

**MARK SCHEME for the May/June 2011 question paper**  
**for the guidance of teachers**

**0580 MATHEMATICS**

**0580/43**

Paper 4 (Extended), maximum raw mark 130

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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### Abbreviations

cao	correct answer only
cso	correct solution only
dep	dependent
ft	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
www	without wrong working
art	anything rounding to
soi	seen or implied

Qu.	Answers	Mark	Part Marks
<b>1 (a)</b>	<b>(i)</b> 34.65	1	
	<b>(ii)</b> 41.58	2	M1 for $0.15 \times 277.2$ implied by 41.6 or 41.58 seen and not spoiled
	<b>(iii)</b> 264	3	M2 for $277.2 \div (1 + 0.05)$ o.e. or M1 for recognition that $105(\%) = 277.20$
	<b>(b)</b>		
	<b>(i)</b> 1000	2	M1 for $2200 \div (2 + 4 + 5) \times 5$
	<b>(ii)</b> 3650	2	M1 for $2200 \div 44 \times 73$
<b>2 (a)</b>	<b>(i)</b> Image at (4, -4), (6, -4), (6, -6), (2, -6)	2	SC1 for reflection in y-axis
	<b>(ii)</b> Image at (-4, -4), (-4, -6), (-6, -6), (-6, -2)	2 ft	SC1 ft if rotated $90^\circ$ anti-clockwise about (0, 0)
	<b>(iii)</b> Reflection $y = -x$	1 ft	ft their Z (name of transformation)
		1 ft	independent (full details)
	<b>(b)</b>		
	<b>(i)</b> Image at (2, 2), (3, 2), (3, 3), (1, 3)	2	SC1 for enlargement s.f. 0.5 with correct orientation, different centre or sf - 0.5, centre (0, 0)
	<b>(ii)</b> $\begin{pmatrix} 0.5 & 0 \\ 0 & 0.5 \end{pmatrix}$ cao	2	B1 B1 each column
<b>(c)</b>	<b>(i)</b> Image at (0, 4), (2, 4), (0, 6), (-4, 6)	2	SC1 if 3 vertices correct
	<b>(ii)</b> $\begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}$	2	SC1 for $\begin{pmatrix} 1 & k \\ 0 & 1 \end{pmatrix}$ , $k \neq 0$ but can be algebraic or numeric or for $\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$

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<p><b>3 (a)</b></p> <p><math>(x + 5)^2 - 2x^2 = 1</math> oe</p> <p><math>(x + 5)^2 = x^2 + 10x + 25</math> or <math>x^2 + 5x + 5x + 25</math></p> <p><math>x^2 + 10x + 25 - 2x^2 = 1</math> <math>0 = x^2 - 10x - 24</math></p> <p><b>(b)</b> 12</p> <p><b>(c)</b> 53.1 to 53.2    www 3</p>		<p>M1</p> <p>B1</p> <p>E1</p> <p>3</p> <p>3</p>	<p>Equiv means equation in the three parts, allowing <math>(x + 5)^2</math> expanded</p> <p>For final line reached without any errors or omissions after any previous line with <math>(x + 5)^2</math> expanded</p> <p>M2 for <math>(x - 12)(x + 2)</math> or full correct expression from formula. Allow SC1 for <math>(x + a)(x + b)</math> and <math>ab = -24</math> or <math>a + b = -10</math> then SC1 <b>ft</b> (dependent on quadratic factors or two roots from formula) for correct selection of +ve root, if only one +ve. Answer of 12 and -2 scores M2 only</p> <p>M2 for <math>2 \times \tan^{-1}(\frac{1}{2})</math> o.e. i.e. any <b>complete</b> method or M1 for <math>\tan = \frac{1}{2}</math> o.e. i.e. any correct method leading to any angle in diagram (expressions can be implicit and bod which angle is being worked out) (Implied by 26.56 to 26.57 or 26.6, 63.43 to 63.44 or 63.4, 126.8 to 126.9) 53 or 127 without working score 0</p>
<p><b>4 (a)</b></p> <p><math>(\cos(A)) = \frac{6^2 + 8^2 - 9^2}{2 \cdot 6 \cdot 8}</math></p> <p>78.58...    www 4</p> <p><b>(b)</b></p> <p><b>(i)</b> 78.6</p> <p><b>(ii)</b> <math>r = \frac{4.5}{\sin(78.6)}</math> oe</p> <p>4.590 to 4.591    cao    www 3</p> <p><b>(c)</b> 35.5 (35.48 to 35.57...) cao    www 4</p>		<p>M2</p> <p>A2</p> <p>1</p> <p>M2</p> <p>A1</p> <p>4</p>	<p>M1 for correct implicit equation with <math>\cos A</math></p> <p>A1 for 0.1979 to 0.198 (this implies M2)</p> <p>Allow 78.58...</p> <p>(M1 for <math>\sin(78.6) = \frac{4.5}{r}</math>)</p> <p>Allow 78.58... or their angle <i>BOM</i> for M2 or M1</p> <p>M1 Area triangle = <math>0.5 \times 6 \times 8 \times \sin(78.6)</math> oe Allow 78.58.. (23.52..)</p> <p>M1 Circle = <math>\pi \times 4.59^2</math> Allow 4.590 to 4.591 (66.15 to 66.22...)</p> <p>M1 (<b>dependent</b>) % = triangle / circle <math>\times 100</math> Dependent on first 2 M's</p>

