

OCR Maths FP1

Topic Questions from Papers

Matrices

Answers

1	(i) $A^2 = \begin{pmatrix} 3 & 8 \\ 4 & 11 \end{pmatrix}$	M1	4	Attempt to find A^2 , 2 elements correct
		A1		All elements correct
	$4A = \begin{pmatrix} 4 & 8 \\ 4 & 12 \end{pmatrix}$	M1		Use correct matrix $4A$
	$A^2 = 4A - I$	A1		Obtain given answer correctly
	(ii)	M1		Multiply answer to (i) by A^{-1} or obtain A^{-1} or factorise $A^2 - 4A$
	$A^{-1} = 4I - A$	A1	2	Obtain given answer correctly
			6	

(Q2, June 2005)

2 (i)	$\det(B) = 0$		3	Attempt to solve their $\det(B)=0$
	$3a - 4 + 6 = 0$	M1		Obtain given answer
	$a = \frac{-2}{3}$	A1 A1		
(ii)	$\frac{1}{3a+2} \begin{pmatrix} 3 & 1 & -4 \\ -4 & 2a & a+6 \\ 2 & -a & a-2 \end{pmatrix}$	M1	4	Show correct process for adjoint entries
		A1		Obtain at least 4 correct entries in adjoint
		B1		Divide by their determinant
		A1		Obtain completely correct answer
(iii)	$a = -1$	M1	3	
	$\begin{pmatrix} -11 \\ 17 \\ -9 \end{pmatrix}$	M1		Attempt product of $B^{-1}C$
	$x = -11, y = 17, z = -9$	A1		Obtain correct answer

(Q7, June 2005)

3	(i) $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$	B1B1	2	Each column correct
	(ii) Shear, e.g. (0,1) transforms to (3,1)	B1B1	2	One example or sensible explanation
	(iii) $\mathbf{M} = \begin{pmatrix} 2 & 3 \\ 0 & 1 \end{pmatrix}$	M1 A1	2	Attempt to find DC (not CD) Obtain given answer

(Q9, June 2005)

4	(i)	M1		Show correct expansion process, allow sign slips
	$2 \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix} - 1 \begin{bmatrix} 1 & 1 \\ 1 & 3 \end{bmatrix} + 3 \begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}$ $2 \times 5 - 1 \times 2 + 3 \times -1$ 5	A1 A1 B1ft	3 1 4	Obtain correct (unsimplified) expression Obtain correct answer State that M is non-singular as $\det \mathbf{M}$ non-zero, ft their determinant
	(ii)			

(Q3, Jan 2006)

<p>5</p> <p>(i) $\frac{1}{2} \begin{pmatrix} 8 & -2 \\ -3 & 1 \end{pmatrix}$</p> <p>(ii) Either</p> <p>$\frac{1}{2} \begin{pmatrix} 14 & 2 \\ -5 & 0 \end{pmatrix}$</p> <p>Or</p> <p>$\frac{1}{5} \begin{pmatrix} 3 & -1 \\ -1 & 2 \end{pmatrix}$</p> <p>B = A⁻¹C</p> <p>B = $\frac{1}{5} \begin{pmatrix} 0 & -2 \\ 5 & 14 \end{pmatrix}$</p> <p>$\frac{1}{2} \begin{pmatrix} 14 & 2 \\ -5 & 0 \end{pmatrix}$</p> <p>Or</p> <p>AB = $\begin{pmatrix} 2a + c & 2b + d \\ a + 3c & b + 3d \end{pmatrix}$</p> <p>$a = 0, c = 1, b = -0.4, d = 2.8$</p> <p>$\frac{1}{2} \begin{pmatrix} 14 & 2 \\ -5 & 0 \end{pmatrix}$</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>M1A1</p> <p>M1</p> <p>A1ft</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>A1ft</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1A1</p> <p>A1</p>	<p>2</p> <p>5</p> <p>7</p>	<p>Transpose leading diagonal and negate other diagonal</p> <p>Divide by determinant</p> <p>State or imply (AB)⁻¹ = B⁻¹A⁻¹</p> <p>Use this result and obtain B⁻¹ = C⁻¹A, or equivalent matrix algebra</p> <p>Matrix multn., two elements correct, for any pair</p> <p>All elements correct ft their (i)</p> <p>Find A⁻¹</p> <p>Premultiply by A⁻¹ stated or implied</p> <p>Matrix multn. Two elements correct</p> <p>All elements correct</p> <p>Correct B⁻¹</p> <p>Find AB</p> <p>Solve one pair of simultaneous equations</p> <p>Each pair of answers</p> <p>Correct B⁻¹</p>
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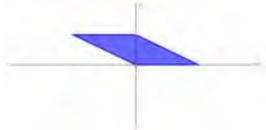
(Q6, Jan 2006)

