UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

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

4024 MATHEMATICS

4024/02 Paper 2, maximum raw mark 100

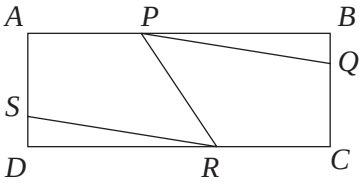
This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, 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.

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

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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 1.09 www	B1 B1	1 1	These marks only, if no working seen After B1 + B1 + B0 + B0 both –1.287.. and 1.087… or – 1.29 and 1.09 seen B1
			[10]	

2	**(a)** **(i)** Convincing use of $AB - AP = CD - CR$	B1	1	Implied by AB = DC, AP = R… Ignore ref to AS and QC
	(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	3	Dependent on congruency case complete, (i.e. B2), but not necessarily named, www. If extra "correct" facts, case must be identified.
	(iii) $B\hat{P}Q = D\hat{R}S$	B1		
	Either angle RPB = PRD or $A\hat{P}R = C\hat{R}P$	B1		
	Conclusion RPB – QPB = PRD – SRD or $R\hat{P}Q = 180 - (B\hat{P}Q + A\hat{P}R) =$ $180 - (D\hat{R}S + C\hat{R}P) = P\hat{R}S$	B1	3	Dependent on B2 and www After 0, PQ// SR and $R\hat{P}Q = P\hat{R}S$ **alternate angles** SC1
	(b) Parallelogram	B1	1	
			[8]	

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

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 $\begin{pmatrix}\\\\-6\end{pmatrix}$ 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, ½ or $\begin{pmatrix}1 & 3\\ \pm 0 & 2\end{pmatrix}$ soi or detA = 2 B1
	(ii) $h = 8$, $k = 2$ www	B2	2 **[8]**	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)** × $\begin{pmatrix}10\\2\end{pmatrix}$ seen M1
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)** × 21 M1 ÷ fig 7 independent M1
	(iii) 2.205 (g) isw	B2	2	After B0 1.05 seen B1
	(c) 2000	B2	2 **[10]**	After B0, division by 8.3 M1

7	**(a)** **(i)** 9.82 (**m**)	B4	4	$\left(h = \frac{25000 \times 0.001}{\pi 0.9^2}\right)$ After B0 $\pi 0.9^2 h$ 1 Their Volume (must be a **volume**) = figs 25 M1 10^{-3} oe used correctly at any stage M1
	(ii) **(a)** $\cos E\hat{O}D = \frac{0.45}{0.9}$ oe seen	B1	1	e.g. sinODE = 0.9 ÷ 1.8 not just ½. **NB** $E\hat{O}D = 60°$ 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)** × 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 **[12]**	After B0 10.00 SC1 $10 \times \frac{2}{3}\pi 0.75^3 = \pi 0.75^2 h$ soi M1

8	**(a) (i)** 21 B1	1	
	(ii) All 8 points plotted ft soi. P2 (0 6 6 3 0 0 6 21ft at intervals of 0.5)		After P0, at least 5 correct plots P
	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 $4 - 2x$ M1 $4x^3 - 18x^2 + 20x$ correctly derived 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]**	

9	**(a)** **(i)** Accurate drawing B3	3	After B0 Right angles at A and E C correctly placed in relation to B a D e.g. BC = 3 and DC = 2, or angle BCD, correct C1
	(ii) 135° ±2° 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) (cosQRS =) $(10.5^2 + 7^2 -$ their 221)/ $(2 \times 10.5 \times 7)$ M2 115 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) $\frac{\sin R\widehat{Q}S}{7} = \frac{\sin \text{their(iii)}}{\text{their}\sqrt{221}}$ oe M1 ($R\widehat{Q}S$ =) 25.1 to 25.5(°) A1	2 **[12]**	

10	**(a)** (1) (3) 9 43 69 77 79 (80)	B1	1	Table not copied so values no
	(b) All 8 points plotted ft	P2		After P0, at least 5 correct plots ft P
	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]	

11	**(a)** **(i)** 50 (m)	B1	1	
	(ii) 15 (m/s) cao	B2	2	After B0 (their **(a) (i)** + 20 × 5) ÷ 10
	(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 × 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 **[12]**	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