MARK SCHEME for the October/November 2007 question paper

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

Abbreviations

cao   correct answer only

oe   or equivalent

soi   seen or implied

www   without wrong working

Question Number		Sub (part) mark	Comments
1	**(a)** $\tan C\hat{A}B = \dfrac{200}{65}$ oe	M1	
	$C\hat{A}B = 72.(0)°$ accept 71.95 to 72.05	A1 (2)	
	(b) (i) Figs $\dfrac{750}{5}$ soi	M1	
	0.15 <u>h</u> oe	A1	
	23 05 or 22 56 + their 00 09 ✓	B1 (3)	Their 00 09 is whatever they think the time is, written in 24 hr. clock style.
	(ii) $\cos P\hat{R}S = \dfrac{300}{750}$ or $\sin P\hat{S}R = \dfrac{300}{750}$	M1	
	$P\hat{R}S = 66.4°$ or $P\hat{S}R = 23.6°$	A1	Expect these angles to be identified, possibly by the final answer. (Degree signs optional)
	(Bearing of S from R =) 113.6 , accept 114, or 180 – their $P\hat{R}S$ ✓ or 90 + their $P\hat{S}R$ ✓	B1 (3)	
		(8)	
2	**(a) (i)** 2.71	B2	
	After B0, 2.709.., or their 2.709…. correctly rounded, or 2.7(0) www B1	(2)	
	(ii) Final ans (b=) $(\pm)\sqrt{x^2-2ax}$ oe	B3	e.g. $(\pm)\sqrt{(x-a)^2-a^2}$
	After B0, $x - a = \sqrt{a^2+b^2}$ soi M1		
	and $(x-a)^2 = a^2 + b^2$ further M1	(3)	
	(b) (i) 8x – 27 oe	B2	
	After B0, 5x or 8x + k seen B1	(2)	
	(ii) Their 8x – 27 < 300 (provided it is an expression in x)	M1	
	x < 40.875 (accept 40.9 or 41)	A1	
	After M0, Final ans. 40.875 (accept 40.9 or 41) SC1	(2)	
	(iii) 40 or their (b)(ii) ✓ rounded **down** to the next whole number.	B1 ✓ (1) (10)	

Question Number		Sub (part) mark	Comments
3	(a) (i) 56	B1	
	(ii) 68 or 180 − 2 × their(i) ✓	B1 ✓ (2)	
	(b) (i) $W\hat{X}V = Y\hat{X}Z$ (vertically opposite) or $V\hat{W}X = X\hat{Z}Y$ ($WV // YZ$) stated	B1	Reason not required for 1ˢᵗ B1 For the 2ⁿᵈ B1 accept (i) 3 pairs of equal angles stated, with one of the above reasons given as appropriate. (ii) 2 pairs of equal angles, with reason **and** conclusion (iii) A solution using the ratios of corresponding sides, provided that the equal angle used is justified, and that similarity has not been assumed.
	convincingly deduces triangles (VWX and YZX) are equiangular	B1 (2)	
	(ii) $\dfrac{YZ}{25} = \dfrac{160}{40}$ oe soi	M1	
	($YZ =$) 100 cao	A1 (2) (6)	
4	(a) Final ans. $ 13.44 or 1344 c	B1 (1)	
	(b) $\dfrac{35-28}{28} \times (100)$ oe	M1	
	25(%)	A1	
	After M0, use of figs $\dfrac{35}{28}$ soi SC1	(2)	
	(c) 5(%)	B2	
	After B0 figs $\dfrac{35 \times 1200 - 399}{35 \times 1200}$ oe M1	(2)	
	(d) ($) 4	B3	
	After B0 ÷ by 115 M1 × by 100 indep. M1		
	After B0, M0 115 seen SC1	(3) (8)	

Question Number		Sub (part) mark	
5	Nonsense in one part may be used to earn M marks in any other part of the question. Throughout, accept equivalent complete methods and decimal angles without degree sign, but degree sign essential if answer in degrees and minutes. **(a) (i)** $(AD^2 =)24^2 + 16^2 \pm 2 \times 24 \times 16\cos112$ **soi** $(AD =)\sqrt{24^2 + 16^2 - 2 \times 24 \times 16\cos112}$ $(= \sqrt{1119.697....}\,)$ $(AD =)$ 33.5 (from 33.46..., accept 33.45 to 33.55) After A0 and at least M1, 1119.697... seen or $(AD =)23.3$ (from $\sqrt{544.30...}\,$) A1 **(anw 2)** **(ii)** $\dfrac{\sin(B\hat{C}D)}{16} = \dfrac{\sin(180-112)}{20}$ **oe** $\sin B\hat{C}D = \dfrac{16\sin(180-112)}{20}$ $(=0.7417...)$ $B\hat{C}D = 47.9$ (from 47.88...), accept 47.85 to 47.95 **(anw 2)** **(iii)** $\dfrac{1}{2} \times 24 \times 16\sin112$ **oe** $= 178$ (cm^2) **(b)** 60 (k) cao		M1 M1 A2 (4) M1 M1 A1 (3) M1 A1 (2) B1 (1) (10)	