6	(i)	$\begin{pmatrix} 0 \\ 0 \end{pmatrix} \begin{pmatrix} 2 \\ 0 \end{pmatrix} \begin{pmatrix} 2 \\ -2 \end{pmatrix} \begin{pmatrix} 0 \\ -2 \end{pmatrix}$	B1 B1 B1	3	For correct vertex (2, -2) For all vertices correct For correct diagram
	(ii) Either	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B1,B1 B1	6	Reflection, in x-axis Correct matrix
		$\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$	B1,B1 B1		Enlargement, centre O s.f.2 Correct matrix
	Or	$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$	B1,B1 B1		Reflection, in the y-axis Correct matrix
		$\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$	B1,B1 B1		Enlargement, centre O s.f. -2 Correct matrix
	Or	$\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$	B1,B1 B1		Stretch, in x-direction s.f. 2 Correct matrix
	$\begin{pmatrix} 1 & 0 \\ 0 & -2 \end{pmatrix}$	B1,B1 B1	Stretch, in y-direction s.f. -2 Correct matrix		
				9	

(Q8, Jan 2006)

7	i)	$\begin{pmatrix} 7 & 4 \\ 0 & -1 \end{pmatrix}$	B1 B1	2	Two elements correct All four elements correct
	(ii)	$\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$	B1	2	A – B correctly found
	$k = 3$		B1		Find k
					4

(Q1, June 2006)

8	(i)	M1	2	For 2 other correct vertices
		A1		For completely correct diagram
	(ii) $\begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}$	B1 B1	2	Each column correct
			4	

(Q2, June 2006)

9	(i)	M1	3	Attempt at matrix multiplication
	$\mathbf{A}^2 = \begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix} \quad \mathbf{A}^3 = \begin{pmatrix} 8 & 0 \\ 0 & 1 \end{pmatrix}$	A1 A1		Correct \mathbf{A}^2 Correct \mathbf{A}^3

(Q7, June 2006)

10	(i)	M1	3	Correct expansion process shown
	$a \begin{bmatrix} a & 0 \\ 2 & 1 \end{bmatrix} - 4 \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} + 2 \begin{bmatrix} 1 & a \\ 1 & 2 \end{bmatrix}$	A1		Obtain correct unsimplified expression
	$a^2 - 2a$	A1		Obtain correct answer
	(ii)	M1		Solve their $\det \mathbf{M} = 0$
	$a = 0$ or $a = 2$	A1A1ft		Obtain correct answers
	(iii) (a)	B1 B1		Solution, as inverse matrix exists or \mathbf{M} non-singular or $\det \mathbf{M} \neq 0$
(b)	B1 B1	4	Solutions, eqn. 1 is multiple of eqn 3	
			10	

(Q8, June 2006)

11	(i) $a = -3$	B1	1	State correct value
	(ii) $2a - 3 = 7$ or $3a - 6 = 9$	M1		Sensible attempt at multiplication
	$a = 5$	A1	2	Obtain correct answer
			3	

(Q1, Jan 2007)

