MARK SCHEME for the May/June 2009 question paper

for the guidance of teachers

4024 MATHEMATICS

4024/02   Paper 2, maximum raw mark 100

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)		$\dfrac{4a^2 + 9}{6a}$ 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 $\dfrac{p \pm (or + or -)\sqrt{q}}{r}$ $p = -11$ and $r = 6$ (or 2×3) $q = 205$ or $\sqrt{q} = 14.3$ to 14.32 0.55 –4.22	**B1** **B1** **B1** **B1**	 4 **[9]**	Completing the square B1 for $\dfrac{-11}{6}$; B1 for $\sqrt{\dfrac{205}{36}}$ 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)	$\dfrac{945 - 378}{378} \times 100$ or $\dfrac{945}{378} \times 100$ 150% cao	**M1** **A1**	 2	Accept $\dfrac{78.125 - 31.25}{31.25} \times 100$
		(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)		$\dfrac{480}{0.6} \times \left(\dfrac{2}{100} = 16\right)$ 16 cao	**M1** **A1**	 2 **[8]**	sc1 for 9.6(euros) or ($)800 seen.

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

	(b)	**(i)**	195 m	**B1**	1	
		(ii)	24.5 or (25.4 to 25.5) seen	**B1**		
			$\dfrac{\text{Distance}}{\text{Time}}$	**M1**		
			7.64 to 7.65	**A1**	3	**N.B.** $\dfrac{190}{25}$ = 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)**	$\dfrac{2}{5}$ oe **fraction**	**B1**	1	Not 40%; 0.4
		(ii) (a) **(b)**	$h = 25$ $2(50 \times 15 + 60 \times 15) + 50 \times 60$ 6300 cm^2	**B1** **M1** **A1**	1 2	sc1 for 3300 or for 9300 cm^2
	(b)	**(i)**	$\dfrac{220}{360} \times 2\pi \times 9 \times 35$ 1208 to 1210	**M1** **A1**	2	
		(ii)	$\dfrac{220}{360} \times \pi \times 9^2 \ (= 155.50 \ldots)$ $\dfrac{1}{2} \times 9^2 \times \sin 140 \ (= 26.03 \ldots)$ 181 to 182	**M1** **M1** **A2**	4	POSSIBLE GRAD ANSWERS **(ii)** 188 to 188.3 from $\dfrac{1}{2} \times 9^2 \times \sin 140 \ (= 32.7 \ldots)$; 177 to 178 from $81 \times \sin 70 \times \sin 20 \ (= 22.3 \ldots)$ **(iii)** 4.9 from cos70; 6.2 from sin20 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 **[12]**	} }sc1 for 3.07 to 3.08 seen

8	(a)	(i)	$PQ = (x + 2)$ m			If **AB** used instead of x, –1 once
		(ii)	$BC = \dfrac{168}{x}$			
		(iii)	$QR = \dfrac{168}{x} + 11 \; \surd \; BC + 11$ all 3 (condone $10 + 1$ for 11)	**B2**	2	sc1 for 1 or 2 correct
	(b)		Area $= (x + 2)(\dfrac{168}{x} + 11) - 168$ or $\surd \; PQ \times QR - 168$ as an expression in x	**M1**		or $(x + 2) + 10(x + 2) + 2 \times \dfrac{168}{x}$ oe
			correct working to $22 + 11x + \dfrac{336}{x}$	**A1**	2	Answer given
	(c)		$p = 158$ to $158\frac{1}{3}$	**B1**	1	
	(d)		Correct scales	**S1**		Condone reversed axes, if labelled
			7 correct plots (ignore $x = 9$) within 1 mm	**P1**		Accept if curve goes through correct points
			Smooth curve	**C1**	3	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	**T1** **G1**	2	Accept "integer" fractions
	(f)	(i)	$143 \leqslant$ answer < 144	**B1**	1	
		(ii)	7.4 to 7.6	**B1**	1 **[12]**	
9	(a)	(i)	$\dfrac{AD}{\sin 38} = \dfrac{17}{\sin 114}$	**M1**		
			$AD = 17 \times \dfrac{\sin 38}{\sin 114}$	**M1 dep.**		------------------------------------- GRADIAN ANSWERS **(i)** 9.7 to 9.8 **(ii)** 140.9 to 141
			11.4 to 11.5	**A1**	3	
		(ii)	$17^2 = 9^2 + 10^2 \pm (2) \times 9 \times 10 \cos x$ } or $\cos x = \pm [(9^2 + 10^2 - 17^2)/(2) \times 9 \times 10]$}	**M1**		
			$\cos C = \dfrac{10^2 + 9^2 - 17^2}{2 \times 9 \times 10} = (-0.6)$	**A1**		
			126 to 127	**A1**	3	

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

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

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