

**MARK SCHEME for the October/November 2009 question paper
for the guidance of teachers**

4024/02

4024 MATHEMATICS

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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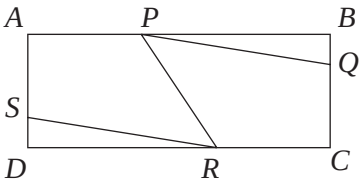
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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

Question Number	Mark scheme details and sub marks	Part Marks	Comments and other sub marks available
1	(a) $(y =) 3$ B1	1	Accept 2^3 seen isw
	(b) $(p =) 2$ B2	2	After B0 $3p + 4 = 8 - 2p + 6$ oe M1
	(c) $(q =) \pm 6$ B3	3	After B0 $(q =) 6$ SC2 or (i) $18(q + 2) - 16q$ soi M1 $q(q + 2)$ soi M1 (ii) $18(q + 2)$ M1 $q(q + 18)$ M1
	(d) For numerical $\frac{p \pm \sqrt{q}}{r}$ seen or used $p = -1$ and $r = 10$ B1	1	(not $\pm p$) or $(x + \frac{1}{10})^{(2)}$
	$q = 141$ or $\sqrt{q} = 11.8....$ (accept 11.9) soi B1	1	or $\frac{705}{500}$ oe or 1.187... if completing the square
	Final answers -1.29 www B1 1.09 www B1	1 1	These marks only, if no working seen
		[10]	After B1 + B1 + B0 + B0 both $-1.287..$ and $1.087...$ or -1.29 and 1.09 seen B1

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

2	(a) (i) Convincing use of $AB - AP = CD - CR$ B1 (ii) $PB = RD$ and $BQ = DS$ stated B1 $\hat{B} = \hat{D}$ (may be implied) B1 Conclusion: (may be at the start) triangles are congruent oe B1 (iii) $\hat{BPQ} = \hat{DRS}$ B1 Either angle $\angle RPB = \angle PRD$ or $\angle APR = \angle CRP$ B1 Conclusion $\angle RPB - \angle QPB = \angle PRD - \angle SRD$ or $\hat{RPQ} = 180 - (\hat{BPQ} + \hat{APR}) = 180 - (\hat{DRS} + \hat{CRP}) = \hat{PRS}$ B1		
	(b) Parallelogram B1		
		1	Implied by $AB = DC$, $AP = RC$. Ignore ref to AS and QC 
		3	Dependent on congruency case complete, (i.e. B2), but not necessarily named, www. If extra "correct" facts, case must be identified.
		3	Dependent on B2 and www After 0, $PQ \parallel SR$ and $\hat{RPQ} = \hat{PRS}$ alternate angles SC1
		1	
		[8]	

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

3	(a) $\frac{d}{50} = \sin 15$ soi	M1	2	Here and elsewhere accept answers rounding to the given 3 sig. fig. ans.
	$(d =) 12.9 \text{ (m)}$	A1		
	(b) $\frac{10}{AB} = \sin 15$ soi	M1	3	
	$AB = \frac{10}{\sin 15}$ $(AB =) 38.6 \text{ (m)}$	M1 A1		
	(c) (i) $15(^{\circ})$	B1	1	Allow ± 0.05 for genuine long methods.
	(ii) $\frac{CM}{10} = \cos$ their (c) (i) oe	M1	2	Accept $10\cos$ their (c) (i) $\checkmark$ if triangle BCM is right angled After 0 in (c) , $\widehat{BCM} = 90^{\circ}$ seen
	$(CM =) 9.66 \text{ (m)}$	A1		
			[8]	SC1
4	(a) (i) (a) $\{ 3, 9, 15 \}$	B1	1	Accept $(8 + \text{their } n(\mathbf{b})) \div 15 \checkmark$ Dependent on even numbers in (b) and probability ≤ 1
	(b) $\{ 6, 12 \}$	B1	1	
	(ii) $\frac{10}{15}$ oe isw	B1	1	
	(b) (i) (a) $4x$	B1	1	Accept $q + 4x = 66$. Their (a) must be in terms of x .
	(b) $66 - 4x$ or $66 -$ their (a)	B1	1	
	(ii) (a) $(x =) 13$ cao isw	B2	2	After B0, $66 - 4x + x = 27 \checkmark$ M1
	(b) 90	B1	1	Accept $(77 + \text{their } x) \checkmark$
			[8]	