12	(i) $\begin{pmatrix} 0 \\ 0 \end{pmatrix} \begin{pmatrix} 0 \\ -1 \end{pmatrix} \begin{pmatrix} 3 \\ 0 \end{pmatrix} \begin{pmatrix} 3 \\ -1 \end{pmatrix}$	M1	2	For at least two correct images
		A1		For correct diagram, co-ords. clearly written down
	(ii) 90° clockwise, centre origin	B1 B1	3	Or equivalent correct description
	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	B1		Correct matrix, not in trig form
	(iii) Stretch parallel to x -axis, s.f. 3	B1 B1	4	Or equivalent correct description, but must be a stretch for 2 nd B1
	$\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$	B1 B1		Each correct column
		9		

(Q9, Jan 2007)

13	(i)	M1		Show correct expansion process for 3 x 3
	$\Delta = \det \mathbf{D} = 3a - 6$	M1		
		M1		Obtain correct answer
		A1		Show correct process for adjoint
		B1		entries
		A1	7	Obtain at least 4 correct entries in adjoint
		M1		Divide by their determinant
		A1A1A1 ft all 3	4	Obtain completely correct answer
			11	Attempt product of form $\mathbf{D}^{-1}\mathbf{C}$, or eliminate to get 2 equations and solve Obtain correct answers, ft their inverse
	(ii)			
	$\frac{1}{\Delta} \begin{pmatrix} 5 \\ 2a-9 \\ 5a-15 \end{pmatrix}$			

(Q10, Jan 2007)

14	(i)	B1	2	Transpose leading diagonal and negate other diagonal or solve sim. eqns. to get 1 st column Divide by the determinant or solve 2 nd pair to get 2 nd column
	$\frac{1}{2} \begin{pmatrix} 5 & -1 \\ -3 & 1 \end{pmatrix}$	B1		
	(ii)	M1		Attempt to use $\mathbf{B}^{-1}\mathbf{A}^{-1}$ or find B Attempt at matrix multiplication
		M1(indep)	4	One element correct, a.e.f.
		A1ft	6	All elements correct, a.e.f.
		A1ft		NB ft consistent with their (i)
	$\frac{1}{2} \begin{pmatrix} 2 & 0 \\ 23 & -5 \end{pmatrix}$			

(Q4, June 2007)

15	(i)	M1 M1 A1	3	Show correct expansion process Show evaluation of a 2 x 2 determinant Obtain correct answer a.e.f.
	(ii)	M1 A1ft B1	2	Substitute $a = 2$ in their determinant
	(iii)	M1 A1	3	Obtain correct answer and state a consistent conclusion
	<i>OR</i>	M1 A1 A1	3	det $M = 0$ so non-unique solutions Attempt to solve and obtain 2 inconsistent equations Deduce that there are no solutions
			8	Substitute $a = 4$ and attempt to solve Obtain 2 correct inconsistent equations Deduce no solutions

(Q7, June 2007)

16	(i)	B1	1	Correct matrix
	(ii)	B1B1B1	3	Sensible alternatives OK, must be a single transformation
	(iii)	B1	1	Matrix multiplication or combination of transformations
	(iv)	M1 A1	2	For at least two correct images For correct diagram
	(v)	B1 B1	2	State correct value State correct relation a.e.f.
			9	

(Q9, June 2007)

17	(i)	M1 A1	2	For 2 other correct vertices seen, correct direction of shear seen For completely correct diagram, must include scales
	(ii)	B1 B1	2	Each column correct
			4	

(Q1, Jan 2008)

18	(i) $\begin{pmatrix} -13 \\ 1 \\ -10 \end{pmatrix}$	B1 B1	2	4B seen or implied or 2 elements correct Obtain correct answer
	(ii) $\begin{pmatrix} 8 & 16 & -4 \\ 0 & 0 & 0 \\ 6 & 12 & -3 \end{pmatrix}$	M1 A1A1A1	4	Obtain a 3 x 3 matrix Each row (or column) correct
	(iii) (8)	M1 A1	2	Obtain a single value Obtain correct answer, must have matrix
			8	

(Q5, Jan 2008)

