

GCSE Mathematics (1MA1)

Themed papers – Vectors

Compiled from student-friendly mark schemes

Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn't show follow-through marks (marks that are awarded despite errors being made) or special cases.

It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme.

NOTES ON MARKING PRINCIPLES

Guidance on the use of codes within this mark scheme

M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.

P1 – process mark. This mark is generally given for setting up an appropriate process to find a solution in the context of the question.

A1 – accuracy mark. This mark is generally given for a correct answer following correct working.

B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.

C1 – communication mark. This mark is given for explaining your answer or giving a conclusion in context supported by your working.

Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

Question 1 (Total 4 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
(a)(i)	$\begin{pmatrix} 1+3 \\ 4+2 \end{pmatrix} = \begin{pmatrix} 4 \\ 6 \end{pmatrix}$	B1	This mark is given for the correct answer only
(a)(ii)	$2\mathbf{a} = \begin{pmatrix} 2 \\ 8 \end{pmatrix}$ or $3\mathbf{b} = \begin{pmatrix} 9 \\ 6 \end{pmatrix}$	M1	This mark is given for a method to use either $\begin{pmatrix} 2 \\ 8 \end{pmatrix}$ or $\begin{pmatrix} 9 \\ 6 \end{pmatrix}$
	$\begin{pmatrix} 2+9 \\ 8+6 \end{pmatrix} = \begin{pmatrix} 11 \\ 14 \end{pmatrix}$	A1	This mark is given for the correct answer only
(b)	Correct line from P drawn on diagram	B1	This mark is given for a correct vector drawn

Question 2 (Total 4 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\overrightarrow{OX} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c}$	P1	This mark is given for the first step to solve the problem
	$\overrightarrow{OD} = \overrightarrow{OX} + \overrightarrow{XD} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c} + 3\mathbf{c} - \frac{1}{2}\mathbf{a}$ $\overrightarrow{CD} = \overrightarrow{OD} - \overrightarrow{OC} = 3.5\mathbf{c} - \mathbf{c} = 2.5\mathbf{c}$	P1	This mark is given for a process to find a vector expression for $\overrightarrow{CD}$
	$\overrightarrow{OC} : \overrightarrow{CD} = k : 1 = \mathbf{c} + 2.5\mathbf{c}$	P1	This mark is given for a process to find the value of k (using ratios)
	$k = \frac{1}{2.5} = \frac{2}{5}$	A1	This mark is given for the correct answer only

