MARK SCHEME for the October/November 2015 series

4024 MATHEMATICS (SYLLABUS D)

4024/21 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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.
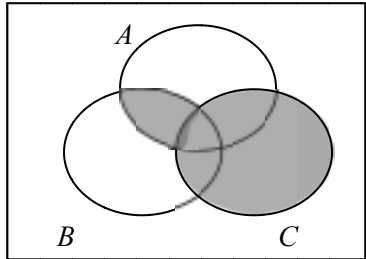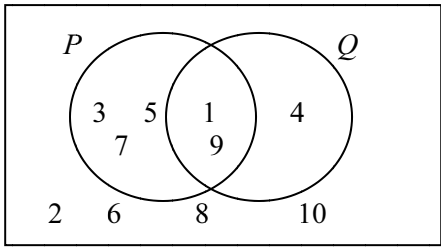
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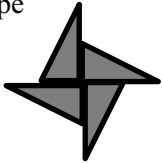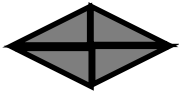
	Question	Answers	Mark	Part marks
1	(a)	2730	2	**B1** for 230 or 2557.5[0] seen or **M1** for $2500 + 2500 \times 0.023 \times 4$ oe
	(b)	262.5[0] final answer	2	**B1** for 1012.5[0] seen or **M1** for $0.15 \times 750 + 36 \times 25$ oe
	(c)	$w = 4.65$ $x = [0].75$ $y = 40.5[0]$ $z = 31.35$	5	**B1** for [$w =$] 4.65 **B1** for [$x =$] [0].75 **B2** for [$y =$] 40.5[0] or **M1** for $32.4[0] \div 0.8$ oe **B1ft** for 31.35
2	(a) (i)	19.2[…] or $3\sqrt{41}$	2	**M1** for [$AB^2 =$] $12^2 + 15^2$ or better
	(ii)	128.6 to 128.7 or 129	3	**M1** for $\tan \theta = \dfrac{their\,12}{15}$ oe **A1** for 38.6 to 38.7 **B1ft** for [$A\hat{B}C =$] $their\ \theta + 90$ **Alternative method** **M2** for complete method using cosine rule for cos ABC using $their$ 19.2
	(b)	44.8[2…]	3	**M2** for $\dfrac{7\sin 65}{9}$ Or **M1** for $\dfrac{9}{\sin 65} = \dfrac{7}{\sin x}$ oe
3	(a) (i)	$\begin{pmatrix} 3 & 4 \\ -1 & 2 \end{pmatrix}$	2	**B1** for one row or one column correct
	(ii)	$\dfrac{1}{4}\begin{pmatrix} 2 & -2 \\ 3 & -1 \end{pmatrix}$ or $\begin{pmatrix} \frac{1}{2} & -\frac{1}{2} \\ \frac{3}{4} & -\frac{1}{4} \end{pmatrix}$ oe isw	2	**B1** for det = 4 soi or for $\begin{pmatrix} 2 & -2 \\ 3 & -1 \end{pmatrix}$
	(b)	$\begin{pmatrix} 4 & -2 \\ 0 & -6 \end{pmatrix}$ oe	2	**B1** for one row or one column correct Or **M1** for $2\mathbf{C} = -4\begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$ oe or for $-\dfrac{1}{2}\mathbf{C} = \begin{pmatrix} -2 & 1 \\ 0 & 3 \end{pmatrix}$

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Question	Answers	Mark	Part marks
(c) (i)	$\begin{pmatrix} 3110 \\ 2715 \\ 2750 \end{pmatrix}$	**2**	**B1** for 2 elements correct in a 3 by 1 matrix or all 3 values correct in dollars or **M1** for $\begin{pmatrix} 1950+1160 \\ 975+1740 \\ 1300+1450 \end{pmatrix}$
(ii)	Amount [in cents] for each week	**1**	
(iii)	85.75 cao	**1**	
4 (a)		**1**	
(b)	$E \cap (D \cup F)'$ or $(D \cup F)' \cap E$	**1**	Or $E \cap D' \cap F'$
(c) (i)		**2**	**B1** for 8 or 9 numbers correctly placed or for 10 numbers correctly placed with one additional number or for 1, 3, 4, 5, 7, 9 seen correctly positioned and no numbers positioned incorrectly
(ii)	7	**1ft**	
(iii)	$\dfrac{3}{10}$ oe	**2ft**	**B1** for *their* 3 seen as numerator of a fraction soi
5 (a)	$3x^2 y(2y^2 - 5x)$	**2**	**B1** for $3x^2(2y^3 - 5xy)$ or $3y(2x^2 y^2 - 5x^3)$ or $x^2 y(6y^2 - 15x)$ or $3xy(2xy^2 - 5x^2)$ or $3x^2 y(A - 5x)$ or $3x^2 y(2y^2 - B)$

Question	Answers	Mark	Part marks
(b)	$x = \pm 1.63[...]$ or $\pm\sqrt{\dfrac{8}{3}}$	3	**M1** for $\dfrac{4(x+2)+2x}{x(x+2)} = 3$ soi **M1dep** for $4x + 8 + 2x = 3x^2 + 6x$ or better
(c) (i)	Correct region shaded with 4 correct lines	3	**B2** for 3 or 4 correct lines or **B1** for 2 correct lines
(ii)	$-\dfrac{1}{2}$ oe	2	**B1** for (3, 3) or (1, 4) soi
6 (a) (i)	$a = 1$, $b = -3$	2	**B1** for one correct
(ii)	5.38 to 5.39 or $\sqrt{29}$	2	**M1** for $\sqrt{5^2 + 2^2}$
(b) (i)	$\mathbf{b} - \dfrac{1}{2}\mathbf{a}$ or $\dfrac{1}{2}(2\mathbf{b} - \mathbf{a})$ final answer	1	
(ii)	$2\mathbf{b} + \dfrac{1}{2}\mathbf{a}$ or $\dfrac{1}{2}(\mathbf{a} + 4\mathbf{b})$ final answer	1	
(iii)	$\lambda : 3\lambda$	2dep	**B1dep** for $\mathbf{b} + \dfrac{1}{4}\mathbf{a}$ seen or $n(\mathbf{b} + \dfrac{1}{4}\mathbf{a}$) seen or $k = \dfrac{1}{2}$ or $OF = \dfrac{1}{2}OE$ oe