19	(i) $a = -6$	M1 A1	2	Use $\det \mathbf{A} = 0$ Obtain correct answer
	(ii) $\mathbf{A}^{-1} = \frac{1}{a+6} \begin{pmatrix} 1 & -3 \\ 2 & a \end{pmatrix}$	B1 B1ft		Both diagonals correct Divide by $\det \mathbf{A}$
	$x = \frac{4}{a+6}, y = \frac{2-a}{a+6}$	M1 A1ft A1ft	5	Premultiply column by \mathbf{A}^{-1} , no other method Obtain correct answers from their \mathbf{A}^{-1}
			7	

(Q7, Jan 2008)

20 (i) $\begin{pmatrix} 1 & 1 \\ 5 & -1 \end{pmatrix}$

B1 Two elements correct

B1 All four elements correct

2

(ii) EITHER

$$\frac{1}{3} \begin{pmatrix} 2 & -1 \\ -5 & 4 \end{pmatrix}$$

B1 Both diagonals correct

B1 Divide by determinant

2

OR

B1 Solve sim. eqns. 1st column correct

B1 2nd column correct

(Q1, June 2008)

21 (i)	B1	Enlargement (centre O) scale factor 6	1
(ii)	B1	Reflection	2
	B1	Mirror line is $y = x$	
(iii)	B1	Stretch in y direction	2
	B1	Scale factor 6, must be a stretch	
(iv)	B1	Rotation	2
	B1	36.9° clockwise or equivalent	

(Q7, June 2008)

22 (i)	M1	Find value of det AB	2
	A1	Correct value 2 seen	
(ii)	M1	Show correct process for adjoint entries	4
	A1	Obtain at least 4 correct entries in adjoint	
	B1	Divide by their determinant	
	A1	Obtain completely correct answer	
(iii) EITHER	M1	State or imply $(\mathbf{AB})^{-1} = \mathbf{B}^{-1}\mathbf{A}^{-1}$	5
	A1	Obtain $\mathbf{B}^{-1} = (\mathbf{AB})^{-1} \times \mathbf{A}$	
	M1	Correct multiplication process seen	
	A1	Obtain three correct elements	
	A1	All elements correct	
OR	M1	Attempt to find elements of B	
	A1	All correct	
	M1	Correct process for \mathbf{B}^{-1}	
	A1	3 elements correct	
	A1	All elements correct	

(Q10, June 2008)

23	(i)	$\frac{1}{10} \begin{pmatrix} 5 & 0 \\ -a & 2 \end{pmatrix}$	B1	2	Both diagonals correct Divide by correct determinant
			B1		
	(ii)	$\begin{pmatrix} 3 & -2 \\ 2a & 6 \end{pmatrix}$	B1	2	Two elements correct Remaining elements correct
			B1		
				4	

(Q2, Jan 2009)

24	$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$	B1 M1 A1 A1	4 4	State or use correct result Combine matrix and its inverse Obtain I or I ² but not 1 Obtain zero matrix but not 0 S.C. If 0/4, B1 for AA⁻¹ = I
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(Q4, Jan 2009)

25	<p><i>Either</i></p> <p>$4k - 4$</p> <p>$k = 1$</p> <p><i>Or</i></p>	<p>M1 M1 A1 M1 A1ft</p> <p>M1 A1 M1 A1 A1</p>	5 5	<p>Consider determinant of coefficients of LHS Sensible attempt at evaluating any 3×3 det Obtain correct answer a.e.f. unsimplified Equate det to 0 Obtain $k = 1$, ft provided all M's awarded</p> <p>Eliminate either x or y Obtain correct equation Eliminate 2nd variable Obtain correct linear equation Deduce that $k = 1$</p>
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(Q5, Jan 2009)

26	<p>(i) <i>Either</i> <i>Or</i></p> <p>(ii)</p> <p>(iii) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$</p> <p>(iv)</p>	<p>B1 DB1 B1 DB1</p> <p>B1 DB1</p> <p>B1 B1</p> <p>B1B1B1</p>	2 2 2 3 9	<p>Reflection, in x-axis Stretch parallel to y-axis, s.f. -1</p> <p>Reflection, in $y = -x$</p> <p>Each column correct</p> <p>Rotation, 90°, clockwise about O S.C. If (iii) incorrect, B1 for identifying their transformation, B1 all details correct</p>
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(Q6, Jan 2009)

