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Mark Scheme (Results)

Summer 2014

Pearson Edexcel International GCSE Mathematics A (4MA0/4HR) Paper 4HR

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

Apart from Questions 14 and 16 (where the mark scheme states otherwise), the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.
NB: All ranges for correct answers on the mark scheme are inclusive.

Question	Working	Answer	Mark	Notes
1	eg. $-22 = 5 \times p - 4 \times -5$ **or** $5p = -22 + 4 \times -5$			M1 for correct substitution (must be into a correct equation)
	eg. $-22 = 5p + 20$ **or** $5p = -22 - 20$ **or** $p = \frac{-22-20}{5}$			M1 for correct simplification (minimum of $-4 \times -5 = +20$)
		-8.4 oe	2	A1 (accept $-\frac{42}{5}$ or $-8\frac{2}{5}$ oe)
				Total 3 marks

Question	Working	Answer	Mark	Notes
2	3.45 **or** $3\frac{27}{60}$			M1 for correctly converting '3h 27m' into a decimal (eg. 3.45) For '3h 27m' there must be some indication that this is the elapsed time from 20:07 to 23:34
	$"3\frac{27}{60}" \times 224$ **or** "3.45" × 224			M1 (independent) allow '3h 27m' × 224 **or** 3.27 × 224 For '3h 27m' there must be some indication that this is the elapsed time from 20:07 to 23:34 NB. 224 × 20 07 gets M0
		772.8	3	A1 accept 773
				Total 3 marks

Question	Working	Answer	Mark	Notes
3 (a)				M1 for $3n + k$ (k may be zero) oe
		$3n + 1$ oe	2	A1 need not be simplified eg. $4 + 3(n – 1)$ NB: $n = 3n + 1$ gains M1 A0
(b)	$3n + 1 = 88$ **or** $(88 – 1) \div 3$			M1 ft "$3n + 1$" =88 NB. Only ft if their expression is of the form $an + b$ where $a > 1$ and $b \neq 0$
		29	2	A1 ft NB. unrounded answer must be an integer
				Total 4 marks

Question	Working	Answer	Mark	Notes
4 (a)		Rotation, 90^o , anticlockwise, centre O	3	B1 Rotate **or** rotated B1 90^o (anticlockwise) **or** -270^o **or** 270^o clockwise B1 (centre) O **or** (0,0) **or** origin (do **not** accept $\begin{pmatrix}0\\0\end{pmatrix}$ but do not count as an additional transformation) NB if more than one transformation then 0 marks
(b)		triangle at (6,1) (7,1) (7,3)	1	B1 cao
				Total 4 marks

Question	Working	Answer	Mark	Notes
5	$\pi \times 3^2$ (= 9π) (= 28.27...)			M1 rounded or truncated to 3 or more sig figs
	20 × 12 (= 240)			M1
	"240" – 2 × "28.27…"			M1 dep on M2
		183	4	A1 for answer in range 183 – 184
				Total 4 marks

Question	Working	Answer	Mark	Notes
6	**Working with all 12 boxes** 12×15 (=180) **or** 12×12 (=144)			M1 for correct total cost or correct total number of drinks (either may appear as part of another calculation)
	$12 \times 12 \times \frac{3}{4} \times 1.5$ oe (=162)			M1 for revenue from all full price drinks sold
	$12 \times 15 \times 1.15$ oe (=207) **or** 180×0.15 oe (=27)			M1 for total revenue or total profit
	$\frac{"207" - "162"}{36}$ **or** $\frac{45}{36}$ **or** $\frac{"27" + ("180" - "162")}{36}$			M1 dep on M3
		1.25	5	A1 cao
				Total 5 marks
	Alternative – working with one box $15 \div 12$ (=1.25) **or** $12 \times \frac{3}{4}$ (=9)			M1 for price of 1 drink **or** number of full price drinks
	$12 \times \frac{3}{4} \times 1.5$ oe (=13.5)			M1 for revenue from all full price drinks sold
	15×1.15 (=17.25)			M1 for total revenue from one box
	$\frac{"17.25" - "13.5"}{3}$ **or** $\frac{3.75}{3}$			M1 dep on M3
		1.25	5	A1 cao
				Total 5 marks

Question	Working	Answer	Mark	Notes
7 (a)		0.9 oe	1	B1 accept 90% or $\frac{9}{10}$ oe
(b)	50×0.1 oe			M1 50×0.1
		5	2	A1 cao
				Total 3 marks

Question	Working	Answer	Mark	Notes
8 (a)	$252 = 2 \times 126 = 2 \times 2 \times 63 = 2 \times 2 \times 3 \times 21$			M1 for a process that isolates at least 2 correct prime factors e.g. $252 = 2 \times 126$, $126 = 3 \times 42$ or a factor tree with 2 primes from 2, 3 or 7 identified or repeated division
		$2 \times 2 \times 3 \times 3 \times 7$	2	A1 for $2 \times 2 \times 3 \times 3 \times 7$ oe with correct prime factors
(b)	$2^2 \times 3^2 \times 7 \times 2^4 \times 3 \times 5$			M1 $"2^2 \times 3^2 \times 7" \times 2^4 \times 3 \times 5$ or a fully correct factor tree or fully correct repeated division
		$2^6 \times 3^3 \times 5 \times 7$	2	A1 cao accept in any order
				Total 4 marks

