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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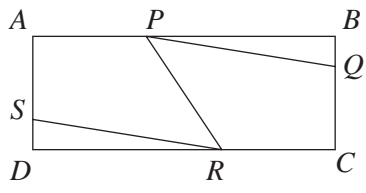
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Question Number	Mark scheme details and sub marks		Part Marks	Comments and other sub marks available
1	**(a)** $(y =)$ 3	B1	1	Accept 2^3 seen isw
	(b) $(p =)$ 2	B2	2	After B0 $3p + 4 = 8 – 2p + 6$ oe M1
	(c) $(q =)$ ±6	B3	3	After B0 $(q =)$ 6 SC2 or (i)$18(q + 2) – 16q$ soi M1 $q(q + 2)$ soi M1 (ii)$18(q + 2)$ M1 $q(q + 18)$ M1
	(d) For numerical $\dfrac{p \pm \sqrt{q}}{r}$ seen or used			(not $\pm p$)
	$\quad p = -1$ and $r = 10$	B1	1	or $(x + \dfrac{1}{10})^{(2)}$
	$\quad q = 141$ or $\sqrt{q}$ = 11.8.... (accept 11.9) soi	B1	1	or $\dfrac{705}{500}$ oe or 1.187… if completing the square
	$\quad$ Final answers -1.29 www	B1	1	These marks only, if no working seen
	$\qquad\qquad\qquad\qquad$ 1.09 www	B1	1	
				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)** $\dfrac{d}{50} = \sin 15$ soi	M1		
	$(d =)$ 12.9 (m)	A1	2	Here and elsewhere accept answers rounding to the given 3 sig. fig. ans.
	(b) $\dfrac{10}{AB} = \sin 15$ soi	M1		
	$AB = \dfrac{10}{\sin 15}$	M1		
	$(AB =)$ 38.6 (m)	A1	3	
	(c) **(i)** 15(º)	B1	1	Allow ±0.05 for genuine long methods.
	(ii) $\dfrac{CM}{10} = \cos$ their **(c) (i)** oe	M1		
	$(CM =)$ 9.66 (m)	A1	2	Accept 10cos their **(c) (i)** √ if triangle BCM is right angled
				After 0 in **(c)**, $B\hat{C}M = 90º$ seen SC1
			[8]	
4	**(a)** **(i)** **(a)** { 3, 9, 15 }	B1	1	
	(b) { 6, 12 }	B1	1	
	(ii) $\dfrac{10}{15}$ 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)**	$\dfrac{1}{2}\begin{pmatrix} 1 & 3 \\ \pm 0 & 2 \end{pmatrix}$ 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	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)** × 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	$\left(h = \dfrac{25000 \times 0.001}{\pi 0.9^2} \right)$ 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) $\cos E\widehat{O}D = \dfrac{0.45}{0.9}$ oe seen B1		1	e.g. sinODE = 0.9 ÷ 1.8 not just ½. **NB** $E\widehat{O}D = 60°$ is **AG**
	(b) 0.497 or 0.498m^2 B3		3	After B0 $\dfrac{120}{360} \pi 0.9^2$ $(= 0.848)$ soi M1 $\dfrac{1}{2} 0.9^2 \sin 120$ oe $(= 0.351)$ M1
	(c) 4880 or 4890 B2		2	After B0 Figs their **(a) (i)** × their **(ii) (b)** or Figs $\dfrac{\text{their}\mathbf{(ii)(b)}}{\pi \times 0.9^2} \times 25$ M1
	(b) ($h =$) 5.00 m B2		2	After B0 10.00 SC1 $10 \times \dfrac{2}{3} \pi 0.75^3 = \pi 0.75^2 h$ 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)	$135° \pm 2°$ 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)	(QS² =) $(12 - 7)^2 + 14^2$ 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 = $10.5^2 + 7^2 \pm 2 \times 10.5 \times 7\cos Q\hat{R}S$ (soi by 0.4200) M1 65.0 A1
		(iv)	$\dfrac{\sin R\hat{Q}S}{7} = \dfrac{\sin \text{their}\textbf{(iii)}}{\text{their}\sqrt{221}}$ oe M1 ($R\hat{Q}S =$) 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	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 M1
		(iii)	(t =) 3 (s)	B2	2	After B0 $\dfrac{t}{12} = \dfrac{5}{20}$ 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 , $(\pm)\dfrac{12}{9}$ soi e.g. by 15 B1
					[12]	