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

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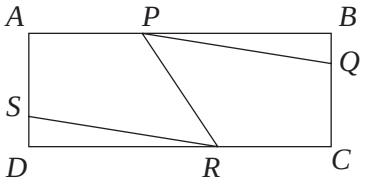
Question Number	Mark scheme details and sub marks	Part Marks	Comments and other sub marks available
1	**(a)** $(y =)$ 3 B1	1	Accept 2^3 seen isw
	(b) $(p =)$ 2 B2	2	After B0 $3p + 4 = 8 - 2p + 6$ oe M1
	(c) $(q =) \pm 6$ B3	3	After B0 $(q =)$ 6 SC2 or (i)$18(q + 2) - 16q$ soi M1 $q(q + 2)$ soi M1 (ii)$18(q + 2)$ M1 $q(q + 2)$ 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 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 = RC. 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 $\begin{pmatrix}2\\12\\-6\end{pmatrix}$ 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, 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 $\pi 0.9^2 h$ B1 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 $\frac{\text{their}\mathbf{(ii)(b)}}{\pi \times 0.9^2} \times 25$ 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]	

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 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 $4 - 2x$ 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 R1 C correctly placed in relation to B and 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 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 **[12]**	Support such as the probabilities $\frac{11}{80}$ or $\frac{40}{80}$ The reference must imply a direct comparison of the brands at 250.

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