5 MATRICES – Further Maths

Jump to:

Section 5.1

Mark schemes

Q1.

Answer	Mark	Comments
$\begin{pmatrix}10\\17\end{pmatrix}$	B2	B1 For each component $\begin{pmatrix}10+0\\5+12\end{pmatrix}$ scores B1

Q2.

Answer	Mark	Comments
$\begin{pmatrix}13 & -30\\0 & 7\end{pmatrix}$	B2	B1 two correct elements

Additional Guidance	
Correct elements must be in their correct positions	

Q3.

Answer	Mark	Comments
Alternative method 1 Starts by multiplying 1st matrix by 3		
$\begin{pmatrix}12 & 6\\3 & 0\end{pmatrix}$	B1	brackets may be missing but values must be in correct position in a 2 by 2 array
At least two values correct from evaluation of	M1	brackets may be missing but values must be in correct position in a 2 by 2 array

their $\begin{pmatrix}12 & 6\\3 & 0\end{pmatrix} \times \begin{pmatrix}2 & 0\\-1 & 5\end{pmatrix}$		multiplication of matrices must be in the order shown
$\begin{pmatrix}18 & 30\\6 & 0\end{pmatrix}$	A1ft	must have brackets ft B0M1

Alternative method 2 Starts by multiplying the matrices		
$\begin{pmatrix}6 & 10\\2 & 0\end{pmatrix}$	M1	brackets may be missing but values must be in correct position in a 2 by 2 array
$\begin{pmatrix}6 & 10\\2 & 0\end{pmatrix}$	A1	brackets may be missing but values must be in correct position in a 2 by 2 array
$\begin{pmatrix}18 & 30\\6 & 0\end{pmatrix}$	B1ft	must have brackets ft 3 × their $\begin{pmatrix}6 & 10\\2 & 0\end{pmatrix}$ their $\begin{pmatrix}6 & 10\\2 & 0\end{pmatrix}$ must be a 2 by 2 array

Additional Guidance	
Alt 1 $\begin{pmatrix}12 & 6\\3 & 0\end{pmatrix}\begin{pmatrix}2 & 0\\-1 & 5\end{pmatrix} = \begin{pmatrix}18 & 42\\6 & 8\end{pmatrix}$	B1M1A0ft
Alt 1 $\begin{pmatrix}12 & 6\\3 & 0\end{pmatrix}\begin{pmatrix}2 & 0\\-1 & 5\end{pmatrix} = \begin{pmatrix}24 & 35\\4 & 0\end{pmatrix}$	B1M0A0ft
Alt 1 $\begin{pmatrix}12 & 6\\1 & 0\end{pmatrix}\begin{pmatrix}2 & 0\\-1 & 5\end{pmatrix} = \begin{pmatrix}18 & 30\\2 & 0\end{pmatrix}$	B0M1A1ft
Alt 1 $\begin{pmatrix}7 & 5\\4 & 3\end{pmatrix}\begin{pmatrix}2 & 0\\-1 & 5\end{pmatrix} = \begin{pmatrix}14 & 25\\5 & 20\end{pmatrix}$	B0M1A0ft
Alt 2 $\begin{pmatrix}6 & 10\\1 & 5\end{pmatrix}$ with answer $\begin{pmatrix}18 & 30\\3 & 15\end{pmatrix}$	M1A0B1ft
Alt 2 $\begin{pmatrix}8 & 0\\-1 & 0\end{pmatrix}$ with answer $\begin{pmatrix}24 & 0\\-3 & 0\end{pmatrix}$	M0A0B1ft
Alt 2 $\begin{pmatrix}8 & 0\\-1 & 0\end{pmatrix}$ with answer $\begin{pmatrix}24 & 0\\-1 & 0\end{pmatrix}$	M0A0B0ft
For the final mark allow if there is intention to enclose the correct	

elements in brackets	
Responses that start by multiplying 2nd matrix by 3 should be marked using the principles of Alt 1	
Multiplying both matrices by 3 can score a maximum of B1 $\begin{pmatrix}12 & 6\\3 & 0\end{pmatrix}$ or $\begin{pmatrix}6 & 0\\-3 & 15\end{pmatrix}$	B1M0A0ft

Q4.

