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Mark Scheme (Results)

Summer 2013

International GCSE Mathematics (4MB0) Paper 02R

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded.
- Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.
- Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - awrt – answers which round to....
  - cao – correct answer only
  - ft – follow through
  - isw – ignore subsequent working
  - SC - special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent
  - eeoo – each error or omission

- **No working**

  If no working is shown then correct answers normally score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

  If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.

  Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.

  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

  If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.

  If there is no answer on the answer line then check the working for an obvious answer.

- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

- **Parts of questions**

  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

International GCSE Maths B
Summer 2013 – Mark Scheme

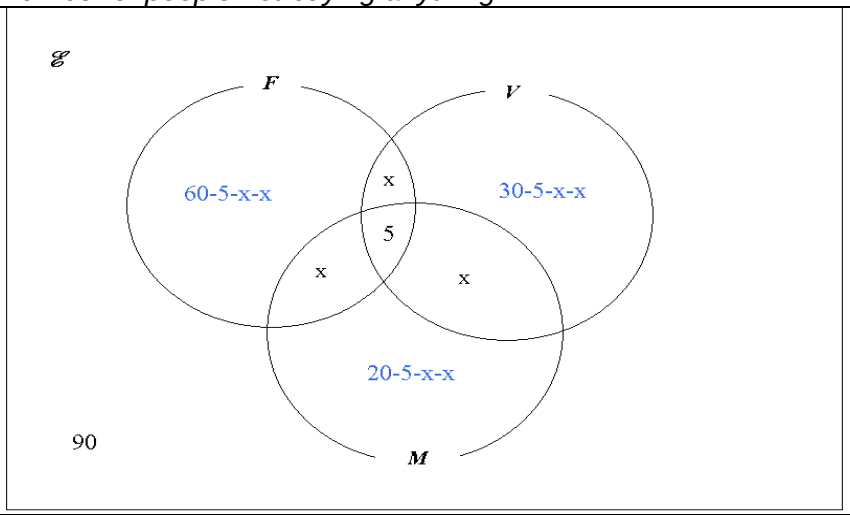
Question Number	Working	Notes		Mark
1	Rearranging so that the coefficient of x or y is the same in both eqns OR isolating x or y Subtracting or adding equations OR substituting expression for x or y to obtain y or x **NB:** Allow 1 slip *total* for both M marks. $x = 4$ $y = 1$ eg $5y = 5$ (M1) then $y = 1$ (A1) then $3x - 2(1) = 10$ (M1dep) then $x = 4$ (A1) OR $5x = 20$ (M1) then $x = 4$ (A1) the $3(4) - 2y = 10$ (M1dep) then $y = 4$ (A1)	M1 M1dep A1 A1	4	4

Question Number	Working	Notes		Mark
2(a)	$\angle CAB = 70^o$ reason: isosceles triangle and $\angle DAF = 50^o$ reason: alternate segment theorem OR $\angle ECD = 60^o$ reason: angles on straight line OR $\angle CDA = 70^o$ reason: alternate segment theorem leading to $\angle CAD = 60^o$ reason: angles on straight line or angles of triangle **OR** Taking O to be the centre of circle $\angle COA = 140^o$ (angles of a quadrilateral) $\angle BAO = \angle BCO = 90^\circ$ (angles between tangent and radius) then $\angle CDA = 70^o$ angle at centre	B1 B1 B1 B1 B1		

	leading to $\angle CAD = 60^o$ angles of a triangle **NB:** At least **TWO** reasons required for full marks (3 marks) plus all angles correct. **Special Case 1:** B1 (1 mark) only if no reasons given but all angles correct. **Special Case 2:** B1 B1 (2 marks) for *one* reason given and all angles correct.	B1	3	
2(b)	$\frac{AD}{\sin 50} = \frac{6}{\sin "\angle CAD"}$ $\therefore AD = \frac{6 \times \sin 50}{\sin "\angle CAD"}$ *AD* = 5.31 cm	M1 M1dep A1	3	**6**

