

**MARK SCHEME for the May/June 2009 question paper  
for the guidance of teachers**

<b>4024/02</b>	<b>4024 MATHEMATICS</b> Paper 2, maximum raw mark 100
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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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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1	(a)		$\frac{4a^2 + 9}{6a}$ final answer	B1	1	
	(b)		$5b(b - 2)$ final answer	B1	1	Condone missing final bracket After $0 + 0$ give sc1 for <u>both</u> correct forms seen.
	(c)	(i)	(6, 2)	B1	1	Condone missing brackets
		(ii)	$\sqrt{(\pm 4)^2 + (\pm 10)^2}$ 10.7 to 10.8	M1 A1	2	Accept $2\sqrt{29}$
(d)		For numerical $\frac{p \pm (or + or -)\sqrt{q}}{r}$ $p = -11$ and $r = 6$ (or $2 \times 3$ ) $q = 205$ or $\sqrt{q} = 14.3$ to $14.32$  0.55 -4.22	B1 B1  B1 B1	4	Completing the square B1 for $\frac{-11}{6}$ ; B1 for $\sqrt{\frac{205}{36}}$ oe dep. on correct formula s.o.i or <u>used</u> ----- If final B0 + B0 then sc1 for 0.5 to 0.6 AND -4.2 to -4.22; or for any two answers given to 2 d.p.	
2	(a)	(i)	Figs 378/the product of at least 2 of 20, 24, 7 and 60  \$31.25	M1  A1	2	Accept \$31.2 $\rightarrow$ \$31.3 \$0.000 031 2 $\rightarrow$ \$0.000 031 3 million;
		(ii)	$\frac{945 - 378}{378} \times 100$ or $\frac{945}{378} \times 100$ 150% cao	M1 A1	2	Accept $\frac{78.125 - 31.25}{31.25} \times 100$
		(iii)	2:5 or $m = 2, n = 5$	B2	2	sc1 for partial simplification seen. 126:315, 54:135, 42:105, 18:45, 14:35, 6:15; or for $\frac{2}{5}$ , or 1:2.5, or 5:2 or 2m:5m
	(b)		$\frac{480}{0.6} \times \left(\frac{2}{100} = 16\right)$ 16 cao	M1 A1	2	sc1 for 9.6(euros) or (\$)800 seen.
						[9]
						[8]

3	(a)	(i)	$\tan x = \frac{11}{4}$ 70 to 70.02	M1 A1	2	For any complete allow appropriate M marks. sc1 for 19.9 to 20
		(ii) (a)	$\sin 28 = \frac{4}{PX}$ or $\frac{PX}{(\sin 90)} = \frac{4}{\sin 28}$ 8.5 to 8.525	M1 A1	2	
		(b)	$d = \frac{4}{\tan 28}$ , or $PX \cos 28$ , or $\frac{4 \sin 62}{\sin 28}$ or $\sqrt{PX^2 - 4^2}$ 7.5 to 7.6 11 - d (= 3.4 to 3.5)	M1 A1 M1	3	GRADIAN ANSWERS (i) 77.80 sc1 for 22.2 or 12.2 (ii) (a) 9.39 ... (b) 8.50 (leading to 2.5) or 7.77 ... from Sine Rule (leading to 3.23)
	(b)	$r^3 = \frac{96}{\frac{4}{3}\pi}$ or 22.9 ... 2.84 to 2.841	M1 A1	2	[9]	
4	(a)	(i) (a)	3 (lines of symmetry)	B1	1	AG. Allow if 140° calculated, but not if quoted.  The second B mark implies the first.
		(b)	order 3	B1	1	
		(ii) (a)	Use of $(9 - 2) \times 180$ etc.	M1	1	
	(b)	$6x + 3y = 1260$ oe $y = 420 - 2x$ oe isw	B1 B1	2		
	(c)	Sensible attempt at solving for $x$ or $y$ $x = 136$	M1 A1	2		
	(b)	(i)	$\angle FEB = 114^\circ$	B1	1	
		(ii)	$\angle BEA = 42^\circ$	B1	1	
		(iii)	$\angle AGD = 63^\circ$	B1	1	[10]
5	(a)	(i) (a)	$\frac{1}{50}$ , 0.02 cao	B1	1	Accept negatives
		(b)	$\frac{1}{2} \times (8 + 4) \times 200$ oe 1200 m	M1 A1	2	
		(c)	5 m/s	B1	1	
		(ii)	$150u = \frac{1}{2} \times 13 \times 150 (= 975)$ oe $u = 6\frac{1}{2}$	M1 A1	2	