Answer	Mark	Comments
$3a - b$ **or** $2a + b$ seen	M1	oe
$3a - b = b$	M1	oe
$2a + b = a + 1$	M1	oe
$a = \frac{2}{5}$	A1	
$b = \frac{3}{5}$	A1	

Q5.

Answer	Mark	Comments
Alternative method 1		
$a = 3$	B1	
$4 - 8a = b$ or $4(1 - 2a) = b$	M1	oe eg $4 \times 1 + -2a \times 4 = b$
$b = -20$	A1ft	ft from B0 M1

Alternative method 2		
$a = 3$	B1	
$\begin{pmatrix}4 - 8a\\4a\end{pmatrix}$	B1	Condone no brackets but do not condone a fraction
$b = -20$	B1ft	ft from B0 B1

Additional Guidance

alt 1 ... a = 12 B0, b = −92 M1 A1ft

Q6.

	Answer	Mark	Comments
(a)	$4s + 5 = -1$ or $-7s - 10 = t$	M1	oe equation
	$s = -1.5$	A1	
	$t = 0.5$	A1ft	ft −7 × their s − 10

(b)	4	A1	

Q7.

Answer	Mark	Comments
$14 + a^3 = 78$ or $2b - 5a = 12$ or $2b - 5a = 12$ or $14 + a^3$ **and** $2b - 5a$	M1	oe eg $a^3 = 64$ or $2b + -5a = 12$ allow eg $7 \times 2 + a^2 \times a$ for $14 + a^3$ allow eg $2 \times b - 5 \times a$ for $2b - 5a$
$a = 4$	A1	
$\frac{12+5\times \text{their } a}{2}$ correctly evaluated	A1ft	accept an exact value or a value rounded to 1 dp or better

Additional Guidance	
$\begin{pmatrix} 14+a^3 \\ 2b-5a \end{pmatrix}$ or $(14 + a^3, 2b - 5a)$ with or without brackets	M1
$a = 4$ (M1 is implied)	M1A1
M1 for $2b - 5a = 12$ is implied by an incorrect value for a with a correct ft answer for b	M1A0A1ft

eg $a = 8$ $b = 26$	
An incorrect but exact value for a seen in working (eg $\frac{8}{3}$) with a rounded value for a on answer line (eg 2.6) Allow ft for b from the exact or the rounded value	
$a = 4$ and -4 with one or both of $b = 16$ and -4	M1A0A1ft
$a = 4$ and -4 (no values for b or incorrect values for b)	M1A0A0ft

Section 5.2

Mark schemes

Q1.

Answer	Mark	Comments
$\begin{bmatrix} 2a & 2b+0.4 \\ 0 & 1.2 \end{bmatrix}$ or $2a = k$ or $k = 1.2$ or $2b + 0.4 = 0$	M1	oe any 3 terms correct in correct position could be implied from second M mark
$2a = k$ and $2b + 0.4 = 0$	M1dep	oe eg $2a = 1.2$ and $2b + 0.4 = 0$
$a = 0.6$ or $b = -0.2$	M1	oe
$a = 0.6$ and $b = -0.2$	A1	oe

Q2.

Answer	Mark	Comments
$2m + 2 = 1$ or $2m + 1 = 0$ or $\frac{1-2}{2}$ or	M1	oe equation or calculation

$\begin{pmatrix} 2m+2 & 2m+1 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$		
$-\frac{1}{2}$ or -0.5	A1	

Additional Guidance	
Condone missing brackets in $\begin{pmatrix} 2m+2 & 2m+1 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	
Allow $\begin{pmatrix} 2m+2 & 2m+1 \\ 2-2 & 2-1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	
Mark positively eg error in matrix multiplication but $2m + 2 = 1$ and answer -0.5	M1, A1
More than one answer given is A0 eg $m + 2 = 1$ and $2m + 1 = 0$ (mark positively) Answer -1 and -0.5	M1 A0

Q3.