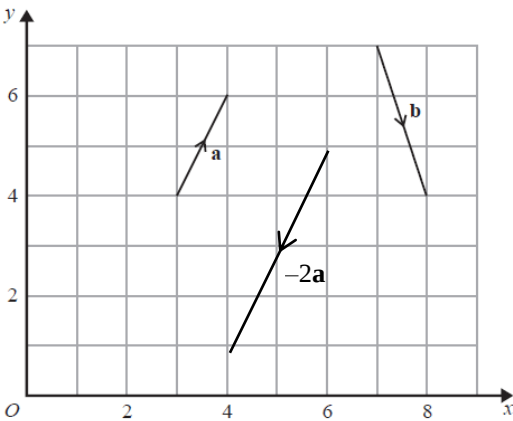
Question 3 (Total 6 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
(a)	$\overrightarrow{FE} = \overrightarrow{FC} + \overrightarrow{CD} + \overrightarrow{DE}$ $= (\mathbf{a} - \mathbf{b}) + \mathbf{a} + \mathbf{b}$	M1	This mark is given for a method to find a vector expression for $\overrightarrow{FE}$
	$= 2\mathbf{a}$	A1	This mark is given for the correct answer only
(b)	$\overrightarrow{MF} = -\overrightarrow{DM} - \overrightarrow{CD} - \overrightarrow{FC}$ $= -\frac{1}{2}\mathbf{b} - \mathbf{a} - (\mathbf{a} - \mathbf{b})$ $= \frac{1}{2}\mathbf{b} - 2\mathbf{a}$	P1	This mark is given for a method to find a vector expression for $\overrightarrow{MF}$
	$\overrightarrow{CE} = \overrightarrow{CX} + \overrightarrow{XE}$ $\overrightarrow{CX} = \overrightarrow{CD} + \overrightarrow{DM} + \frac{1}{n+1}\overrightarrow{MF}$ $\overrightarrow{XE} = \overrightarrow{XM} + \overrightarrow{ME}$ $= \frac{1}{n+1}\overrightarrow{FM} + \overrightarrow{ME}$ $\overrightarrow{CE} = \mathbf{a} + \mathbf{b}$ $\overrightarrow{CX} = \mathbf{a} + \frac{1}{2}\mathbf{b} + \frac{1}{n+1}\left(\frac{1}{2}\mathbf{b} - 2\mathbf{a}\right)$ $= \mathbf{a} - \frac{2}{n+1}\mathbf{a} + \frac{1}{2}\mathbf{b} + \frac{1}{2(n+1)}\mathbf{b}$ $= \frac{n+1}{n+1}\mathbf{a} - \frac{2}{n+1}\mathbf{a} + \frac{(n+1)}{2(n+1)}\mathbf{b} + \frac{1}{2(n+1)}\mathbf{b}$ $= \frac{n-1}{n+1}\mathbf{a} + \frac{(n+2)}{2(n+1)}\mathbf{b}$ $\overrightarrow{XE} = \frac{1}{n+1}\left(2\mathbf{a} - \frac{1}{2}\mathbf{b}\right) + \frac{1}{2}\mathbf{b}$ $= \frac{2}{n+1}\mathbf{a} - \frac{1}{2(n+1)}\mathbf{b} + \frac{1}{2}\mathbf{b}$ $= \frac{2}{n+1}\mathbf{a} - \frac{1}{2(n+1)}\mathbf{b} + \frac{(n+1)}{2(n+1)}\mathbf{b}$ $= \frac{2}{n+1}\mathbf{a} + \frac{n}{2(n+1)}\mathbf{b}$	P1	This mark is given for a method to find vector expressions for $\overrightarrow{CX}$ and $\overrightarrow{XE}$

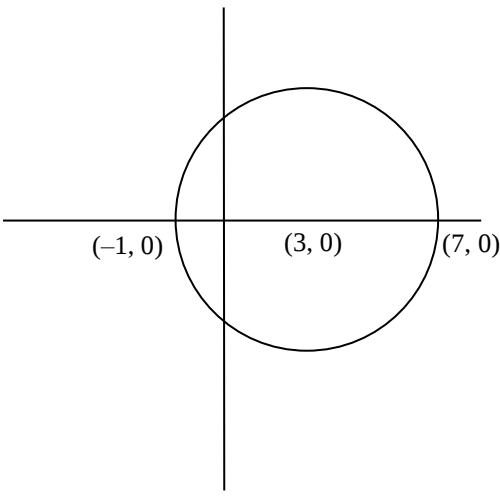
Question 3 continued (Total 6 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\overrightarrow{CE} = \overrightarrow{CX} + \overrightarrow{XE}$ $\mathbf{a} + \mathbf{b} = \frac{n-1}{n+1} \mathbf{a} + \frac{(n+2)}{2(n+1)} \mathbf{b} + \frac{2}{n+1} \mathbf{a} + \frac{n}{2(n+1)} \mathbf{b}$ Thus $\frac{n-1}{n+1} = \frac{(n+2)}{2(n+1)} \quad \text{or} \quad \frac{2}{n+1} = \frac{n}{2(n+1)}$ $2(n+1)(n-1) = (n+1)(n+2)$ $2(n-1) = n+2$ $n-2 = 2$ or $4(n+1) = n(n+1)$	P1	This mark is given for a process to find the value of n
	$n = 4$	A1	This mark is given for the correct answer only

