-2\\3\end{pmatrix}$ and $\begin{pmatrix}1\\2\\-1\end{pmatrix}$ are perpendicular.

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6 Find t so that $\begin{pmatrix}t\\-1\\4\end{pmatrix}$ and $\begin{pmatrix}3\\2t\\1\end{pmatrix}$ are perpendicular.

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7 Find the possible values of k for which $\begin{pmatrix}k\\k\\2\end{pmatrix}$ and $\begin{pmatrix}k\\1\\-3\end{pmatrix}$ are perpendicular.

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8 $|\mathbf{a}|=6$, $|\mathbf{b}|=4$ and $\mathbf{a}\cdot\mathbf{b}=-12$. Find the angle between $\mathbf{a}$ and $\mathbf{b}$.

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9 The points $\mathrm{P}(1,1,1)$, $\mathrm{Q}(3,2,3)$ and $\mathrm{R}(1,5,4)$ form a triangle. Find angle QPR.

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10 Given that $\mathbf{a}\cdot\mathbf{b}=5$ and $\mathbf{a}\cdot\mathbf{c}=-2$, find $\mathbf{a}\cdot(3\mathbf{b}-2\mathbf{c})$.

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11 Find a vector of the form $\begin{pmatrix}p\\q\\1\end{pmatrix}$ that is perpendicular to both $\begin{pmatrix}1\\0\\2\end{pmatrix}$ and $\begin{pmatrix}0\\1\\-1\end{pmatrix}$.

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12 *AQA-style*. The vectors $\mathbf{a}$ and $\mathbf{b}$ are given by $\mathbf{a}=\begin{pmatrix}3\\-1\\2\end{pmatrix}$ and $\mathbf{b}=\begin{pmatrix}1\\4\\p\end{pmatrix}$, where p is a constant.

(a) Given that $\mathbf{a}$ and $\mathbf{b}$ are perpendicular, find p. [2 marks]

(b) In the case $p=2$, find the angle between $\mathbf{a}$ and $\mathbf{b}$, giving your answer to the nearest $0.1°$. [3 marks]

(c) Show that there is no value of p for which $\mathbf{a}$ and $\mathbf{b}$ are parallel. [2 marks]

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13 *Edexcel-style*. Relative to a fixed origin, the points A, B and C have position vectors $3\mathbf{i}-\mathbf{j}+2\mathbf{k}$, $5\mathbf{i}+2\mathbf{j}-4\mathbf{k}$ and $\mathbf{i}+4\mathbf{k}$ respectively.

(a) Find angle ABC, in degrees to one decimal place. (3)

(b) Find the exact area of triangle ABC, giving your answer in the form $p\sqrt{q}$, where p and q are integers. (3)

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