AQA, Edexcel, OCR, MEI

A Level

A Level Mathematics

C4 Vectors

Name:

MME

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Total Marks: /107

C4 - Vectors (Answers)
MEI, OCR, AQA, Edexcel

1. State whether each of the following quantities are scalars or vectors. For parts g) and h), you are given that $\boldsymbol{a}$ and $\boldsymbol{b}$ are vectors:

   (a) Vector. [1]

   (b) Scalar. [1]

   (c) Vector. [1]

   (d) Vector. [1]

   (e) Vector. [1]

   (f) Scalar. [1]

   (g) Scalar. [1]

   (h) Vector. [1]

2. Simplify the following expressions:

   (a) $\begin{pmatrix} 2 \\ 8 \\ 4 \end{pmatrix}$. [1]

   (b) $\begin{pmatrix} 4 \\ 4 \\ 6 \end{pmatrix}$. [1]

   (c) $8\boldsymbol{i} + 10\boldsymbol{j}$. [1]

   (d) $12\boldsymbol{i} + 6\boldsymbol{j}$. [1]

3. Evaluate the following expressions:

   (a) $\sqrt{2}$. [2]

   (b) 5. [2]

   (c) 68. [2]

   (d) 2. [3]

4. Calculate each of the scalar (dot) products below. Also specify whether the vectors are orthogonal to one another or not:

   (a) 3. They are *not* orthogonal. [2]

   (b) 0. They are orthogonal. [2]

   (c) −19. They are *not* orthogonal. [2]

   (d) 0. They are orthogonal. [2]

   (e) $5+\sqrt{3}$. They are *not* orthogonal. [2]

5. Find the distance between the following lines and the location of the mid point between them:

   (a) Distance $=\sqrt{5}$, Midpoint $=\begin{pmatrix} \frac{3}{2} \\ 1 \\ 2 \end{pmatrix}$. [3]

   Distance $=3\sqrt{3}$, Midpoint $=\frac{1}{2}\begin{pmatrix} 7 \\ 3 \\ 7 \end{pmatrix}$. [3]

   Distance $=\sqrt{86}$, Midpoint $=\frac{1}{2}\begin{pmatrix} 7 \\ -6 \\ 1 \end{pmatrix}$. [3]

6. Consider the position vectors $\overrightarrow{OA}=\begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix}$ and $\overrightarrow{OB}=\begin{pmatrix} 2 \\ 6 \\ 1 \end{pmatrix}$:

   (a) $\sqrt{17}$. [3]

   (b) $\frac{1}{5}\begin{pmatrix} 7 \\ 18 \\ 5 \end{pmatrix}$. [3]

7. Write the equation of the line through $\begin{pmatrix}1\\1\\1\end{pmatrix}$ in the direction $\begin{pmatrix}1\\2\\1\end{pmatrix}$ in:

(a) $\boldsymbol{r} = \begin{pmatrix}1\\1\\1\end{pmatrix} + s\begin{pmatrix}1\\2\\1\end{pmatrix}$. [1]

(b) $x - 1 = \frac{y-1}{2} = z - 1$. [3]

8. Consider two points, $A = \begin{pmatrix}1\\2\\2\end{pmatrix}$ and $B = \begin{pmatrix}2\\0\\4\end{pmatrix}$:

(a) $\boldsymbol{r} = \begin{pmatrix}1\\2\\2\end{pmatrix} + s\begin{pmatrix}1\\-2\\2\end{pmatrix}$. [2]

(b) $x - 1 = \frac{2-y}{2} = \frac{z-2}{2}$. [3]

9. Write the following equations of lines in vector form:

(a) $\boldsymbol{r} = s\begin{pmatrix}2\\1\end{pmatrix}$. [2]

(b) $\boldsymbol{r} = \frac{1}{3}\left[s\begin{pmatrix}1\\3\end{pmatrix} - \begin{pmatrix}1\\0\end{pmatrix}\right]$. [2]

(c) $\boldsymbol{r} = \begin{pmatrix}1\\2\\0\end{pmatrix} + \begin{pmatrix}2\\3\\1\end{pmatrix}s$. [3]

10. Find the equation of the following planes in *vector form*:

(a) $\boldsymbol{r} = \begin{pmatrix}1\\1\\1\end{pmatrix} + s\begin{pmatrix}1\\2\\1\end{pmatrix} + t\begin{pmatrix}3\\0\\0\end{pmatrix}$. [1]

(b) $\boldsymbol{r} = s\begin{pmatrix}3\\2\\1\end{pmatrix} + t\begin{pmatrix}2\\1\\0\end{pmatrix}$. *You may have a different answer. Vector forms aren't unique.* [2]

11. Find the equation of the following planes in *cartesian form*:

    (a) $x = 1$. [3]

    (b) $3x + 2z = 5$. [3]

12. *Challange:* $6x - 3y + 10z = 48$. [6]

13. Find the points of intersection between the following lines/planes:

    (a) $(-1, -2)$. [3]

    (b) $(\frac{50}{7}, \frac{25}{7})$. [4]

14. Calculate the angle between the following vectors. Give you answers in *degrees* to two decimal places where necessary:

    (a) $33.69°$. [2]

    (b) $60.50°$. [2]

    (c) $19.11°$. [2]

    (d) $128.11°$. [2]

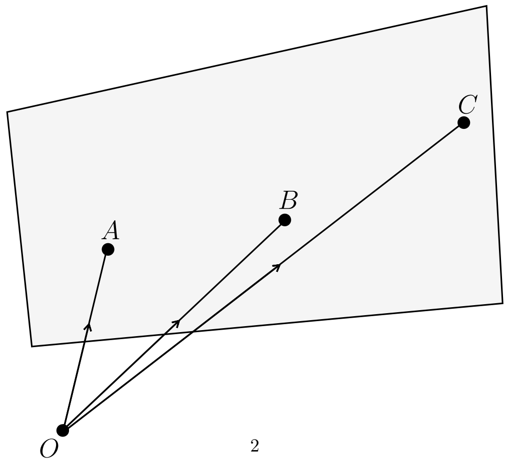
15. Calculate the angle between the following planes. Give you answers in *degrees* to two decimal places where necessary:

    (a) $70.89°$. [2]

    (b) $90°$. [2]

Turn over

16. You are given that the points A, B, C all lie in a plane, where $\overrightarrow{OA} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$, $\overrightarrow{OB} = \begin{pmatrix} 2 \\ 2 \\ 1 \end{pmatrix}$ and $\overrightarrow{OC} = \begin{pmatrix} 3 \\ 3 \\ 2 \end{pmatrix}$.



(a) $\overrightarrow{AB} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} 2 \\ 2 \\ 1 \end{pmatrix}$. [2]

(b) $\boldsymbol{n} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}$. [3]

(c) $y = x$. [3]

(d) Yes. [1]

(e) Yes. [1]

(f) No. [1]