Question Number		Sub (part) mark	Comments
6			For diameter 5, only method marks are available throughout.
	(a)(i) 6	B1 (1)	
	(ii) (a) π (their 15)^2 707 (cm^2) accept 706.5 to 707.5	M1 A1 (2)	
	(b) $\frac{1}{6}(\pi 5^2 - 7\pi 5^2)$ oe or $\frac{1}{6}($ their(a) $- their7\pi 5^2)$ or $\frac{theirA\bar{O}B}{360}their\pi 15^2 - \frac{theirA\bar{O}B}{360}their\pi 5^2 - their\pi 5^2$ $= 26.2$ (cm^2) accept 26.15 to 26.25	M1 A1 (2)	
	(b) (i) 60(°)	B1 (1)	Accept radian form
	(ii) $\frac{their(i)}{360} \times 2\pi 5$	M1	Expressions may be constructed using radians.
	$\frac{their(i)}{360} \times 2\pi(their15)$	M1	
	$\frac{their(i)}{360} \times 2\pi 5 + \frac{their(i)}{360} \times 2\pi(their15) + 2\pi 5$ oe **indep**	M1	
	$= 52.4$ (cm) (accept 52.35 to 52.45)	A1	
	After MO, $2\pi 5$ seen SC1 (anw 2)	(4)	i.e. if no other marks are scored, a correct circumference of a small circle gets 1 mark.
		(10)	

Question Number		Sub (part) mark	Comments
7	**(a)(i)** $\dfrac{k}{3+2+1} \times 75$ $k = 1, 2$ or 3.	M1	
	$= 25$ (litres)	A1 (2)	
	(ii) e.g. 40, 35, 36 (cents/litre) seen	M1	
	Final ans. 25 (litre bag)	A1	
	(anw 0)	(2)	
	(b)(i) $\dfrac{1}{3}\pi 10^2 \times 24$ soi	M1	
	$-\dfrac{1}{3}\pi 5^3 \times 12$ oe e.g. $\dfrac{7}{8}(\dfrac{1}{3}\pi 10^2 \times 24)$ a further	M1	
	$2199.1\ldots$ or their volume in cm³ ÷ 10³ indep	M1	
	2.20 (litres) (accept 2.195 to 2.205) cao	A1	
	(anw 3)	(4)	
	(ii) $\dfrac{75}{their\,b(i)}$ soi	M1	
	34 or their (ii) rounded **down** ✓	A1✓ (2)	
	(iii) Use of (ratio of vols. $=$) $10^3 : 5^3$ seen		
	or use of $\dfrac{1}{3}\pi 5^2 \times 12 - \dfrac{1}{3}\pi 2.5^2 \times 6$ $(= 274.89..)$	M1	
	272 or their (b)(ii) $\times 8$✓ or $\dfrac{75}{their\,2.199} \times 8$✓ rounded down	A1✓ (2)	
		(12)	

Question Number		Sub (part) mark	Comments
8	Condone inaccuracies of up to 1 mm in plotting and drawing. If plots are not visible, allow P marks if curve passes within 1 mm of correct plot. Both P and dep C marks can be recovered following a grossly wrong plot if the plot is ignored and the curve passes within 1 mm of the correct point. Lined or plain paper used : no penalty, extend tolerances to 2 mm. <u>Penalties</u> deducted from P and C marks only: Wrong scale(s) −1 once. Interchanged axes : no penalty if labelled, −1 otherwise. Non-uniform scale : −2 after marking as generously as possible. **(a)** $(x =)$ 12 or −2 After B0, correct factors of their quadratic or their $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ M1		B1 B1 (2)	
	(b)(i) All 6 given points plotted. 4 correct points P1 Smooth curve, not grossly thick, through all plotted points, dep on P1	P2 C1 (3)	
	(ii) Curve drawn to (12,0) or ✓ from (a)	D1 (1)	Ignore drawn to negative x Follow through only if the shape remains reasonably parabolic.
	(iii) 45 (m) or 45 ± 0.5 if read from the graph.	H1 (1)	
	(iv) Using $y = 30$ (e.g. 0.6 to 0.8 and/or 9.3 to 9.5 seen) (distance travelled =) 8.5 to 8.9 (m)	M1 A1 (2)	
	(c)(i) $(p =)$ 49	B1	
	(ii)(a) 49 (m) cao	B1	
	(b) 5 (m) cao	B1 (3) (12)	

