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

mathsgenie.co.uk
1 \[ a = \begin{pmatrix} \frac{2}{3} \\ \frac{1}{5} \end{pmatrix} \text{ and } b = \begin{pmatrix} 1 \\ 5 \end{pmatrix} \]

(a) Write down as a column vector

(i) \[ a + b = \begin{pmatrix} \frac{2}{3} \\ \frac{1}{5} \end{pmatrix} + \begin{pmatrix} 1 \\ 5 \end{pmatrix} = \begin{pmatrix} \frac{3}{8} \\ \frac{7}{21} \end{pmatrix} \]

(ii) \[ 2a + 3b = 2 \begin{pmatrix} \frac{2}{3} \\ \frac{1}{5} \end{pmatrix} + 3 \begin{pmatrix} 1 \\ 5 \end{pmatrix} = \begin{pmatrix} \frac{4}{6} \\ \frac{3}{15} \end{pmatrix} \]

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) Write down as a column vector

(i) \( \mathbf{a} + \mathbf{b} \)
\[
\begin{pmatrix} 4 \\ 1 \end{pmatrix} + \begin{pmatrix} 2 \\ 2 \end{pmatrix} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}
\]

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

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

(b) From the point \( P \), draw the vector \( \mathbf{c} \)
\( a = \begin{pmatrix} -2 \\ 3 \end{pmatrix} \) and \( b = \begin{pmatrix} 5 \\ -1 \end{pmatrix} \)

(a) Write down as a column vector

(i) \( a + b \)

\[
\begin{pmatrix} -2 \\ 3 \end{pmatrix} + \begin{pmatrix} 5 \\ -1 \end{pmatrix} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}
\]

(ii) \( 2a - b \)

\[
2\begin{pmatrix} -2 \\ 3 \end{pmatrix} - \begin{pmatrix} 5 \\ -1 \end{pmatrix} = \begin{pmatrix} -9 \\ 7 \end{pmatrix}
\]

(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).

(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).

(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).

(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).

(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)
6 \quad ABCDEF \text{ is a regular hexagon with centre } \ O.

\overrightarrow{OA} = a
\overrightarrow{OB} = b

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

\hline
-2a \hline
(1)

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

\hline
- \( a + b \) \hline
(1)

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

\hline
- b \hline
(1)

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

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

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

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

\[
\overrightarrow{AC} = -2a - 2b
\]

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

\[
\overrightarrow{AC} = -2a + 2b
\]

(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 \( \overrightarrow{AB} \)

\[ -5a + 3b \]

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

half of \( \overrightarrow{AB} \)

\[ -\frac{5}{2}a + \frac{3}{2}b \]

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

\[ 5a - \frac{5}{2}a + \frac{3}{2}b \]

or \[ 5a - 2.5a + 1.5b \]

\[ \frac{5}{2}a + \frac{3}{2}b \]

(Total for question 8 is 3 marks)