27	<p>$3a + 5b = 1, a + 2b = 1$</p> <p>$a = -3, b = 2$</p>	<p>M1 M1 A1 A1</p>	4 4	<p>Obtain a pair of simultaneous equations Attempt to solve Obtain correct answers.</p>
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(Q2, June 2009)

28	(i)	B1 B1 B1	3	Find coordinates (0, 0) (3, 1) (2, 1) (5, 2) found Accurate diagram sketched
	(ii) $\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$	B1 B1		2
	(iii) <i>Either</i> $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$	B1 M1	6 11	Correct inverse for their (ii) stated Post multiply C by inverse of (ii)
	Or	A1ft M1		Correct answer found Set up 4 equations for elements from correct matrix multiplication
		A2ft		All elements correct, -1 each error
		B1 B1 B1		Shear, x axis invariant or parallel to x-axis eg image of (1, 1) is (3, 1) SR allow s.f. 2 or shearing angle of correct angle to appropriate axis

(Q8, June 2009)

29	(i)	M1 A1	3	Correct expansion process shown Obtain correct unsimplified expression
		A1		Obtain correct answer
	(ii)	M1 A1ft A1ft	3	Equate their det to 0 Obtain correct answers, ft solving a quadratic
	(iii) (a)	B1 B1	4 10	Equations consistent, but non unique solutions
	(b)	B1 B1		Correct equations seen & inconsistent, no solutions

(Q9, June 2009)

30 (i)	$\begin{pmatrix} a-4 & 2 \\ 3 & 0 \end{pmatrix}$	B1	Two elements correct
		B1	2 Remaining elements correct

(ii)	$4a - 6$ $a = \frac{3}{2}$	B1	Correct determinant
		M1	Equate det A to 0 and solve
		A1	3 Obtain correct answer a. e. f.

31 (i)	B1 B1 2	Rotation 90° (about origin) Anticlockwise
<hr style="border-top: 1px dashed black;"/>		
(ii) Either	M1	Show image of unit square after reflection in $y = -x$
$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	A1	Deduce reflection in x -axis
Or	B1ft B1ft 4 M1	Each column correct ft for matrix of their transformation Post multiply by correct reflection matrix
	A1 B1B1	Obtain correct answer State reflection, in x -axis
		S.C. If pre-multiplication, M0 but B1 B1 Available for correct description of their matrix
	6	

(Q5, Jan 2010)

32 (i)	M1 M1 A1	Show correct expansion process for 3×3 or multiply adjoint by A Correct evaluation of any 2×2 at any stage Obtain correct answer
$\det \mathbf{A} = \Delta = 6a - 6$		
$\mathbf{A}^{-1} = \frac{1}{\Delta} \begin{pmatrix} 3a-1 & a+1 & -4 \\ 1 & 2a-1 & -2 \\ -3 & -3 & 6 \end{pmatrix}$	M1 A1 B1 A1 7	Show correct process for adjoint entries Obtain at least 4 correct entries in adjoint Divide by their determinant Obtain completely correct answer
<hr style="border-top: 1px dashed black;"/>		
(ii)	M1	Attempt product of form $\mathbf{A}^{-1}\mathbf{C}$ or eliminate to get 2 equations and solve
$\frac{1}{\Delta} \begin{pmatrix} 5a-7 \\ 4a-5 \\ 3 \end{pmatrix}$	A1A1A1 ft all 3 4	Obtain correct answer S.C. if det now omitted, allow max A2 ft
	11	

(Q9, Jan 2010)

33 (i) (-7)	M1 Obtain a single value A1 2 Obtain correct answer as a matrix

(ii) $BA = \begin{pmatrix} 5 & -20 \\ 3 & -12 \end{pmatrix}$ $\begin{pmatrix} -7 & -20 \\ 11 & -20 \end{pmatrix}$	M1 Obtain a 2×2 matrix A1 All elements correct B1 4C seen or implied by correct answer B1ft 4 Obtain correct answer, ft for a slip in BA
	6

(Q2, June 2010)