	(b)	(i)	195 m	B1	1	
		(ii)	24.5 or (25.4 to 25.5) seen $\frac{\text{Distance}}{\text{Time}}$ 7.64 to 7.65	B1 M1 A1	3	N.B. $\frac{190}{25} = 7.6$ scores the M1 only
					[10]	
6	(a)		$p = 11$ $q = 30$ $r = 60$ $s = 6$	all four B2	2	sc1 for 2 or 3 correct
	(b)		$x = 2n + 1$ oe $y = n(n + 1)$ oe $z = 2n(n + 1)$ oe $\sqrt{2 \times y}$	B1 B1 B1	3	In (b), accept any unsimplified form but $-1$ , once, if not given explicitly
	(c)		102	B1	1	
					[6]	
7	(a)	(i)	$\frac{2}{5}$ oe fraction	B1	1	Not 40%; 0.4
		(ii) (a)	$h = 25$	B1	1	
		(b)	$2(50 \times 15 + 60 \times 15) + 50 \times 60$ $6300 \text{ cm}^2$	M1 A1	2	sc1 for 3300 or for $9300 \text{ cm}^2$
	(b)	(i)	$\frac{220}{360} \times 2\pi \times 9 \times 35$ 1208 to 1210	M1 A1	2	
		(ii)	$\frac{220}{360} \times \pi \times 9^2 (= 155.50 \dots)$ $\frac{1}{2} \times 9^2 \times \sin 140 (= 26.03 \dots)$ 181 to 182	M1 M1 A2	4	POSSIBLE GRAD ANSWERS (ii) 188 to 188.3 from $\frac{1}{2} \times 9^2 \times \sin 140 (= 32.7 \dots)$ ; 177 to 178 from $81 \times \sin 70 \times \sin 20 (= 22.3 \dots)$ (iii) 4.9 from $\cos 70$ ; 6.2 from $\sin 20$ sc1 for 4.08 ... or for 2.7 ... ----- - If A0, then sc1 for 155 to 156 seen or for 25.9 to 26.1 seen
		(iii)	$d = 9 - 9\cos 70$ $= 5.92$ to $5.93$	M1 A1	2	} } sc1 for 3.07 to 3.08 seen
					[12]	

8	(a)	(i)	$PQ = (x + 2) m$			If <b>AB</b> used instead of	
		(ii)	$BC = \frac{168}{x}$				
		(iii)	$QR = \frac{168}{x} + 11 \sqrt{BC} + 11$ (condone $10 + 1$ for 11)	all 3	<b>B2</b>	2	sc1 for 1 or 2 correct
	(b)		Area = $(x + 2) \left( \frac{168}{x} + 11 \right) - 168$ or $\sqrt{PQ} \times QR - 168$ as an expression in $x$ correct working to $22 + 11x + \frac{336}{x}$		<b>M1</b>		or $(x + 2) + 10(x + 2) + 2 \times \frac{168}{x}$ oe
					<b>A1</b>	2	Answer given
	(c)		$p = 158$ to $158 \frac{1}{3}$		<b>B1</b>	1	
	(d)		Correct scales		<b>S1</b>		Condone reversed axes, if labelled
		7 correct plots (ignore $x = 9$ ) within 1 mm  Smooth curve		<b>P1</b>  <b>C1</b>	  3	Accept if curve goes through correct points  Not grossly thick; no straight lines Ignore curve for $x < 3$ and $x > 8$	
(e)		Clear attempt to draw tangent at (4, 150) gradient = $-6$ to $-12$		<b>T1</b> <b>G1</b>	2	Accept "integer" fractions	
(f)	(i)		$143 \leq \text{answer} < 144$		<b>B1</b>	1	
	(ii)		7.4 to 7.6		<b>B1</b>	1	
						<b>[12]</b>	
9	(a)	(i)	$\frac{AD}{\sin 38} = \frac{17}{\sin 114}$		<b>M1</b>	3	GRADIAN ANSWERS (i) 9.7 to 9.8 (ii) 140.9 to 141
			$AD = 17 \times \frac{\sin 38}{\sin 114}$		<b>M1</b>		
		11.4 to 11.5		<b>A1</b>			
		(ii)	$17^2 = 9^2 + 10^2 \pm (2) \times 9 \times 10 \cos x$ } or $\cos x = \pm [(9^2 + 10^2 - 17^2)/(2) \times 9 \times 10]$ }		<b>M1</b>		
		$\cos C = \frac{10^2 + 9^2 - 17^2}{2 \times 9 \times 10} = (-0.6)$		<b>A1</b>			
		126 to 127		<b>A1</b>	3		