Question	Working	Answer	Mark	Notes
9	$x + 24 = 4x - 30$			M1 for forming a correct equation in x
		$x = 18$		A1 cao
	$x + 2y + x + 24 = 180$ or $x + 2y + 4x - 30 = 180$ or $x + 2y + 4x - 30 + x + 24 + x + 2y = 360$			M1 for forming a correct equation in x and y **or** a correct equation in y (NB. Their found value of x (which may not be correct) may be substituted)
		$y = 60$	4	A1 cao
				Total 4 marks

Question	Working	Answer	Mark	Notes
10 (a)	$2.1 \div (1 + 2 + 3)$ (= 0.35) **or** $2.1 \div 6$ $2.1 \div (1 + 2 + 3) \times 2$ **or** $2.1 \div 6 \times 2$ oe			M1 allow $2.1 \div (1 + 2 + 3) \times 3$ (=1.05) for the method mark
		0.7	2	A1 (accept 0.70)
(b)	eg. $6 \div 3 = 2$ **and** 2×0.75 **or** $\frac{0.75}{3} \times 6$ oe			M1 for a complete method
		1.5	2	A1 cao
				Total 4 marks

Question	Working	Answer	Mark	Notes
11(a)	$7 + 7 + 8 + d = 4 \times 8$ **or** 7, 7, 8, (x) **or** 4×8 (=32)			M1
		10	2	A1 (accept 7, 7, 8, 10 on answer line)
(b)	$\frac{(2\times"7"-3)+(2\times"7"-3)+(2\times"8"-3)+(2\times"10"-3)}{4}$ **or** $\frac{2\times32-12}{4}$ **or** $2 \times 8 - 3$			M1 ft for a complete method using candidate's 4 numbers from (a) **or** $\frac{2a-3+2b-3+2c-3+2d-3}{4}$ oe
		13	2	A1 cao
				Total 4 marks

Question	Working	Answer	Mark	Notes
12 (a)				M1 $(2t \pm 1)(t \pm 3)$ **or** $(2t \pm 3)(t \pm 1)$ NB. Accept $1t$ in place of t
		$(2t-1)(t-3)$	2	A1 cao
(b)	$bx^2 = a - y$ **or** $-bx^2 = y - a$			M1 for isolating bx^2 (or $-bx^2$)
	$x^2 = \frac{a-y}{b}$ **or** $x^2 = \frac{y-a}{-b}$ **or** $x^2 = -\frac{y-a}{b}$			M1 for isolating x^2
		$x = \pm\sqrt{\frac{a-y}{b}}$	3	A1 **or** $x = \pm\sqrt{\frac{y-a}{-b}}$ **or** $x = \pm\sqrt{-\frac{y-a}{b}}$ (condone omission of ±)
				Total 5 marks

Question	Working	Answer	Mark	Notes
13 (a)	14 16 17 18 20 21 22 23 23 24 24			M1 arrange in order **or** One of 21(median), 17(LQ), 23(UQ) identified
	(14 16 17 18 20 <u>21</u> 22 23 23 24 24) (14 16 <u>17</u> 18 20) and (22 23 <u>23</u> 24 24) 23 - 17			M1 Identify any **two** of 21, 17 and 23
		6	3	A1 cao
(b)		Carmelo **and** reason using IQR	2	B1 ft from (a) Carmelo - he has a lower IQR oe (IQR must be part of the statement)
				Total 5 marks

Question	Working	Answer	Mark	Notes
14 (a)	$7.8 \times 10^8 \times 1000$ **or** 7.8×10^{11}oe **or** $8 \div 1000$ **or** 0.008			M1 for correct conversion from m to km or from km to m
	$7.8 \times 10^8 \times 1000 \div 8$ **or** $7.8 \times 10^8 \div 0.008$			M1 (indep) award for digits 975 (eg. an answer of 9.75×10^7 gets M0 M1 A0)
		9.75×10^{10}	3	A1 cao
(b)	1.95×10^{10} km			B1 cao
	$\frac{1.95\times10^{10}}{"9.75\times10^{10}"}$ (=0.2(km)) **or** $\frac{1.95\times10^{13}}{"9.75\times10^{10}"}$ (=200(m)) **or** $\frac{1.95\times10^{10}}{7.8\times10^{8}}\times8$ (=200(m)) **or** $\frac{1.95\times10^{13}}{7.8\times10^{11}}\times8$ (=200(m)) **NB: 1.95 may be the candidate's upper bound**			M1 ft from (a) also award for $\frac{1.9\times10^{10}}{"9.75\times10^{10}"}$ **or** $\frac{1.9\times10^{13}}{"9.75\times10^{10}"}$ **or** $\frac{1.9\times10^{10}}{7.8\times10^{8}}\times8$ **or** $\frac{1.9\times10^{13}}{7.8\times10^{11}}\times8$
		200	3	A1 cao **must be from correct figures used in a correct calculation**
				Total 6 marks