Answer	Mark	Comments
$\begin{pmatrix} 1 & 1 \\ -3 & -2 \end{pmatrix}$	B2	B1 2 by 2 matrix with at least two elements correct
their $\begin{pmatrix} 1 & 1 \\ -3 & -2 \end{pmatrix}$ (×) $\begin{pmatrix} -2 & -1 \\ 3 & 1 \end{pmatrix}$	M1	Multiplication can be in either order if their $\begin{pmatrix} 1 & 1 \\ -3 & -2 \end{pmatrix}$ is a 2 by 2 matrix Do not award if their $\begin{pmatrix} 1 & 1 \\ -3 & -2 \end{pmatrix}$ is **M**
$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	A1	Must have B2 with M1 seen

Section 5.3 – 5.4
Mark schemes

Q1.

Answer	Mark	Comments
Reflection in the x-axis or reflection in $y = 0$	B1	

Additional Guidance	
Reflect(ed) in the x-axis	B1
Do not allow if there is additional incorrect information eg1 Reflection in the x-axis about the origin eg2 Reflection in the x-axis and rotated	 B0 B0
Reflection	B0

Q2.

Answer	Mark	Comments
Rotation, through 90° (anticlockwise), about O **or** Rotation, through 270° clockwise, about O	B3	B1 for each part SC1 $\begin{pmatrix}1\\0\end{pmatrix} \rightarrow \begin{pmatrix}0\\1\end{pmatrix}$ **or** $\begin{pmatrix}0\\1\end{pmatrix} \rightarrow \begin{pmatrix}-1\\0\end{pmatrix}$ **or** $\begin{pmatrix}\cos 90 & -\sin 90\\ \sin 90 & \cos 90\end{pmatrix}$

Q3.

Answer	Mark	Comments
$\begin{pmatrix}-1 & -3\\2 & 4\end{pmatrix}\begin{pmatrix}a\\2\end{pmatrix}$ or $\begin{pmatrix}-a-6\\2a+8\end{pmatrix}$	M1	Allow $(-a - 6\ 2a + 8)$
$-a - 6 = a$ or $2a + 8 = 2$	M1	oe linear equation(s) (not $a = -3$) Implies M1 M1
$-a - 6 = a$ and $2a + 8 = 2$	A1	oe equations (not $a = -3$)
Shows both equations have a common solution (a = –3) and		ft M1 M1 A0

Yes	A1ft	Must show that their two linear equations do not have a common solution and No SC4 $\begin{pmatrix}-1 & -3\\ 2 & 4\end{pmatrix}\begin{pmatrix}-3\\ 2\end{pmatrix}=\begin{pmatrix}-3\\ 2\end{pmatrix}$ and Yes SC3 $\begin{pmatrix}-1 & -3\\ 2 & 4\end{pmatrix}\begin{pmatrix}-3\\ 2\end{pmatrix}=\begin{pmatrix}-3\\ 2\end{pmatrix}$

Additional Guidance	
$\begin{pmatrix}a\\ 2\end{pmatrix}\begin{pmatrix}-1 & -3\\ 2 & 4\end{pmatrix}$ is first M0 unless recovered	
In matrices, allow missing brackets or inclusion of 'fraction' lines	
Only one equation can score a maximum of M1 M1 A0 A0	
a = –3 with no correct working	Zero
$\begin{pmatrix}-a-6\\ 2a+8\end{pmatrix}=\begin{pmatrix}a\\ 2\end{pmatrix}$ with no further valid work	M1 M0 A0 A0
The final A mark may be seen in various ways eg1 Solves both equations obtaining a = –3 each time and Yes (or shows that both equations simplify to $2a$ = –6 and Yes) eg2 Solves one equation obtaining a = –3 and shows by substitution that a = –3 satisfies the other equation and Yes eg3 Adds the two equations to obtain a correct statement and Yes $-2a-6=0$ $2a+8=2$ $2=2$	

Q4.