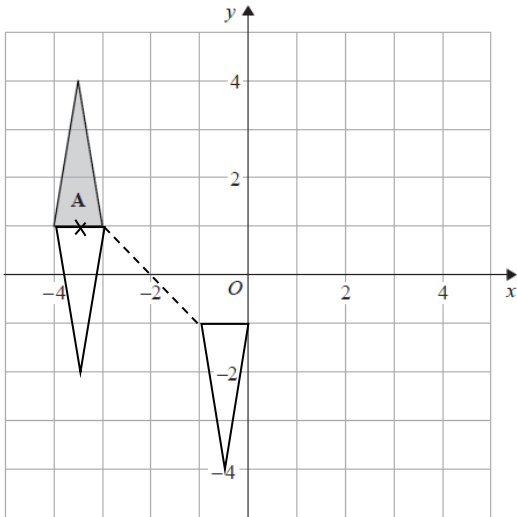
Question 4 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
		B1	This mark is given for a correct vector drawn (including the arrow)
	$\mathbf{a} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \mathbf{b} = \begin{pmatrix} 1 \\ -3 \end{pmatrix}$	M1	This mark is given for writing $\mathbf{a}$ and $\mathbf{b}$ as column vectors
	$\mathbf{a} + 2\mathbf{b} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} + \begin{pmatrix} 2 \\ -6 \end{pmatrix} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$	A1	This mark is given for the correct answer only

Question 5 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	The curve cuts the y axis at $x = 0$ $y = a^x = a^0 = 1$ $(0, 1)$	B1	This mark is given for the correct answer only
(b)		M1	This mark is given for any one of a circle with radius 4, centre $(3, 0)$ or points $(-1, 0)$ and $(7, 0)$ labelled
		M1	This mark is given for any further element of a circle with radius 4, centre $(3, 0)$ or points $(-1, 0)$ and $(7, 0)$ labelled
		A1	This mark is given for a fully correct sketch only: a circle with radius 4 and centre $(3, 0)$ and with the points $(-1, 0)$ and $(7, 0)$ labelled

Question 6 (Total 2 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
		M1	This mark is given for showing a rotation of 180° about $(-2, 0)$ followed by a translation $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$
	$(-3.5, 1)$	A1	This mark is given for the correct answer only

Question 7 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\overrightarrow{OP} = \frac{1}{3} \overrightarrow{OX} = \frac{1}{3} \mathbf{a}$ $\overrightarrow{OR} = \frac{1}{4} \overrightarrow{OY} = \frac{1}{4} \mathbf{b}$	P1	This mark is given a process to find $\overrightarrow{OP}$ and $\overrightarrow{OR}$
	$\overrightarrow{ZO} = \frac{1}{3} \overrightarrow{YX} = \mathbf{a} - \mathbf{b}$ $\overrightarrow{ZY} = \mathbf{a}$	P1	This mark is given for a process to use vector equivalence of opposite sides of a parallelogram to find vector expressions for $\overrightarrow{ZO}$ and $\overrightarrow{ZY}$
	$\overrightarrow{ZP} = \mathbf{a} - \mathbf{b} + \frac{1}{3} \mathbf{a}$ $\overrightarrow{ZR} = \mathbf{a} - \mathbf{b} + \frac{1}{4} \mathbf{b}$		This mark is given for a process to find $\overrightarrow{ZP}$ and $\overrightarrow{ZR}$ in terms of $\mathbf{a}$ and $\mathbf{b}$
	$12 \overrightarrow{ZP} = 12\mathbf{a} - 12\mathbf{b} + 4\mathbf{a} = 16\mathbf{a} - 12\mathbf{b}$ $12 \overrightarrow{ZR} = 12\mathbf{a} - 12\mathbf{b} + 3\mathbf{b} = 12\mathbf{a} - 9\mathbf{b}$ $16\mathbf{a} - 12\mathbf{b} = \frac{4}{3}(12\mathbf{a} - 9\mathbf{b}) \text{ so } \overrightarrow{ZP}$ $= \frac{4}{3} \overrightarrow{ZR}$		This mark is given for a process to write $\overrightarrow{ZP}$ and $\overrightarrow{ZR}$ as multiples of the same vector
	4 : 3		This mark is given for the correct answer only (or an equivalent ratio)