Question Number	Working	Notes		Mark
3(a)	$\frac{dy}{dx} = -1 - 2x$ = 0 (1 term correct in a linear exp in *x*) $\therefore x = -\frac{1}{2}$ Substituting "*x*" in *y* $\therefore y = 6\frac{1}{4}$	M1 A1 M1dep A1	4	
3(b)(i) 3(b)(ii)	$\frac{dy}{dx}$ (*x* = -1) = +1, $\frac{dy}{dx}$ (*x* = 0) = -1 Since gradients are +1, 0 and -1 at *x* = -1, -1/2 and 0 respecitively $\therefore \left(-\frac{1}{2}, 6\frac{1}{4}\right)$ is a maximum (correct conclusion) **NB:** All 3 values of $\frac{dy}{dx}$ must be used for a correct conclusion	B1 B1		

	OR $\frac{d^2y}{dx^2} = -2$ $\therefore \left(-\frac{1}{2}, 6\frac{1}{4}\right)$ is a maximum (correct conclusion)	B1	2	**6**

Question Number	Working	Notes		Mark
4(a)	$n\ (F \cup M \cup V)'$ **or** $n\ F' \cap M' \cap V'$ **or** Number of people not buying *F*, *M* or *V* ***or*** *number of people not buying anything*	B1	1	
4(b)		B2 - 1eeoo	2	
4(c)	$F \cap V' \cap M$ or $(F \cap V') \cap (M \cap V')$ (o.e)	B1	1	
4(d)	"90 + (60-5-*x*-*x*) + (20-5-*x*-*x*) + (30-*x*-*x*-5) + 5 + *x* + *x* + *x*" = 172 (an attempt to add **all** of the values from *their* Venn diagram. allowing 1 slip fully correct (**NB:** there must be at least TWO entries in the Venn diagram in (b otherwise award no marks *x* = 6	 M1 M1dep A1	 3	 **7**

Question Number	Working	Notes		Mark
5(a)	$\frac{3x+5}{x+3} = \frac{2x}{3}$ $3(3x + 5) = 2x(x + 3)$ (Removing the denominators.)) $2x^2 - 3x - 15 = 0$ (correct conclusion)	M1 M1dep A1	3	
5(b)	$x = \frac{3 \pm \sqrt{(-3)^2 - 4(2)(-15)}}{2 \times 2}$ (Fully correct substitution into formula) x = awrt 3.6 (or better 3.589) $3 \times "3.589" + 5$ (substituting *their x* into (3*x*+5) 15.8 km	M1 A1 M1 A1ft	4	**7**

Question Number	Working	Notes		Mark
6(a)	$\mathbf{M} = \begin{pmatrix} 2 \\ -1 \\ 0 \end{pmatrix}$ **Special Case:** Award B1 (1 mark) for a (1x3) matrix	B2 -1eeoo	2	
6(b)	**Marks for value of *a*** (1, 1): $6 + 4 = a$ $a = 10$ **Marks for *b*** (1, 2): $2a - 2 + 2 - 4b = 12$ $b = 2$ **Marks for *c*** (2, 1): $2c - 2 + 2 - 5d = 2 - c$ $c = 4$ **Marks for *d*** (2, 2): $4 + 2 = 3d$ $d = 2$	M1 A1 M1 A1 M1 A1 M1 A1	8	**10**