34 (a) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	B1B12 Each column correct SC B2 use correct matrix from MF1 Can be trig form
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(b) (i)	B1B12 Stretch, in x -direction sf 5
(ii)	B1B12 Rotation, 60° clockwise

6

(Q5, June 2010)

35 (i)	M1 Show correct expansion process for 3×3 M1 Correct evaluation of any 2×2 A1 3 Obtain correct answer
$\det \mathbf{A} = a^2 - a$	

(ii) (a)	M1 Find a pair of inconsistent equations A1 State inconsistent or no solutions
(b)	M1 Find a repeated equation A1 State non unique solutions
(c)	B1 State that $\det \mathbf{A}$ is non-zero or find correct solution B1 6 State unique solution SC if $\det \mathbf{A}$ incorrect, can score 2 marks for correct deduction of a unique solution, but only once
	9

(Q9, June 2010)

36 (i) $\begin{pmatrix} 7 & 9 \end{pmatrix}$

B1B1 2 Each element correct
 SC (7,9) scores B1

(ii) (18)

B1* Obtain correct value
 depB1 2 Clearly given as a matrix

(iii) $\begin{pmatrix} 12 & -4 \\ 6 & -2 \end{pmatrix}$

M1 Obtain 2×2 matrix
 A1 Obtain 2 correct elements
 A1 3 Obtain other 2 correct elements
 7

(Q1, Jan 2011)

37

A^2

B1 $(A^{-1})^{-1} = A$ seen or implied
 M1 Use product inverse correctly
 A1cao 3 Obtain correct answer
 3

(Q5, Jan 2011)

38

(Q7, Jan 2011)

39 (i)	M1	Show correct expansion process for 3 x 3
	M1	Correct evaluation of any 2 x 2
(i) $\det M = a^2 - 7a + 6$	A1	3 correct answer
(ii) $\begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$	B1 B1	2 Each column correct
	M1	Solve $\det M = 0$
(ii) $a = 1$ or 6	A1 A1	3 Obtain correct answer for the (i) axes
(iii)	dep B1	2 Scale factor $\sqrt{3}$
(iii) (a)	M1	Attempt to eliminate one variable
	B1	3 Obtain (0, 2) in equations in 2 unknowns
	A1	3 Justify infinite number of solutions
	B1	3 Accurate diagram, method and conclusion consistent with their (i) or (ii)
(b) $\det C = 4$	B1	Correct value found
	B1	2 Scale factor for area
	9	

(Q9, Jan 2011)

40 (i)	$\begin{pmatrix} 4 & 4a \\ 12 & 0 \end{pmatrix}$	B1	3B seen or implied
		B1	2 elements correct
		B1	3 Other 2 elements correct, a.e.f., including brackets
(ii)	$\begin{pmatrix} 4 + 4a & 3a \\ 4 & 1 \end{pmatrix}$	M1	Sensible attempt at matrix multiplication
		A1	2 for AB or BA Obtain correct answer
		5	

(Q1, June 2011)

41	$k^2 - 16$	B1	Obtain correct det
		M1	Equate their det to 0
	$k = \pm 4$	A1	3 Obtain correct answers
		3	

(Q3, June 2011)

42	$\det C = \Delta = 5a - 5$	$\frac{1}{\Delta} \begin{pmatrix} 5 & -4 & 1 \\ -5 & 4a & -a \\ 5 & -3a-1 & 2a-1 \end{pmatrix}$	<p>M1 Show correct expansion process for 3×3 or multiplication of C and adjC</p> <p>M1 Correct evaluation of any 2×2</p> <p>A1 Obtain correct answer</p> <p>M1 Show correct process for adjoint entries</p> <p>A1 Obtain at least 4 correct entries in adjoint</p> <p>A1 Obtain completely correct adjoint</p> <p>B1 Divide their adjoint by their determinant</p>
			7

(Q6, June 2011)

43 (i)		<p>B1 (0, 3) seen</p> <p>B1 (3, 0) seen</p> <p>B1 3 Square with A ' B' and C' positioned correctly</p>	

