

## MARK SCHEME for the October/November 2007 question paper

<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.

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.

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### **Abbreviations**

cao correct answer only

oe or equivalent

soi seen or implied

www without wrong working

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

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3	(a) (i) 56	B1	Reason not required for 1 <sup>st</sup> B1
	(ii) 68 or $180 - 2 \times \text{their(i)}$ ✓	B1 ✓ (2)	
	(b) (i) $\widehat{WXV} = \widehat{YZZ}$ (vertically opposite) or $\widehat{VWX} = \widehat{XZY}$ ( $WV \parallel YZ$ ) stated	B1	For the 2 <sup>nd</sup> 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 <b>and</b> 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) $\frac{YZ}{25} = \frac{160}{40}$ oe soi	M1	
	(YZ = ) 100 cao	A1 (2) (6)	
4	(a) Final ans. \$ 13.44 or 1344 c	B1	
		(1)	
	(b) $\frac{35-28}{28} \times (100)$ oe	M1	
	25(%)	A1	
	After M0, use of figs $\frac{35}{28}$ soi	SC1	
		(2)	
	(c) 5(%)	B2	
	After B0 figs $\frac{35 \times 1200 - 399}{35 \times 1200}$ oe	M1	
		(2)	
	(d) (\$) 4	B3	
	After B0 ÷ by 115	M1	
	× by 100	indep. M1	
	After B0, M0 115 seen	SC1	
		(3)	
		(8)	

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5	<p>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.</p> <p><b>(a) (i)</b> <math>(AD^2 =) 24^2 + 16^2 \pm 2 \times 24 \times 16 \cos 112</math> <b>soi</b></p> <p><math>(AD =) \sqrt{24^2 + 16^2 - 2 \times 24 \times 16 \cos 112}</math> <math>(= \sqrt{1119.697\dots})</math></p> <p><math>(AD =) 33.5</math> (from 33.46..., accept 33.45 to 33.55)</p> <p>After A0 and at least M1, 1119.697... seen or <math>(AD =) 23.3</math> (from <math>\sqrt{544.30\dots}</math>) <b>A1</b></p> <p><b>(anw 2)</b></p> <p><b>(ii)</b> <math>\frac{\sin(\widehat{BCD})}{16} = \frac{\sin(180-112)}{20}</math> <b>oe</b></p> <p><math>\sin \widehat{BCD} = \frac{16 \sin(180-112)}{20}</math> <math>(=0.7417\dots)</math></p> <p><math>\widehat{BCD} = 47.9</math> (from 47.88...), accept 47.85 to 47.95 <b>(anw 2)</b></p> <p><b>(iii)</b> <math>\frac{1}{2} \times 24 \times 16 \sin 112</math> <b>oe</b></p> <p><math>= 178</math> (cm<sup>2</sup>)</p> <p><b>(b) 60 (k) cao</b></p>	<p>M1</p> <p>M1</p> <p>A2</p> <p><b>(4)</b></p> <p>M1</p> <p>M1</p> <p>A1</p> <p><b>(3)</b></p> <p>M1</p> <p>A1</p> <p><b>(2)</b></p> <p>B1</p> <p><b>(1)</b></p> <p><b>(10)</b></p>	

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Question Number		Sub (part) mark	Comments
6	<p>(a)(i) 6</p> <p>(ii) (a) <math>\pi</math> (their 15)<sup>2</sup> 707 (cm<sup>2</sup>) accept 706.5 to 707.5</p> <p>(b) <math>\frac{1}{6}(\pi 15^2 - 7\pi 5^2)</math> oe or <math>\frac{1}{6}(\text{their(a)} - \text{their } 7\pi 5^2)</math> or <math>\frac{\text{their } \widehat{AOB}}{360} \text{their } \pi 15^2 - \frac{\text{their } \widehat{AOB}}{360} \text{their } \pi 5^2 - \text{their } \pi 5^2</math> = 26.2 (cm<sup>2</sup>) accept 26.15 to 26.25</p> <p>(b) (i) 60(°)</p> <p>(ii) <math>\frac{\text{their}(i)}{360} \times 2\pi 5</math>  <math>\frac{\text{their}(i)}{360} \times 2\pi(\text{their } 15)</math>  <math>\frac{\text{their}(i)}{360} \times 2\pi 5 + \frac{\text{their}(i)}{360} \times 2\pi(\text{their } 15) + 2\pi 5</math> oe <b>indep</b> = 52.4 (cm) (accept 52.35 to 52.45)  After MO, 2π5 seen SC1  (<i>anw</i> 2)</p>	<p>B1 (1)</p> <p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>B1 (1)</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>SC1</p> <p>(4)</p> <p>(10)</p>	<p>For diameter 5, only method marks are available throughout.</p> <p>Accept radian form</p> <p>Expressions may be constructed using radians.</p> <p>i.e. if no other marks are scored, a correct circumference of a small circle gets 1 mark.</p>