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

5	(a) (i) $\begin{pmatrix} 4 \\ 0 \\ 6 \end{pmatrix}$	B2	2	After B0, one error or $\begin{pmatrix} 6 \\ 12 \\ 0 \end{pmatrix}$ or $\begin{pmatrix} 2 \\ 12 \\ -6 \end{pmatrix}$ seen B1
	(ii) Final ans (29 7)	B2	2	Condone omission of brackets. After B0, either correct B1 or final ans a col. vector SC1
	(b) (i) $\frac{1}{2} \begin{pmatrix} 1 & 3 \\ \pm 0 & 2 \end{pmatrix}$ isw	B2	2	After B0, $\frac{1}{2}$ or $\begin{pmatrix} 1 & 3 \\ \pm 0 & 2 \end{pmatrix}$ soi or detA = 2 B1
	(ii) $h = 8, k = 2$ www	B2	2	After B0, $\begin{pmatrix} 2 & -3 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} h \\ k \end{pmatrix} = \begin{pmatrix} 10 \\ 2 \end{pmatrix}$ or their (b) (i) $\times \begin{pmatrix} 10 \\ 2 \end{pmatrix}$ seen M1 [8]
6	(a) 9 : 250 isw	B1	1	Accept 250 : 9, 9 ÷ 250 Condone g
	(b) (i) 9.45 (g)	B1	1	
	(ii) (a) 0.3 (%)	B1	1	
	(b) 0.9 (%)	B3	3	After B0 Figs their (b) (ii) (a) $\times 21$ M1 ÷ fig 7 independent M1
	(iii) 2.205 (g) isw	B2	2	After B0 1.05 seen B1
	(c) 2000	B2	2	After B0, division by 8.3 M1 [10]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

7	(a) (i) 9.82 (m)	B4	4	$\left(h = \frac{25000 \times 0.001}{\pi 0.9^2} \right)$ After B0 $\pi 0.9^2 h$ B1 Their Volume (must be a volume) = figs 25 M1 10^{-3} oe used correctly at any stage M1
	(ii) (a) $\cos \widehat{EOD} = \frac{0.45}{0.9}$ oe seen	B1	1	e.g. $\sin ODE = 0.9 \div 1.8$ not just $\frac{1}{2}$. NB $\widehat{EOD} = 60^\circ$ is AG
	(b) 0.497 or 0.498m ²	B3	3	After B0 $\frac{120}{360} \pi 0.9^2 (= 0.848)$ soi M1 $\frac{1}{2} 0.9^2 \sin 120$ oe (= 0.351) M1
	(c) 4880 or 4890	B2	2	After B0 Figs their (a) (i) $\times$ their (ii) (b) or Figs $\frac{\text{their(ii)(b)}}{\pi \times 0.9^2} \times 25$ M1
	(b) ($h =$) 5.00 m	B2	2	After B0 10.00 SC1 $10 \times \frac{2}{3} \pi 0.75^3 = \pi 0.75^2 h$ soi M1
[12]				

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

8	(a) (i) 21	B1	1	
	(ii) All 8 points plotted ft soi. (0 6 6 3 0 0 6 21ft at intervals of 0.5)	P2		After P0, at least 5 correct plots P1
	Smooth curve through all plotted points	C1	3	Dependent on P1. Straight line graphs or ruled sections will be C0
	(iii) 0.2 to 0.35, 1.3 to 1.4 2.8 to 2.95	B2	2	After B0, 1 correct value B1 or clear attempt to read their graph at $y = 4$ M1
	(b) (i) $5 - 2x$ and $4 - 2x$	B1	1	Accept such as $5 - x - x$
	(ii) $x \times$ their $5 - 2x \times$ their $4 - 2x$ $4x^3 - 18x^2 + 20x$ correctly derived	M1 A1	2	Their expressions must be in x AG Expect some intermediate working. Attempts at working back, factorising $4x^3 - 18x^2 + 20x$ must be accurate and convincing.
	(iii) 2.8 to 2.95	B1	1	Or their value in (a) (iii) >2
	(iv) (a) Their max between 0 and 2	B1	1	Accept 6
	(b) 0.7 to 0.8 cao	B1	1	
			[12]	