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<p><b>5 (a)</b></p> <p><b>(b)</b></p> <p><b>(c)</b></p>	<p>9.11, 4.25, 2, ..., 2, 4.25, 9.11</p> <p>12 points plotted Smooth curve through 12 points Two branches, neither touching <math>y</math>-axis</p> <p><b>(i)</b> <math>x = 0</math> <b>(ii)</b> tangent at <math>-1.5</math> <math>-3</math> to <math>-1.8</math></p> <p><b>(iii)</b> <math>-1.7</math> to <math>-1.55</math>, <math>-0.7</math> to <math>-0.55</math>, <math>0.55</math> to <math>0.7</math>, <math>1.55</math> to <math>1.7</math> <b>(iv)</b> <math>y = 2x</math> drawn to meet graph twice 1 <math>1.8</math> to <math>1.9</math></p>	<p>3</p> <p>5</p> <p>1 T1 2</p> <p>2</p> <p>B1 B1 B1</p>	<p>B2 for 4 or 5 correct and B1 for 2 or 3 correct</p> <p>P3, <b>ft</b> their <b>(a)</b>, P2 for 10 or 11 points, P1 for 8 or 9. C1 correct shape <b>ft</b> their points shape same. Ignore anything between <math>-0.5</math> and <math>0.5</math>. B1 independent</p> <p><b>Dependent</b> on tangent M1(also dep on T1) for attempt at rise/run or SC1 for 1.8 to 3 B1 for 1 or more correct</p>
<p><b>6 (a)</b></p> <p><b>(b)</b></p>	<p><b>(i)</b> 5.8 <b>(ii)</b> 4.6 to 4.65 <b>(iii)</b> 2.35 to 2.5 <b>(iv)</b> 172 or 171</p> <p><b>(i)</b> 72 to 76, 38 to 42 <b>(ii)</b> Their correct <math>\Sigma fx \div 200</math></p> <p><b>(iii)</b> <math>p \div 2</math>, <math>q</math>, where <math>p, q</math> are from <b>(b)(i)</b> Histogram with two new columns of correct width Two correct heights</p>	<p>1 1 1 2</p> <p>2 4</p> <p>2ft 2ft</p>	<p>SC1 for 28 or 29</p> <p>Must be integers. B1 either. M1 for 3 or 4 correct mid-values seen 2, 5, 6.5, 8.5 M1 for <math>\Sigma fx</math>, <b>ft</b> their frequencies and <math>x</math> anywhere in interval, including boundaries <math>36 \times 2 + (72 \text{ to } 76) \times 5 + (38 \text{ to } 42) \times 6.5 + 50 \times 8.5</math> M1 for <math>\div 200</math> or their 200 (dependent on second M1) (74, 40 give 1127 then 5.635 (or 5.64 or 5.63)) Other pairs of frequencies from <b>(b)(i)</b> must have a sum of 114 to gain the A mark. B1 either <b>ft</b> (<b>ft</b> their table)</p> <p>B1 B1 <b>ft</b> (<b>ft</b> their freq. densities)</p>