	Question	Answers	Mark	Part marks
		SECTION B		
7	**(a)**	A correct shape with one of diagonal lines as line of symmetry	**1**	
	(b)	Correct shape	**2**	**B1** for three additional triangles drawn round *M*, at least two correct Or **SC1** for
	(c) **(i)**	*C* at (3, 1) (3, 3) (4, 3)	**2**	**B1** for either vertical or horizontal correct Or for two vertices correct and correct orientation
	(ii)	$y = x$ oe	**1**	
	(iii)	Translation $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$	**2**	**B1** for translation or $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ Or **M1** for *D* seen at (1, 3), (3, 3), (3, 4)
	(iv) **(a)**	(2, 0) (4, 0) (4, –1)	**1**	
	(b)	Rotation, 90° clockwise, (0,0) oe	**2**	**B1** for two correct from: Rotation, 90° clockwise oe, (0, 0) oe
	(c)	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	**1**	
8	**(a)**	$\pi r^2 + \pi r\,(r + 4)$ with correct working leading to $6r(r + 2)$	**2**	**M1** for $\pi r^2 + \pi r\,(r + 4)$ or $\pi r\,(r + r + 4)$
	(b)	48, 90	**1**	
	(c)	Correct shape curve through 7 correct points	**2**	**B1ft** for at least 5 correct points plotted
	(d)	$[h =]\ \sqrt{8r + 16}$ or $2\sqrt{2r + 4}$ $[h =]\ \sqrt{(r + 4)^2 - r^2}$ or better	**2**	**M1** for $(r + 4)^2 = r^2 + h^2$ or better
	(e)	16	**2**	**M1** for $8r + 16 = 144$ oe

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Question	Answers	Mark	Part marks
(f) **(i)**	4.8 to 4.95	**1**	
(ii)	8 cao	**2**	**B1** for 7.[…] or **M1** for substituting *their* f(i) into $\sqrt{(r+4)^2 - r^2}$
9 **(a)** **(i)**	4 [minutes] 18 [seconds]	**1**	
(ii)	1 [minute] 0 [seconds]	**2**	**B1** for attempt to read at 12.5 and 37.5
(b)	10, 12, 13, 5, 2	**2**	**B1** for 3 correct
(c)	17 [minutes] 30 [seconds]	**2**	**B1** for three times only seen including 6, 5:30 and time in range $5:30 < t \leqslant 6$
(d) **(i)**	23	**1**	
(ii)	$\dfrac{7}{50}$ or 0.14	**2**	**B1ft** for *their* 2 + *their* 5 seen or **time** = 5 [mins] seen Or **SC1** for answer $\dfrac{2}{50}$ oe
(e)	$\dfrac{4}{175}$ oe	**2**	**M1** for $\dfrac{a}{50} \times \dfrac{a-1}{49}$ where $a < 50$ Or **B1** for $\dfrac{8}{50}$ **and** $\dfrac{7}{49}$ seen Or **SC1** for answer $\dfrac{8}{175}$ oe or answer $\dfrac{16}{625}$ oe
10 **(a)** **(i)**	$\dfrac{1}{2}(x+15)(x-3) = 75$ Correct expansion leading to $x^2 + 12x - 195 = 0$ www	**M1** **A1**	Or equivalent equation for area
(ii)	9.2 cao	**3**	**B2** for 9.19[8…] or 9.2[0] seen OR **B1** for $\sqrt{12^2 - 4 \times 1 \times -195}$ soi And **B1** for $\dfrac{-12 \pm \sqrt{their\,924}}{2}$ oe
(iii)	7.3	**2**	**M1** for $2AD - 0.8 + 15 + their\ 9.2 = 38.0$ oe Or $2BC + 0.8 + 15 + their\ 9.2 = 38.0$ oe Or **SC1** for answer $[BC =]\ 6.5$

Question	Answers	Mark	Part marks
(b) (i)	72°	**2**	**B1** for $L\hat{M}N = 108°$ seen
(ii)	$\dfrac{4}{7}$	**3**	**M2** for 126 : *their* 72 soi or **B1** for 126 seen Or **SC2** for answer $\dfrac{7}{4}$
11 (a) (i)	9.19[…]	**2**	**M1** for $\dfrac{1}{2} \times 4 \times 6 \times \sin 50$
(ii)	183 to 184	**1ft**	ft 20 × *their* 9.19
(iii)	310 to 310.5	**5ft**	ft 292 + 2 × *their* 9.19 **B3** for 4.60 or 4.59[8…] or **M2** for $4^2 + 6^2 - 2 \times 4 \times 6 \times \cos 50$ or **M1** for cosine formula with one error AND **M1** for 20×(4 + 6 + *their*4.60) + 2×*their*9.19 oe
(b)	21.3[2…]	**4**	**B1** for correct change of units soi **M1** for use of $\pi \times r^2 \times 0.7 = 0.1$ **M1** for $r^2 = \dfrac{0.1}{0.7 \times \pi}$ soi