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

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Question Number		Sub (part) mark	Comments
8	<p>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.</p> <p>(a) <math>(x =) 12</math>            or <math>-2</math></p> <p>After B0, correct factors of their quadratic            or their <math>\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}</math></p> <p>(b)(i) All 6 given points plotted.            4 correct points</p> <p>Smooth curve, not grossly thick, through all plotted points, dep on P1</p> <p>(ii) Curve drawn to <math>(12,0)</math> or <math>\surd</math> from (a)</p> <p>(iii) 45 (m) or <math>45 \pm 0.5</math> if read from the graph.</p> <p>(iv) Using <math>y = 30</math> (e.g. 0.6 to 0.8 and/or 9.3 to 9.5 seen)            (distance travelled =) 8.5 to 8.9 (m)</p> <p>(c)(i) <math>(p =) 49</math></p> <p>(ii)(a) 49 (m) cao</p> <p>(b) 5 (m) cao</p>	<p>B1            B1</p> <p>M1</p> <p>(2)</p> <p>P2</p> <p>P1</p> <p>C1            (3)</p> <p>D1            (1)</p> <p>H1            (1)</p> <p>M1            A1            (2)</p> <p>B1</p> <p>B1</p> <p>B1            (3)</p> <p>(12)</p>	<p>Ignore drawn to negative x            Follow through only if the shape remains reasonably parabolic.</p>



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Question Number		Sub (part) mark	Comments
9	<p>(a) <math>\begin{pmatrix} 0 \\ -2 \end{pmatrix}</math></p> <p>(b)(i)(a) <math>-b</math></p> <p>(b) <math>2(b-a)</math> or <math>2b-2a</math></p> <p>(c) <math>2a</math> or their <math>(a) + 3a + b - a</math> ✓</p> <p>(d) <math>a</math> or <math>-2b + 3a +</math> their <math>(b)</math> ✓</p> <p>(ii)(a) Trapezium <math>\quad\quad\quad</math> dep on the ans. <math>a</math> in (i)(d) Two sides <math>(AD, BC) \parallel</math> also dep on the ans. <math>a</math> in (i)(d)</p> <p>(b) 1:2:3 cao <math>\quad\quad\quad</math> independent</p> <p>(c) In this part give <math>-1</math> <b>once</b> for omission of appropriate reason.</p> <p>(i) <math>(\widehat{CEA} =) 146^\circ</math> : Angle in the same segment.</p> <p>(ii) <math>(\widehat{CBA} =) 73^\circ</math> : Angle at the centre twice angle at circumf.</p> <p>(iii) <math>(\widehat{CFA} =) 34^\circ</math> : Angles in opposite segments supplementary</p> <p>(iv) <math>(\widehat{DCF} =) 73^\circ</math> or <math>180 - (\text{their(ii)} + \text{their(iii)})</math> ✓ Opposite angles in a cyclic quad and/or angle sum of a triangle.</p> <p>(<i>anw 3</i>)</p>	<p>BI (1)</p> <p>BI</p> <p>BI</p> <p>BI ✓</p> <p>BI ✓ (4)</p> <p>BI BI (2)</p> <p>BI (1)</p> <p>BI</p> <p>BI</p> <p>BI</p> <p>BI ✓ (4) (12)</p>	<p>Must be simplified.</p> <p>Must be simplified</p>

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

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