	(b)	(i) (a) $\overrightarrow{OQ} = \mathbf{p} + \mathbf{q}$ (b) $\overrightarrow{RS} = \mathbf{p} - \mathbf{q}$ ✓ (a) – 2q (c) $\overrightarrow{OS} = 2\mathbf{p} + 2\mathbf{q}$ ✓ 2 × (a) (d) $\overrightarrow{OT} = 4\mathbf{p}$  (ii) (O, P and T are) collinear oe $OT = 4OP$ oe	B1 B1 B1 B1  B1 B1	1 1 1 1  2 [12]	In (b) (i), –1, unsimplified answers  Marks in (ii) are dep on a correct (i) (d)
10	(a)	Correct scales and axes Correct bases (width + position) Heights (2), 10, 8, 7, 4, 2	S1 B1 H1	3	Condone reversed axes if clearly labelled
	(b)	$7 < t \leq 9$	B1	1	
	(c)	$(4 \times 2) + (10 \times 3.5) + (8 \times 4.5) + (14 \times 6) + (8 \times 8) + (6 \times 10.5)$ $(= 290)$ $\div 50$ 5.8	M1  M1 A1	3	8, 35, 36, 84, 64, 63 Condone up to 3 slips  Indep of first M
	(d)	(i) 0  (ii) $\frac{14}{25}$ oe 0.56	B1  B1	1  1	Condone $\frac{0}{50}$ , none, nil
	(e)	(i) $\frac{54}{175} (= \frac{14}{25} \times \frac{27}{49})$ (0.308 to 0.309)  (ii) $\frac{88}{175} (= 2 \times \frac{14}{25} \times \frac{22}{49})$ (0.502 to 0.503)	B1  B2	1  2  [12]	In (e), –1, once, for any answer not in lowest terms, or in decimal form  sc1 for $\frac{44}{175}$ (0.251 to 0.252)
11	(a)	(i) $\begin{pmatrix} -3 & 9 \\ -3 & 2x \end{pmatrix}$  (ii) $\mathbf{AB} = \begin{pmatrix} 1 & 0 \\ -1 + \frac{x}{3} & 1 \end{pmatrix}$ or $\mathbf{BA} = \begin{pmatrix} 1 & 3-x \\ 0 & 1 \end{pmatrix}$  or $\mathbf{B}^{-1} = \begin{pmatrix} 0 & 3 \\ -1 & 3 \end{pmatrix}$ oe $x = 3$	B2  B1  B1 dep.	2  2	sc1 for 3 correct elements  e.g. $3 \begin{pmatrix} 0 & 1 \\ -\frac{1}{3} & 1 \end{pmatrix}$ , (0.33 or better)

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<b>(b)</b>	<b>(i) (a)</b>	SF = -2	<b>B1</b>	1		
	<b>(b)</b>	Centre is (1, 2)	<b>B2</b>	2		B1 for each coord. sc1
	<b>(ii)</b>	Shear, x-axis inv., SF = 2	<b>B1</b> <b>B1</b>	2		Mention of a 2 <sup>nd</sup> transformation loses both marks
	<b>(iii) (a)</b>	$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} k \\ 2 \end{pmatrix} = \begin{pmatrix} k+4 \\ 2 \end{pmatrix}$				
	<b>(b)</b>	$k = 4$ ET(L) = E((8, 2)) = (-13, 2)	<b>MA1</b> <b>B2</b>	1 2	sc1 for (-2.5, 2)	
				<b>[12]</b>		