Question Number		Sub (part) mark	Comments
9	(a) $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$	B1 (1)	
	(b)(i)(a) $-\mathbf{b}$	B1	
	(b) $2(\mathbf{b} - \mathbf{a})$ or $2\mathbf{b} - 2\mathbf{a}$	B1	
	(c) $2\mathbf{a}$ or their(a) $+ 3\mathbf{a} + \mathbf{b} - \mathbf{a}$ ✓	B1✓	Must be simplified.
	(d) $\mathbf{a}$ or $-2\mathbf{b} + 3\mathbf{a} +$ their (b) ✓	B1✓ (4)	Must be simplified
	(ii)(a) Trapezium dep on the ans. **a** in (i)(d) Two sides (AD , BC) // also dep on the ans. **a** in (i)(d)	B1 B1 (2)	
	(b) 1:2:3 cao independent	B1 (1)	
	(c) In this part give -1 **once** for omission of appropriate reason.		
	(i) $(C\hat{E}A =)$ 146 (°) : Angle in the same segment.	B1	Or opposite angles of cyclic quads AOCF and AECF
	(ii) ($C\hat{B}A =$) 73 (°) : Angle at the centre twice angle at circumf.	B1	
	(iii) ($C\hat{F}A =$) 34 (°) : Angles in opposite segments supplementary	B1	May have been justified in (i)
	(iv) ($D\hat{C}F =$) 73 (°) or 180 – (their(ii) + their(iii)) ✓ Opposite angles in a cyclic quad and/or angle sum of a triangle.	B1✓ (4)	
	(anw 3)	(12)	

Question Number		Sub (part) mark	Comments
10	The general instructions given in Q8 apply here.		
	(a)(i) $4 \times 75 + 56 \times 125 + 84 \times 175 + 76 \times 225 + 36 \times 275 + 4 \times 325$ condone consistent use of other value in each interval, and one error or omission	M1	
		A1	
	50300 (g) oe cao		
	(ii) 193 (g) (accept 192.5 to 193.5) or their (i) ÷ 260 ✓	B1 ✓ (3)	E.g. if the answer only is given here, the mark is B1 + SC1.
	After M0 in (a), 50300 soi SC1	B1	
	(b) (i) (0 4 60) 144 220 256 (260)	(1)	
	(ii) All 7 points plotted ✓	P2 ✓	
	5 points plotted ✓ P1		
	Smooth curve, not grossly thick, through all plotted points, dep on P1 and ogive shape	C1 (3)	
	(iii)(a) 190.0 to 197.5 (g) clearly intended as the answer.	B1 (1)	
	(b) Intention to read graph at 65 and 195 e.g. 152.5 to 157.5 **and** 230 to 235 seen	M1	
	(I.Q. range =) 72.5 to 82.5 (g)	A1 (2)	
	(c) 260 – 144 (table value) (= 116) 5 (sacks)	M1 A1 (2)	
		(12)	

Question Number		Sub (part) mark	Comments
11	**(a)(i)** $\sqrt{(2-4)^2 + (9-6)^2}$ oe 3.61 or better (3.605....)	M1 A1 *(2)*	
	(ii) $3x + 2y = 24$ or any 3 term equivalent After B0, m = $\dfrac{-3}{2}$ or c = 12 soi or their line through (2,9) or (4,6) B1	B2 *(2)*	e.g. $y = -\dfrac{3}{2}x + 12$
	(b)(i) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B1 *(1)*	
	(ii) Reflection in the line $y = x$	M1 A1 *(2)*	And no other transformation stated.
	(iii)(a) $\begin{pmatrix} -3 \\ -3 \end{pmatrix}$	B1 *(1)*	
	(b) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} h \\ k \end{pmatrix} + \begin{pmatrix} -3 \\ -3 \end{pmatrix}$ seen **dep** on T1	B1 *(1)*	
	(c) $(h, k) = (-k-3, h-3)$ oe soi $h = 0$ and $k = -3$	M1 A1 *(2)*	Method mark must be earned here.
	(d) (0, -3) or (their h, their k) ✓	B1✓ *(1)* **(12)**	Allow either.