Answer	Mark	Comments
$\begin{pmatrix}2a & b\\ -b & -a\end{pmatrix}\begin{pmatrix}3\\ 4\end{pmatrix}=\begin{pmatrix}8\\ -7\end{pmatrix}$	M1	

$6a + 4b = 8$ and $-3b - 4a = -7$	M1dep	oe allow these to be written as a matrix equation in all likelihood this will imply M2 as the matrices may not be seen
Solve eg $12a + 8b = 16$ and $-12a - 9b = -21$ **or** $18a + 12b = 24$ and $-16a - 12b = -28$ or substitution eg $a = \frac{8 - 4b}{6}$ and $\frac{-4(8 - 4b)}{6} - 3b = -7$ **or** $b = \frac{4 - 3a}{2}$ and $-4a - \frac{3(4 - 3a)}{2} = -7$	M1dep	oe for making coefficients of a or b equal dependent on first M1 only oe
$a = -2$ **or** $b = 5$	A1	
$a = -2$ **and** $b = 5$	A1	

Additional Guidance	
Matrices wrong way round can be recovered by correct equations in second M	
Point written as coordinates rather than a matrix can be recovered by correct equations in second M	
a **or** b correct with no incorrect working	M1, M1, M1, A1, A0

Q5.

Answer	Mark	Comments
$\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}\begin{pmatrix}-1 & 0\\0 & 1\end{pmatrix}$	M1	$\begin{pmatrix}1\\0\end{pmatrix}\rightarrow\begin{pmatrix}-1\\0\end{pmatrix}\rightarrow\begin{pmatrix}0\\-1\end{pmatrix}$ **or** $\begin{pmatrix}0\\1\end{pmatrix}\rightarrow\begin{pmatrix}0\\1\end{pmatrix}\rightarrow\begin{pmatrix}1\\0\end{pmatrix}$
$\begin{pmatrix}0 & 1\\-1 & 0\end{pmatrix}$	A1	SC1 $\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}$

Q6.

	Answer	Mark	Comments
(a)	$\begin{pmatrix}-1 & 0\\0 & -1\end{pmatrix}$	B2	B1 Rotation 180° (about/centre O) or indication that $\begin{pmatrix}1\\0\end{pmatrix}\rightarrow\begin{pmatrix}-1\\0\end{pmatrix}$ or indication that $\begin{pmatrix}0\\1\end{pmatrix}\rightarrow\begin{pmatrix}0\\-1\end{pmatrix}$ or $\begin{pmatrix}-1 & 0\\0 & 1\end{pmatrix}(\times)\begin{pmatrix}1 & 0\\0 & -1\end{pmatrix}$ or $\begin{pmatrix}1 & 0\\0 & -1\end{pmatrix}(\times)\begin{pmatrix}-1 & 0\\0 & 1\end{pmatrix}$ or reflection in $y = -x$ and $\begin{pmatrix}0 & -1\\-1 & 0\end{pmatrix}$
(b)	Correct square (vertices O, A" (−3, 0) B" (−3, −3) and C " (0, −3)) with correct labelling	B3	B2 Correct square with incorrect or no labelling or correct points plotted with correct labelling B1 3 by 3 square in wrong position (ignore labelling)

		or correct points plotted with incorrect or no labelling or enlargement scale factor −3 (centre O) or $\begin{pmatrix}-3 & 0\\ 0 & -3\end{pmatrix}\begin{pmatrix}1\\ 0\end{pmatrix}=\begin{pmatrix}-3\\ 0\end{pmatrix}$ or $\begin{pmatrix}-3 & 0\\ 0 & -3\end{pmatrix}\begin{pmatrix}1\\ 1\end{pmatrix}=\begin{pmatrix}-3\\ -3\end{pmatrix}$ or $\begin{pmatrix}-3 & 0\\ 0 & -3\end{pmatrix}\begin{pmatrix}0\\ 1\end{pmatrix}=\begin{pmatrix}0\\ -3\end{pmatrix}$

Q7.