Question Number	Working	Notes		Mark
7(a)	**Yellow** **Blue** **1** 2 3 3 3 4 7 **2** 3 4 4 4 5 8 **3** 4 5 5 5 6 9 **4** 5 6 6 **6** **7** **10** **5** 6 7 7 **7** **8** **11** **6** **7** **8** **8** **8** **9** **12**	B2 -1eeoo	2	
7(b)(i) 7(b)(ii)	1/36 **or** 0.0278 10/36 **or** 0.278 Probabilities are ft from *their* table	B1ft B1ft	2	
7(c)(i)	P(score=2) x P(score=2) = $\frac{1}{36}\times\frac{1}{36}$ $\frac{1}{1296}$ or 0.0008	M1 A1		
7(c)(ii)	P(total = 9) = {P(4 then 5) + P(5 then 4)} + {P(3 then 6) + P(6 then 3)} + {P(2 then 7) + P(7 then 2)} $= 2\times\left(\frac{5}{36}\times\frac{5}{36}\right)+\left(\frac{4}{36}\times"\frac{5}{36}"+"\frac{5}{36}"\times\frac{4}{36}\right)$ $+\left(\frac{1}{36}\times"\frac{6}{36}"+"\frac{6}{36}"\times\frac{1}{36}\right)$ 2 {Grand Total probs} correct All {Grand Total probs} correct **NB:** B marks are ft from *their* table **All "correct"** Grand Totals added = $\frac{102}{1296}$ or $\frac{51}{648}$ or $\frac{17}{216}$ or 0.079 **Special Case:** $\left(\frac{5}{36}\times\frac{5}{36}\right)+\left(\frac{4}{36}\times"\frac{5}{36}"\right)+\left(\frac{1}{36}\times"\frac{6}{36}"\right)$ scores B1 B0 M0	B1ft B1ft M1 A1	6	**10**

Question Number	Working	Notes		Mark
8(a)	**Penalise labelling ONCE only in this QUESTION (parts a-d)** ΔABC drawn and labelled.	 B1	 1	
8(b)	ΔDEF drawn $\left(\Delta DEF = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 1 & 2 \end{pmatrix}\right)$	B2 -1eeoo	 2	
8(c)	$\left(\Delta PQR = \begin{pmatrix} 4 & 4 & 8 \\ -4 & -8 & -12 \end{pmatrix}\right)$ If triangle not plotted then you may still award the available B2 marks for their coordinates of the vertices ΔPQR drawn **NB:** fts are from *their* matrix multiplication	B2 -1eeoo B1ft	 3	
8(d)	270° (rotation) OR -90° (rotation) OR 90° clockwise (Enlargement) scale factor 2, About origin (o.e)	B1 B1 B1	 3	**9**

Question Number	Working	Notes		Mark
9(a)(i) 9(a)(ii)	$\overrightarrow{OC}$ = **a** + 2**b** $\overrightarrow{CB}$ = - (" **a** + 2**b**") + **4**b $\overrightarrow{CG}$ = $\frac{3}{5}$"(2**b** – **a**)" $\frac{3}{5}$(2**b** – **a**) (oe)	B1 M1 M1dep A1	 4	
9(b)(i)	$\overrightarrow{FG}$ = $\frac{3}{5}$"(**a** + 2**b**)" + "$\frac{3}{5}$(2**b** – **a**)" = $\overrightarrow{FC} + \overrightarrow{CG}$ $\overrightarrow{FG}$ = $\frac{12}{5}$**b** A1 ft **NB:** Only apply ft if their vectors correctly arrive at $\overrightarrow{FG}$ = "λ"**b**	 M1 A1ft		

	OR $\Delta s \frac{FCG}{OCB}$ are similar , $\frac{FC}{OC} = \frac{CG}{CB} = \frac{FG}{OB} = \frac{3}{5}$ $\therefore \overrightarrow{FG} = \frac{3}{5} \times 4\mathbf{b}$ $\lambda = \frac{12}{5}$ (cao)	M1 A1ft A1	4	
9(c)	From given ratios and (b)(i), as: $\Delta s \frac{FCG}{OCB}$ are similar , $\frac{FC}{OC} = \frac{CG}{CB} = \frac{FG}{OB} = \frac{3}{5}$ **OR** $FG : OB = \frac{12}{5} : 4 = 12 : 20 = 3 : 5$ leading to $\therefore \lvert\Delta OCB\rvert : \lvert\Delta FCG\rvert = 5^2 : 3^2$ (o.e) (so the M marks can be "fts") 25 : 9 **NB:** Sight of vector division, eg $\frac{\overrightarrow{FG}}{\overrightarrow{OB}} = \frac{\left(\frac{12}{5}\mathbf{b}\right)}{4\mathbf{b}}$ scores M0 M0 A0	M1ft M1dep A1	3	
9(d)	$\lvert\Delta OCB\rvert = "\frac{25}{9}" \times \lvert\Delta FCG\rvert = "\frac{25}{9}" \times 18$ (=50) ΔOCB = 50 (cao)	M1 A1	2	**13**