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7 (a)	Correct tree diagram.	5	B1 for labels flower and not flower First pair B1 for $\frac{7}{10}$ and $\frac{3}{10}$ B1 for next three branches after flowers B1 for clear labels for colours B1 for $\frac{2}{3}$ , $\frac{1}{4}$ and $\frac{1}{12}$ in correct places If three branches at ends of both branches of first pair, lose final B, unless probabilities of 0 indicated.
(b)	$\frac{33}{40}$ o.e. (0.825) cao	3	M2 for $1 - \frac{7}{10} \times \frac{1}{4}$ (M1 for $\frac{7}{10} \times \frac{1}{4}$ or $\frac{7}{10} \times (1 - \frac{1}{4})$ ) oe or M2 for $\frac{3}{10} + \frac{7}{10} \times \frac{2}{3} + \frac{7}{10} \times \text{their } \frac{1}{12}$ or $\frac{3}{10} + \frac{7}{10} \times \frac{3}{4}$ oe
(c)	7 cao	2	M1 for $120 \times \frac{7}{10} \times \text{their } \frac{1}{12}$
8 (a)	Arc centre $D$ , radius 6 cm	1	
(b)	(i) Perp bisector of $AB$ , with two pairs of arcs (ii) Bisector of angle $B$ , with arcs	2 2	At least 3 cm from $AB$ . SC1 accurate without arcs or accurate arcs (but no choice) At least 5 cm from $B$ . SC1 accurate without arcs or accurate arcs (but no choice)
(c)	(i) $Q$ at intersection of loci (ii) 2.7 cm to 2.9 cm cao	1 1	Dependent on at least both SC1's Dependent on (c)(i)
(d)	Region inside arc, to left of perp bisector and below angle bisector	1	Dependent on at least both SC1's in (b)
9 (a)	(i) 81 (ii) 8.5	2 2	B1 for $(f(2) =) 7$ B1 for $(f(0.5) =) 2.5$
(b)	$\frac{x-1}{3}$ oe	2	M1 for $(x =) \frac{y-1}{3}$ or $(x =) \frac{f(x)-1}{3}$ or $3y = x - 1$ or $3f(x) = x - 1$ or $-1$ then $\div 3$ in flowchart (must be clear)
(c)	$3x^2 + 12x + 13$ final answer	2	M1 for $3(x+2)^2 + 1$ or better
(d)	$(x =) \frac{-3 \pm \sqrt{3^2 - 4(1)(1)}}{2(1)}$  -2.62, -0.38 final answer	2  1,1	B1 for $\sqrt{3^2 - 4(1)(1)}$ or better Seen anywhere If in form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ oe, B1 for $p = -3$ and $r = 2(1)$ or $(x + \frac{3}{2})^2$ B1 then $\sqrt{\frac{9}{4} - 1}$ B1 If 0, SC1 for -2.6 or -2.62 or -2.618... <b>and</b> -0.4(0) or -0.38 or -0.382 to -0.381 seen <b>Answers only B1 B1</b>

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<b>10 (a)</b>	<b>(i) (a)</b> $\mathbf{p} + \mathbf{q}$	1		
	<b>(b)</b> $\frac{1}{2}\mathbf{p} - \frac{1}{2}\mathbf{q}$ oe	2	M1 for $\overrightarrow{LC} + \overrightarrow{CM}$ o.e. can be written in terms of $\mathbf{p}$ and/or $\mathbf{q}$	
	<b>(c)</b> $\frac{3}{4}\mathbf{p} + \frac{3}{4}\mathbf{q}$ oe cao	2	M1 for $\overrightarrow{AD} + \overrightarrow{DL} + \overrightarrow{LN}$ o.e can be written in terms of $\mathbf{p}$ and/or $\mathbf{q}$ ft their <b>(i)(b)</b>	
	<b>(ii)</b> $\overrightarrow{AN}$ is a multiple of $\overrightarrow{AC}$ o.e	1	Must be vectors (dependent on answers to <b>(a)</b> , <b>(c)</b> )	
<b>(b)</b>	<b>(i)</b> 30	2	M1 for $2x + x + 15 + 75 = 180$ or better	
	<b>(ii)</b> 135	1ft	ft 165 – their $x$ but only if final answer obtuse	
<b>11 (a)</b>	<b>(i)</b> 10	1		
	<b>(ii)</b> $\frac{3 \times 4}{2}$ or $\frac{3 \times (3+1)}{2}$ (= 6)	1		
	<b>(iii)</b> 7260	1		
	<b>(iv)</b> 12 840	2	M1 for $S_{200} - S_{120}$ ( $20100 - 7260$ ) or $\frac{80}{2}(121 + 200)$ o.e.	
	<b>(v)</b> 160 400	2	M1 for $2(1 + 2 + 3 + \dots + 400)$ o.e.	
	<b>(b)</b>	<b>(i)</b> 36, 100	1, 1	Ignore right-hand column
		<b>(ii)</b> 11025	1	
		<b>(iii)</b> $\left[\frac{n(n+1)}{2}\right]^2$ oe	1	isw
		<b>(iv)</b> 3 348 900	1	M1 for square root then $\times 2$ (1056)
		<b>(v)</b> 32	2	or SC1 for answer 33