Answer	Mark	Comments
Rotation through 180° centre the origin or enlargement scale factor –1 centre the origin	B2	B1 $\begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}$ or enlargement scale factor – 1 or rotation through 180° or indication that **B** represents rotation through 270° (anticlockwise centre the origin) or indication that **B** represents rotation through 90° clockwise (centre the origin)

Additional Guidance	
For B2 ignore any reference to clockwise or anticlockwise rotation	
Condone omission of degrees symbol throughout eg B is rotation through 270	B1

Mark intention eg1 Rotate(d) 180 about o eg2 Enlarge(d) sf –1	 B2 B1
Allow rotation through 540 centre the origin	B2
Do not allow if there is additional information that is incorrect eg1 Rotation through 180° and a reflection eg2 Enlargement sf –1 rotated through 90° eg3 Rotation through 180° centre the origin so the shape turns	 B0 B0 B2
Rotation	B0
Enlargement	B0
Do not allow turn for rotation	
Do not allow eg half turn for 180°	
Do not allow negative enlargement	

Q8.

Answer	Mark	Comments
Rotation and 180 and centre O or Enlargement and scale factor –1 and centre O	B2	oe B1 Rotation and 180 or Enlargement and scale factor –1 or $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Additional Guidance	
Response that is not a single transformation is always B0 unless they give the two possible B2 answers	
Rotation through 180 clockwise about O	B2
Rotation through 180 anti-clockwise about O	B2
For B2 or B1 ignore a circular arrow as direction not required	
Do not allow half turn or turn eg1 Half turn eg2 Turn 180	 B0 B0

$\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ from multiplying given matrices in either order	B1
Allow matrix to have brackets missing and/or commas but must be 2 by 2 array	
$\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ scores B1 even if description of transformation is incorrect	
$\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ seen followed by multiplication of matrix by a vector is not a choice	B1

Q9.

Answer	Mark	Comments
Rotation and 270 (anti-clockwise) and centre O or Rotation and 90 clockwise and centre O	B2	oe B1 270 (anti-clockwise) or 90 clockwise Do not allow if reflection or translation or enlargement also stated

Additional Guidance	
270 is anti-clockwise by default so 'anti-clockwise' not required for B2 or B1	B1
270	B1
270 clockwise	B0
Response that is not a single transformation is always B0 eg Rotation, 270 (anti-clockwise), centre O Scale factor 3 (enlargement)	B0
Reflection 270 (anti-clockwise)	B0
Rotation and 270 clockwise and centre O	B0
Turn 90 clockwise centre O (B1 for 90 clockwise)	B1
Do not allow a circular arrow for clockwise direction eg 90 with circular arrow indicating clockwise	B0
Do not allow quarter turn etc eg Quarter turn clockwise	B0

Q10.

Answer	Mark	Comments
Alternative method 1		
$\begin{pmatrix}3&0\\0&3\end{pmatrix}$ or 3 $\begin{pmatrix}1&0\\0&1\end{pmatrix}$	B1	
$\begin{pmatrix}-1&0\\0&-1\end{pmatrix}$	B1	
their $\begin{pmatrix}-1&0\\0&-1\end{pmatrix}$ (×) their $\begin{pmatrix}3&0\\0&3\end{pmatrix}$	M1	Either order This mark cannot be implied Must have scored B1 or B2
$\begin{pmatrix}-3&0\\0&-3\end{pmatrix}$ or –3 $\begin{pmatrix}1&0\\0&1\end{pmatrix}$ or 3 $\begin{pmatrix}-1&0\\0&-1\end{pmatrix}$	M1dep	Correctly multiplies their pair of 2 by 2 matrices
$\begin{pmatrix}-3&0\\0&-3\end{pmatrix}$ or –3 $\begin{pmatrix}1&0\\0&1\end{pmatrix}$ or 3 $\begin{pmatrix}-1&0\\0&-1\end{pmatrix}$ and scale factor –3	A1	Must gain B1 B1 M1 M1