Question Number	Working	Notes		Mark
10(a)	Height of hemispherical top = 20 – 2*r* = *h* + *r* correct conclusion	B1	1	
10(b)	$V = \pi h r^2 + \frac{1}{2} \times \frac{4}{3} \pi r^3$ (one volume correct) (both volumes correct) $V = \pi(20 - 3r)r^2 + \frac{1}{2} \times \frac{4}{3} \pi r^3$ (eliminating *h*) $\therefore \frac{V}{\pi} = y = r^2\left(20 - \frac{7}{3}r\right)$ (correct conclusion	M1 M1dep M1dep A1	4	

10(c)	61 170 or 171 216 ***Note: Penalise ncc ONCE***	B1 B1 B1	3	
10(d)	correct curve drawn -<u>1 mark for each of the following:</u> • incorrect/non-uniform scale • straight line segments • each point missed (± ½ small square) • each missed segment • each point not plotted • each point incorrectly plotted (± ½ small square) • tramlines • very poor curve eg line too thick	B3 -1eeoo	3	
10(e)	$V_{max} \approx 218(\pm 1)\pi$ (condone missing π)	B1ft	1	
10(f)	Indication of looking for range $5.1(\pm 0.1) \leq r \leq 6.3(\pm 0.1)$ **OR** 5.1 – (to) 6.3 ***Note:*** If there is no indication on their diagram (eg a horizontal line or vertical lines) and they have an incorrect inequality eg "5.7 $\geq r$ and $r \leq$ 6.3", then award M0 A0. A correct inequality eg $5.1(\pm 0.1) \leq r \leq 6.3(\pm 0.1)$ by itself scores M1 A1	M1 A1ft	2	**14**

Question Number	Working	Notes		Mark
11(a)	**Penalise incorrect rounding ONCE.** $\sin 25 = \frac{5}{BE}$ *BE* = 11.831 cm -> **11.8 cm**	M1 A1	2	
11(b)	*X* is a pointt on *DC* so that *EX* is perpendicular to *DC* so *DX* = 3 cm *ED* = $\sqrt{(12^2 + "3"^2)}$ $(= \sqrt{153})$ *ED* = 12.3693 -> **12.4 cm**	B1 M1 A1	3	
11(c)	$\sin 30 = \frac{8}{BD}$ (BD= 16) "12.3693"^{2} = "11.831"^{2} + "16"^{2} - $2\times"11.831"\times"16"\times\cos\angle EBD$ $\therefore \angle EBD = \cos^{-1}\left(\frac{"11.831"^2+"16"^2-"12.3693"^2}{2\times"11.831"\times"16"}\right)$ $\angle EBD$ = 50.074 ->**50.1°, 50.2°** **NB:** Watch for an answer of $\angle EBD$ = 129 or 130 which usually means a score of M1 M1 M0 A0.	M1 M1dep M1dep A1	4	
11(d)	*ACDE:* $ACDE = \frac{1}{2}\times(8+5)\times 12$ (=78) *ACDE* = 78 cm^2 Δ*BED:* $\therefore \Delta BED = \frac{1}{2}\times"11.831"\times"16"\times\sin"50.075"$ [**OR** (Heron's formula) $s = \frac{"12.369"+"11.831"+"16"}{2}$ (= 20.1) $\Delta BED = \sqrt{20.1\times(20.1-"12.369")\times(20.1-"11.831")\times(20.1-"16")}$ **OR** Sine Rule for $\angle EDB = 47.182^o$ $\therefore$ $\angle DEB = 82.744^o$ $\therefore \Delta BED = \frac{1}{2}\times"12.369"\times"11.831"\times\sin"82.744"$] ΔBED = awrt 72, 73 (eg 72.42, 72.584 cm^2)	M1 A1 M1 M1 M1 A1		

	Required Surface Area = **150, 151** cm^2	A1	5	**14**

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