Page 8	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

9	(a) (i) Accurate drawing	B3	3	After B0 Right angles at A and E R1 C correctly placed in relation to B and D e.g. BC = 3 and DC = 2, or angle BCD, correct C1
	(ii) $135^\circ \pm 2^\circ$	B1	1	Independent.
	(b) (i) $DE : ST \neq 1 : 3.5$ oe	B1	1	Accept a correct literal statement that includes DE and ST
	(ii) $(QS^2 =) (12 - 7)^2 + 14^2$ used www	B2	2	AG Condone long methods reaching such as 220.7 and rounding to 221 www After B0, $(12 - 7)$ and 14 seen B1
	(iii) $(\cos QRS =) (10.5^2 + 7^2 - \text{their } 221) / (2 \times 10.5 \times 7)$ 115	M2 A1	3	soi by -0.4200 After M0 their $221 = 10.5^2 + 7^2 \pm 2 \times 10.5 \times 7 \cos \widehat{QRS}$ (soi by 0.4200) M1 65.0 A1
	(iv) $\frac{\sin \widehat{RQS}}{7} = \frac{\sin \text{their (iii)}}{\text{their } \sqrt{221}}$ oe $(\widehat{RQS} =) 25.1 \text{ to } 25.5(^\circ)$	M1 A1	2 [12]	

Page 9	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

10	(a) (1) (3) 9 43 69 77 79 (80) B1	1	Table not copied so values not seen B0
	(b) All 8 points plotted ft P2		After P0, at least 5 correct plots ft P1
	Smooth ogive curve through all plotted points C1	3	Dependent on P1. Straight line graphs or ruled sections will be C0
	(c) (i) 192 – 198 B1	1	Not 200.
	(ii) 142 – 148 B1	1	After B0 in (c) , reading their cumulative curve at 40 and 8 M1
	(d) Curve through the points (50,3), (350,80), (250,40), (275,60), (200,20) P3	3	After P0, 3 correct points plotted P2 2 correct points plotted P1
	(e) (i) 71 or 72 B1	1	In (e) (i) and (ii) , accept non integer values rounding to these given.
	(ii) 47, 48 or 49 B1	1	After B0 in (e) , M1 available for reading both graphs at 260
	(f) B with some support B1	1	Support such as the probabilities $\frac{11}{80}$ or $\frac{40}{80}$ The reference must imply a direct comparison of the brands at 250.
		[12]	

Page 10	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – October/November 2009	4024	02

11	(a) (i) 50 (m)	B1	1	
	(ii) 15 (m/s) cao	B2	2	After B0 (their (a) (i) + 20×5) $\div 10$ M1
	(iii) ($t =$) 3 (s)	B2	2	After B0 $\frac{t}{12} = \frac{5}{20}$ oe M1
	(iv) $12t =$ their (a) (i) + $20(t - 5)$ ($t =$) 6.25 (s) cao	M1 A1	2	After M0,A0, a correct area used SC1
	(b) (i) 50 (m) and 150 (m)	B1	1	Accept their $d_1 =$ their (a) (i) and their $d_2 =$ their (a) (i) + 100 or $10 \times$ their (a) (i)
	(ii) speed	B1	1	Accept 20 m/s. Not increasing speed
	(iii) 10 (m/s) cao	B1	1	
	(c) 25(.0) (s)	B2	2	25.0 allows for the use of decimals such as 1.33. Accept values rounding to 25.0. Allow recovery of 25 after decimals After B0 , $(\pm) \frac{12}{9}$ soi e.g. by 15 B1
			[12]	