(ii)	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ or $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$	<p>B1* Reflection in $y = x$ or $y = -x$</p> <p>DB1 Correct matrix, dep on stating reflection</p>	
	$\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$ or $\begin{pmatrix} -3 & 0 \\ 0 & -3 \end{pmatrix}$	<p>B1* Enlargement scale factor 3 or s.f. -3</p> <p>DB1 4 Correct matrix, dep on stating enlargement S.C. B2 for a pair of transformations consistent with their diagram.</p>	
			7

(Q8, June 2011)

44		$3p + 4q = 1, \quad -3p - 5q = 1, \quad 2p + 3q = 0$ $p = 3$ and $q = -2$	<p>B1 State identity matrix is $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$</p> <p>M1 Find a pair of simultaneous equations</p> <p>A1 Correct pair of distinct equations</p> <p>M1 Attempt to solve</p> <p>A1 Obtain correct answers</p> <p>[5]</p>	
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(Q2, Jan 2012)

45	(a)		$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$	B1 B1 [2]	Each column correct	
	(b)	(i)		B1 DB1 [2]	Stretch Scale factor 4 in the y direction	Not "in the y-axis"
	(b)	(ii)	4	B1 B1 [2]	Correct value of determinant Scale factor for area	Allow scale factor of stretch or equiv.

(Q5, Jan 2012)

46	(i)		$\det \mathbf{X} = \Delta = 10 - 9a - a^2$	M1 M1 A1 [3]	Show correct expansion process for 3×3 Correct evaluation of any 2×2 Obtain correct answer aef	
	(ii)		$a = 1$ or -10	M1 A1FT A1FT [3]	Their $\det \mathbf{X} = 0$ Obtain correct answers from their (i)	
	(iii)		$\frac{1}{\Delta} \begin{pmatrix} -a & 2 & 6-9a \\ 5 & -a-9 & 18-3a \\ -a & 2 & a^2-4 \end{pmatrix}$	M1 A1 A1 B1ft [4]	Show correct process for adjoint entries Obtain at least four correct entries in adjoint Obtain completely correct adjoint Divide by their determinant	

(Q9, Jan 2012)

47	(i)		$\begin{pmatrix} 5 & 2 \\ 13 & 6 \end{pmatrix}$	M1 A1 [2]	Multiplication attempt, 2 elements correct All elements correct	
	(ii)		EITHER $\mathbf{B}^{-1}\mathbf{A}^{-1} = (\mathbf{AB})^{-1}$ $\frac{1}{4} \begin{pmatrix} 6 & -2 \\ -13 & 5 \end{pmatrix}$ OR	B1 B1ft B1ft [3] B1 B1 B1	Stated or used Divide by correct determinant Both diagonals correct Either inverse correct Two elements correct in final answer , both inverses must be correct All elements correct	

(Q2, June 2012)

48	(i)		B1* depB1 [2]	Shear eg image of (0, 1) is (2, 1) or parallel to the x-axis	
	(ii)	<p>Either</p> $\begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}$ $\begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$ <p>Or</p> $\mathbf{Z} = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ $\begin{pmatrix} a & 2a+b \\ c & 2c+d \end{pmatrix}$ $\begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$	<p>B1 B1 B1</p> <p>M1 A1</p> <p>[5]</p> <p>B1</p> <p>B1 B1</p> <p>M1 A1</p>	<p>State $\mathbf{Z} = \mathbf{YX}$ Obtain $\mathbf{Y} = \mathbf{ZX}^{-1}$ State or use correct inverse</p> <p>Matrix multiplication, 2 elements correct Obtain completely correct simplified exact matrix</p> <p>Correct order for matrix multiplication</p> <p>Obtain 2 correct elements Obtain other 2 correct elements</p> <p>Equate elements, 2 correct Obtain completely correct simplified exact matrix</p>	
	(iii)		B1* depB1 [2]	Rotation 60° clockwise	

(Q9, June 2012)