Question 8 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$AB = \mathbf{b} - \mathbf{a}$	P1	This mark is given for the start to a process by finding the vector AB
	$OM = OA + \frac{1}{2}AB$ $= \mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a})$	P1	This mark is given for a process to find the vector OM
	$AP = AO + \frac{3}{5}OM$ $= -\mathbf{a} + \frac{3}{5}(\mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a}))$ $= -\mathbf{a} + \frac{3}{5}(\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b})$ $= -\frac{7}{10}\mathbf{a} + \frac{3}{10}\mathbf{b}$	P1	This mark is given for a process to find the vector AP
	$AN = -\mathbf{a} + k\mathbf{b} = \frac{10}{7}AP$ $= \frac{10}{7}(-\frac{7}{10}\mathbf{a} + \frac{3}{10}\mathbf{b}) = -\mathbf{a} + \frac{3}{7}\mathbf{b}$	P1	This mark is given for a process to find $k = \frac{3}{7}$ using AN as a multiple of AP
	Thus $ON : NB = 3 : 4$	A1	This mark is given for the correct answer only

Question 9 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\overrightarrow{BC} = 2\mathbf{b} - 3\mathbf{a}$ $\overrightarrow{CB} = 3\mathbf{a} - 2\mathbf{b}$	B1	This mark is given for finding the vector equation for at least one of $\overrightarrow{BC}$ or $\overrightarrow{CB}$
	$\overrightarrow{AD} = \overrightarrow{AB} + \frac{3}{4} \overrightarrow{BC}$ $\overrightarrow{DE} = \frac{3}{4} \overrightarrow{CB} + \overrightarrow{BE}$	M1	This mark is given for a method to find the vector expression for at least one of $\overrightarrow{BC}$ or $\overrightarrow{CB}$
	$\overrightarrow{AD} = 3\mathbf{a} + \frac{3}{4}(2\mathbf{b} - 3\mathbf{a}) = \frac{3}{4}(2\mathbf{b} + \mathbf{a})$ $\overrightarrow{DE} = \frac{3}{4}(3\mathbf{a} - 3\mathbf{b}) + 6\mathbf{b} = \frac{9}{4}(2\mathbf{b} + \mathbf{a})$	A1	This mark is given for a method to find the vector equation for at least one of $\overrightarrow{BC}$ or $\overrightarrow{CB}$
	$\overrightarrow{DE} = 3\overrightarrow{AD}$ so vectors are parallel and have the point D in common Thus ADE is a straight line	C1	This mark is given for a complete correct conclusion

Question 10 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ or $\overrightarrow{BA} = \mathbf{a} - \mathbf{b}$	M1	This mark is given for a start to the method
	$\frac{3}{5}(\mathbf{b} - \mathbf{a}) + \mathbf{a}$	M1	This mark is given for a complete method
	$\frac{2\mathbf{a} + 3\mathbf{b}}{5}$	A1	This mark is given for a correct answer or an equivalent

Question 11 (Total 5 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$	1	This mark is given for finding a vector expression for $\overrightarrow{AB}$
	$\overrightarrow{MN} = -\frac{1}{2}\mathbf{b} + \mathbf{a} + 2\mathbf{a}$ $= -\frac{1}{2}\mathbf{b} + 3\mathbf{a}$	1	This mark is given for finding a vector expression for $\overrightarrow{MN}$
	$\overrightarrow{PN} = -k(\mathbf{b} - \mathbf{a}) + 2\mathbf{a}$ $= -k\mathbf{b} + (2 + k)\mathbf{a}$	1	This mark is given for finding a vector expression for $\overrightarrow{PN}$
	Since $\overrightarrow{MN}$ is a multiple of $\overrightarrow{PN}$ $\frac{-\frac{1}{2}}{-k} = \frac{3}{(2 + k)}$ $-\frac{1}{2}(2 + k) = -3k$	1	This mark is given for recognising that $\overrightarrow{MN}$ is a multiple of $\overrightarrow{PN}$ and comparing coefficients of $\mathbf{a}$ and $\mathbf{b}$
	$k = \frac{2}{5}$	1	This mark is given for the correct answer only

