Name: ________________________________

GCSE (1 – 9)

Vectors

Instructions

• Use black ink or ball-point pen.
• Answer all questions.
• Answer the questions in the spaces provided – there may be more space than you need.
• Diagrams are NOT accurately drawn, unless otherwise indicated.
• You must show all your working out.

Information

• The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.
• Keep an eye on the time.
• Try to answer every question.
• Check your answers if you have time at the end

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1 \hspace{1cm} a = \begin{pmatrix} \frac{2}{3} \\ 0 \end{pmatrix} \text{ and } b = \begin{pmatrix} 1 \\ 0 \end{pmatrix}

(a) Write down as a column vector

(i) \(a + b\)
\[
\begin{pmatrix} \frac{2}{3} \\ 0 \end{pmatrix} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} \frac{3}{3} \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}
\]

(ii) \(2a + 3b\)
\[
2 \begin{pmatrix} \frac{2}{3} \\ 0 \end{pmatrix} + 3 \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} \frac{4}{3} \\ 0 \end{pmatrix} + \begin{pmatrix} 3 \\ 0 \end{pmatrix} = \begin{pmatrix} \frac{4}{3} + 3 \\ 0 + 0 \end{pmatrix} = \begin{pmatrix} \frac{13}{3} \\ 0 \end{pmatrix}
\]

The vector \(c\) is drawn on the grid.

(b) From the point \(P\), draw the vector \(4c\)

(Total for question 1 is 4 marks)
\[
a = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad \text{and} \quad b = \begin{pmatrix} 3 \\ 2 \end{pmatrix}
\]

(a) Write down as a column vector

(i) \( a + b \)
\[
\begin{pmatrix} 4 \\ 1 \end{pmatrix} + \begin{pmatrix} 3 \\ 2 \end{pmatrix}
\]
\[
\begin{pmatrix} 7 \\ 3 \end{pmatrix}
\]

(ii) \( 2a - b \)
\[
2 \begin{pmatrix} 4 \\ 1 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}
\]
\[
\begin{pmatrix} 8 \\ 2 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}
\]
\[
\begin{pmatrix} 5 \\ 0 \end{pmatrix}
\]

\( c = \begin{pmatrix} 5 \\ -4 \end{pmatrix} \)

(b) From the point \( P \), draw the vector \( c \)

(Total for question 2 is 4 marks)
3

\[ a = \begin{pmatrix} -2 \\ 3 \end{pmatrix} \text{ and } b = \begin{pmatrix} 5 \\ -1 \end{pmatrix} \]

(a) Write down as a column vector

(i) \[ a + b \]
\[ \begin{pmatrix} -2 \\ 3 \end{pmatrix} + \begin{pmatrix} 5 \\ -1 \end{pmatrix} \]
\[ \begin{pmatrix} 3 \\ 2 \end{pmatrix} \]
(1)

(ii) \[ 2a - b \]
\[ 2 \begin{pmatrix} -2 \\ 3 \end{pmatrix} - \begin{pmatrix} 5 \\ -1 \end{pmatrix} \]
\[ \begin{pmatrix} -4 \\ 6 \end{pmatrix} - \begin{pmatrix} 5 \\ -1 \end{pmatrix} \]
\[ \begin{pmatrix} -9 \\ 7 \end{pmatrix} \]
(2)

(b) Translate the triangle by the vector \[ \begin{pmatrix} 3 \\ -2 \end{pmatrix} \]

(Total for question 3 is 4 marks)
4 \ A is the point (3, 2) and \ B is the point (4, -1).

\( \text{(a) Write down as a column vector } \overrightarrow{AB} \)
\[
\begin{pmatrix}
4 \\
-1
\end{pmatrix} -
\begin{pmatrix}
3 \\
2
\end{pmatrix}
\]
\[
\begin{pmatrix}
1 \\
-3
\end{pmatrix}
\]
\( \) (1)

\( C \) is the point (5, -2) and \( D \) is the point (2, 1).

\( \text{(b) Write down as a column vector } \overrightarrow{CD} \)
\[
\begin{pmatrix}
2 \\
1
\end{pmatrix} -
\begin{pmatrix}
5 \\
-2
\end{pmatrix}
\]
\[
\begin{pmatrix}
-3 \\
3
\end{pmatrix}
\]
\( \) (1)

(Total for question 4 is 2 marks)

5 \ A is the point (5, -1) and \ B is the point (4, -3).

\( \text{(a) Write down as a column vector } \overrightarrow{AB} \)
\[
\begin{pmatrix}
4 \\
-3
\end{pmatrix} -
\begin{pmatrix}
5 \\
-1
\end{pmatrix}
\]
\[
\begin{pmatrix}
-1 \\
-2
\end{pmatrix}
\]
\( \) (1)

\( C \) is the point (1, 6) and \( D \) is the point (-3, 9).

\( \text{(b) Write down as a column vector } \overrightarrow{CD} \)
\[
\begin{pmatrix}
-3 \\
9
\end{pmatrix} -
\begin{pmatrix}
1 \\
6
\end{pmatrix}
\]
\[
\begin{pmatrix}
-4 \\
3
\end{pmatrix}
\]
\( \) (1)

(Total for question 5 is 2 marks)
\( \overrightarrow{OA} = a \)
\( \overrightarrow{OB} = b \)

(a) Find, in terms of \( a \), the vector \( \overrightarrow{AD} \)

\( \overrightarrow{AD} = -2a \) (1)

(b) Find, in terms of \( a \) and \( b \), the vector \( \overrightarrow{AB} \)

\( \overrightarrow{AB} = -a + b \) (1)

(c) Find, in terms of \( a \) and \( b \), the vector \( \overrightarrow{AF} \)

\( \overrightarrow{AF} = -b \) (1)

(Total for question 6 is 3 marks)
The diagram shows a parallelogram.

\[ \overrightarrow{OA} = 2a \]
\[ \overrightarrow{OB} = 3b \]

(a) Find, in terms of a, the vector \( \overrightarrow{DA} \)

(b) Find, in terms of a and b, the vector \( \overrightarrow{AB} \)

(c) Find, in terms of a and b, the vector \( \overrightarrow{AC} \)

(Total for question 7 is 3 marks)
\( \overrightarrow{OA} = 5a \)
\( \overrightarrow{OB} = 3b \)

\( M \) is the midpoint of \( AB \)

(a) Find, in terms of \( a \) and \( b \), the vector \( \overrightarrow{AB} \)

\( \frac{5a - \frac{5}{2}a + \frac{3}{2}b}{\overline{3b}} \)

(b) Find, in terms of \( a \) and \( b \), the vector \( \overrightarrow{AM} \)

half of \( \overrightarrow{AB} \)

\( \frac{-\frac{5}{2}a + \frac{3}{2}b}{\overline{3b}} \)

(c) Find, in terms of \( a \) and \( b \), the vector \( \overrightarrow{OM} \)

\( \frac{5a - 2.5a + 1.5b}{\overline{3b}} \)

(Total for question 8 is 3 marks)