Alternative method 2 Algebraic method		
$\begin{pmatrix}3&0\\0&3\end{pmatrix}$ or 3 $\begin{pmatrix}1&0\\0&1\end{pmatrix}$	B1	
$\begin{pmatrix}-1&0\\0&-1\end{pmatrix}$	B1	
their $\begin{pmatrix}3&0\\0&3\end{pmatrix}\begin{pmatrix}x\\y\end{pmatrix} = \begin{pmatrix}3x\\3y\end{pmatrix}$ | their $\begin{pmatrix}-1&0\\0&-1\end{pmatrix}$ (×) $\begin{pmatrix}x\\y\end{pmatrix} = \begin{pmatrix}-x\\-y\end{pmatrix}$	M1	This mark cannot be implied Must have scored B1 or B2 Multiplications must be correctly worked out

their $\begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}$ (×) their $\begin{pmatrix}3x\\ 3y\end{pmatrix}$ = $\begin{pmatrix}-3x\\ -3y\end{pmatrix}$ their $\begin{pmatrix}3 & 0\\ 0 & 3\end{pmatrix}$ (×) their $\begin{pmatrix}-x\\ -y\end{pmatrix}$ = $\begin{pmatrix}-3x\\ -3y\end{pmatrix}$	M1dep	Multiplications must be correctly worked out
$\begin{pmatrix}-3x\\ -3y\end{pmatrix}$ and scale factor –3	A1	Must gain B1 B1 M1 M1

Alternative method 3 Unit square method		
$\begin{pmatrix}3 & 0\\ 0 & 3\end{pmatrix}$ or 3 $\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$	B1	
$\begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}$	B1	
their $\begin{pmatrix}3 & 0\\ 0 & 3\end{pmatrix}$ (×) $\begin{pmatrix}1 & 0 & 1\\ 0 & 1 & 1\end{pmatrix}$ = $\begin{pmatrix}3 & 0 & 3\\ 0 & 3 & 3\end{pmatrix}$ their $\begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}$ (×) $\begin{pmatrix}1 & 0 & 1\\ 0 & 1 & 1\end{pmatrix}$ = $\begin{pmatrix}-1 & 0 & -1\\ 0 & -1 & -1\end{pmatrix}$	M1	This mark cannot be implied Must have scored B1 or B2 Multiplications must be correctly worked out May be seen as three products
their $\begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}$ (×) their $\begin{pmatrix}3 & 0 & 3\\ 0 & 3 & 3\end{pmatrix}$ = $\begin{pmatrix}-3 & 0 & -3\\ 0 & -3 & -3\end{pmatrix}$ their $\begin{pmatrix}3 & 0\\ 0 & 3\end{pmatrix}$ (×) their $\begin{pmatrix}-1 & 0 & -1\\ 0 & -1 & -1\end{pmatrix}$ = $\begin{pmatrix}-3 & 0 & -3\\ 0 & -3 & -3\end{pmatrix}$	M1dep	Multiplications must be correctly worked out May be seen as three products
$\begin{pmatrix}-3 & 0 & -3\\ 0 & -3 & -3\end{pmatrix}$	A1	Must gain B1 B1 M1 M1 May be seen as three 2 by 1 matrices

and scale factor –3		

Additional Guidance	
If both matrices are incorrect	Zero
Matrices must be used - ignore diagrams	
In matrices, allow missing brackets or inclusion of 'fraction' lines	
Alt 1 B2 gained then $\begin{pmatrix} -3 & 0 \\ 0 & -3 \end{pmatrix}$ stated	B2 M0 M0 A0
Allow 'enlargement –3' for 'scale factor –3' Do not allow '–3' for 'scale factor –3'	
Scale factor –3 with no valid working	Zero
$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix} = \begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$ scores B1 but does not score M1 M1 for the multiplication of two matrices with B1 scored	
Alt 3 May also see working for $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$	

Q11.

	Answer	**Mark**	**Comments**
(a)	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	B1	

(b)	Rotation of 180° about the origin Enlargement SF −1 centre the origin	B2	B1 if either the 180° or the origin is missing B1 if either the SF or the centre is missing

Additional Guidance
Ignore any reference to direction Accept 'Rotation of half a turn' for B1
Answers of Rotation or Enlargement with no other description attached score B0
Rotation 90° is B0 (incorrect angle, no centre of rotation)

Enlargement SF2 is B0 (incorrect SF and no centre of enlargement)

(c)	$\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$	B1	

Additional Guidance
If no working or answer seen in (c), look at (b) ... the matrix for M^2 might be written there, and, if correct, will score B1 in (c)