Question 12 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\overrightarrow{BA} = \mathbf{a} - 3\mathbf{b}$ or $\overrightarrow{YA} = \frac{1}{2}(\mathbf{a} - 3\mathbf{b})$	M1	This mark is given for a method to represent BA or YA as vectors
	$\overrightarrow{XY} = \mathbf{b} + \frac{1}{2}(\mathbf{a} - 3\mathbf{b})$ or $\overrightarrow{YZ} = \mathbf{a} + \frac{1}{2}(\mathbf{a} - 3\mathbf{b})$ or $\overrightarrow{XZ} = 2\mathbf{a} - 2\mathbf{b}$	M1	This mark is given for a method to represent one of XY , YZ or XZ as vectors
		M1	This mark is given for a method to represent a second of XY , YZ or XZ as vectors
	$\overrightarrow{XY} = \frac{1}{2}(\mathbf{a} - \mathbf{b})$ or $\overrightarrow{YZ} = \frac{3}{2}(\mathbf{a} - \mathbf{b})$ or $\overrightarrow{XZ} = 2(\mathbf{a} - \mathbf{b})$	M1	This mark is given for a method to simplify at least two vector terms to enable comparison of two of $\overrightarrow{XY}$, $\overrightarrow{XZ}$ and $\overrightarrow{YZ}$
	$\overrightarrow{XY}$, $\overrightarrow{XZ}$ and $\overrightarrow{YZ}$ are each multiples of $(\mathbf{a} - \mathbf{b})$ and so are parallel; point Y is common, so X , Y and Z lie on a straight line	C1	This mark is given for a complete proof with reference to two of $\overrightarrow{XY}$, $\overrightarrow{XZ}$ and $\overrightarrow{YZ}$ being parallel and a common point

Mark scheme for 1MA1 Higher themed papers: Vectors

Performance data:

Q	Taken from			Total Marks available	TOPIC	Spec Ref	AO	% Mean marks	Edexcel mean averages Marks of candidates who achieved grade:										
	Q	Series	Paper						ALL	9	8	7	6	5	4	3	2	1	U
1a	4a	Mock Set 2	3H	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1b	4b	Mock Set 2	3H	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	19	June 2017	1H	4	Geometry	G25R4R8	3	25	0.98	3.15	2.10	1.25	0.72	0.39	0.20	0.09	-	-	0.03
3a	20a	June 2019	2H	2	Geometry	G25	1	65	1.29	1.98	1.94	1.78	1.41	0.84	0.35	0.10	-	-	0.03
3b	20b	June 2019	2H	4	Geometry	N11, G25	3	20	0.80	2.03	1.49	1.06	0.66	0.38	0.18	0.08	-	-	0.05
4a	10a	June 2018	2H	3	Geometry	G25	1	45	0.45	0.89	0.76	0.62	0.47	0.29	0.14	0.04	-	-	0.01
4b	10b	June 2018	2H	2	Geometry	G25	1	34	0.67	1.67	1.32	0.95	0.62	0.34	0.15	0.08	-	-	0.04
5a	20a	June 2017	3H	1	Algebra	A14	1	20	0.20	0.81	0.49	0.22	0.10	0.05	0.03	0.03	-	-	0.03
5b	20b	June 2017	3H	3	Algebra	A13	2	25	0.76	2.66	2.01	1.10	0.44	0.14	0.04	0.02	-	-	0.01
6	20	Nov 2018	3H	2	Geometry	G8	2	11	0.21	1.30	0.68	0.48	0.38	0.28	0.15	0.08	-	-	0.01
7	24	Nov 2019	3H	5	Geometry	R4, R8, G25	3	7	0.34	4	2.41	1.59	0.75	0.24	0.04	0	-	-	0
8	21	Nov 2018	1H	5	Geometry	G25	3	4	0.18	2.50	0.82	0.71	0.30	0.15	0.11	0.07	-	-	0.03
9	19	Mock Set 3	3H	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	19	Mock Set 4	2H	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	21	Nov 2017	3H	5	Geometry	G25	3	1	0.06	1.75	1.15	0.53	0.19	0.06	0.01	0.00	-	-	0.00
12	21	Mock Set 1	2H	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				52					5.94	22.74	15.17	10.29	6.04	3.16	1.4	0.59	-	-	0.24