49	(i)		M1 M1 A1 [3]	Show correct expansion process for 3x3 Correct evaluation of any 2x2 Obtain correct answer	
	(ii)	(a)	B1 [1]	det $\mathbf{D} = 15$ so unique sol'n or solve to find correct solution (-2/5, 1, 4/5)	SC B1 once if unique solution following their incorrect det \mathbf{D} non zero
	(ii)	(b)	B1 M1 A1 [3]	Their det $\mathbf{D} = 0$, so non-unique solutions Attempt to solve equations with $a = 2$ Explain inconsistency with correct working	
	(ii)	(c)	B1 M1 A1 [3]	Their det $\mathbf{D} = 0$, so non-unique solutions Attempt to solve equations with $a = 0$ Explain consistency with correct working	

(Q10, June 2012)

50	(i)		B1 B1 B1 [3]	I or 3I seen or used 2 elements correct Other 2 elements correct	
	(ii)		B1 B1 [2]	Divide by correct determinant Both diagonals correct	

(Q1, Jan 2013)

51		$3\lambda^2 - 7\lambda + 2$ $\frac{1}{3}$ or 2	M1 M1 A1 B1* DM1 A1 [6]	Show correct expansion process for correct 3 x 3 Correct evaluation of any 2 x 2 Obtain correct 3 term quadratic Equate their det to 0 Attempt to solve a quadratic equation Obtain correct answers
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(Q5, Jan 2013)

52	(i)	$\begin{pmatrix} 1 & 2 \\ 0 & 2 \end{pmatrix}$	B1 B1 [2]	Each column correct
	(ii)	<i>Either</i> $P: \begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ <i>Or</i> $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ $Q: \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$ $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$	B1 DB1 B1 B1 DB1 B1 [6]	<i>Either</i> Stretch, s.f. 2 in y direction Correct matrix <i>Or</i> Shear, x-axis invariant e.g. (0,1) \rightarrow (2,1) Shear, x axis invariant e.g. (0, 1) \rightarrow (1, 1) Stretch, s.f.2 in y direction, Correct matrix N.B. "in the x/y axis" is incorrect
	(iii)	$PQ: \begin{pmatrix} 1 & 1 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} 1 & 4 \\ 0 & 2 \end{pmatrix}$	M1 A1 [2]	Attempt at matrix multiplication of two 2 x 2 matrices from (ii) Obtain correct result cao

(Q6, Jan 2013)

53	(i)	(7 23)	B1B1 [2]	Each element correct, missing brackets B1 only
	(ii)	$\begin{pmatrix} 6 & -15 \\ 4 & -10 \end{pmatrix}$ det CB = 0 singular	M1 A1 A1 A1FT A1FT [5]	Obtain 2 x 2 matrix Obtain 2 correct elements Obtain other 2 correct elements Obtain their det CB , must be a 2 x 2 matrix Correct conclusion from their det CB

(Q2, June 2013)

54	(i)	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	B1B1 [2]	Each column correct
	(ii)	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B1B1 [2]	Each column correct
	(iii)	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	M1 A1FT [2]	Attempt at matrix multiplication in correct order Obtain correct answer from their (i) and (ii)
	(iv)	Reflection, in $y = x$	B1B1 [2]	Correct description of their (iii) only

(Q7, June 2013)

55	(i)	$a + 3$ $a = -3$	M1 M1 A1 M1 A1FT [5]	Show correct expansion process for 3×3 Correct evaluation of any 2×2 Obtain correct answer Use $\det \mathbf{A} = 0$ Obtain correct answer from their $\det \mathbf{A}$
	(ii)	$\frac{1}{a+3} \begin{pmatrix} 1 & -1 & 1 \\ 7 & a-4 & 1-2a \\ -11 & 8-a & 3a-2 \end{pmatrix}$ $\frac{1}{a+3} \begin{pmatrix} 2 \\ 2-4a \\ 7a-1 \end{pmatrix}$	M1 A1 A1 B1 M1 A2 [7]	Show correct processes for adjoint entries Obtain at least 4 correct entries in adjoint Obtain completely correct adjoint Divide adjoint by their $\det \mathbf{A}$ Pre-multiply column matrix by their \mathbf{A}^{-1} Obtain correct answer, A1 for 1 element correct

(Q10, June 2013)