Question	Working	Answer	Mark	Notes
15 (a)		$\frac{2}{7}$ then two pairs of branches with $\frac{3}{5}, \frac{2}{5}$ on the W and R branches respectively fully correct tree diagram	2	M1 $\frac{2}{7}$ on lower LH branch **OR** two additional pairs branches labelled with white and red A1 for fully correct tree diagram with all probabilities and labels NB: Accept 0.28571… rounded or truncated to 3 or more sig figs for $\frac{2}{7}$
(b)	$\frac{5}{7}\times"\frac{3}{5}"$			M1 ft from their tree diagram
		$\frac{15}{35}$	2	A1 oe eg. $\frac{3}{7}$ **or** 0.428571… rounded or truncated to 3 or more sig figs Accept 0.43 if working shown
(c)	$\frac{5}{7}\times"\frac{2}{5}"$ or $\frac{2}{7}\times"\frac{3}{5}"$		3	M1 for a correct product only ft probabilities < 1 / M2 for $1-"\frac{15}{35}"-"\frac{2}{7}"\times"\frac{2}{5}"$
	$\frac{5}{7}\times"\frac{2}{5}"+\frac{2}{7}\times"\frac{3}{5}"$			M1 for full method
		$\frac{16}{35}$		A1 oe accept decimal answer 0.457142… rounded or truncated to 3 or more sig figs Accept 0.46 if working shown
				Total 7 marks

Question		Working	Answer	Mark	Notes
16	(a)	Eg. Area = $(4x-3)(x+1)+\left[3x-(x+1)\right]\times 4$ **OR** Area = $4\times 3x$ + $(x+1)(4x-3-4)$ **OR** Area = $(4x-3)\times 3x-$ $(4x-3-4)(3x-(x+1))$			M1 for a complete correct expression for area of hexagon
					A1 for all brackets correctly expanded
			Answer given	3	A1 for convincing progression to given equation
	(b)	$\dfrac{-9\pm\sqrt{9^2-4\times 4\times(-47)}}{2\times 4}$			M1 for correct substitution; condone one sign error; brackets not necessary; condone + instead of ± in formula **There may be partial evaluation – if so, this must be correct**
		$\sqrt{833}$ **or** $\sqrt{81+752}$ **or** $7\sqrt{17}$ **or** 28.8…..			M1 (independent) for correct simplification of discriminant (if evaluated, at least 3sf rounded or truncated)
			2.48, − 4.73	3	A1 awrt 2.48 and −4.73 NB. If negative solution is discarded (or omitted at any stage) then full marks can still be obtained **Award 3 marks if first M1 scored and answer correct**
	(c)	3 ×"2.48".... (=7.44…) **or** 4 × "2.48" – 3 (=6.93…)			M1
			7.45	2	A1 for 7.44 - 7.45

16b	**Alternative** $x^2+\frac{9}{4}x-\frac{47}{4}=0$ $(x+\frac{9}{8})^2-\frac{81}{64}-\frac{47}{4}=0$		M1	for $(x+\frac{9}{8})^2$ oe
	$(x+\frac{9}{8})=\pm\sqrt{\frac{833}{64}}$		M1	for $(x+\frac{9}{8})=\pm\sqrt{\frac{833}{64}}$ oe
		2.48, − 4.73	3	A1 awrt 2.48 and −4.73 NB. If negative solution is discarded (or omitted) then full marks can still be obtained **Award 3 marks if first M1 scored and answer correct**
				Total 8 marks

Question	Working	Answer	Mark	Notes
17 (a)		$4x^2y$	2	B2 (B1 for ax^ny^m with two of $a = 4$; $n = 2$; $m = 1$)
(b)	$2(x-2)(x+2)$ **or** $(2x-4)(x+2)$ **or** $(x-2)(2x+4)$			M1 for numerator factorised
	$4x(x-2)$ **or** $2x(2x-4)$			M1 for denominator factorised
		$\frac{x+2}{2x}$	3	A1 accept $\frac{1}{2}+\frac{1}{x}$
	Alternative to (b): $\frac{2x^2-8}{4x^2-8x}=\frac{x^2-4}{2x^2-4x}=\frac{(x-2)(x+2)}{2x(x-2)}$	$\frac{x+2}{2x}$	3	**In order to use this mark scheme, correct simplification of the original fraction must be seen** M1 $(x-2)(x+2)$ M1 $2x(x-2)$ A1 accept $\frac{1}{2}+\frac{1}{x}$
				Total 5 marks

Question	Working	Answer	Mark	Notes
18 (a)	$\angle AOC = 90 - 36$	54	2	B1 cao
		Angle between tangent and radius is 90^o		B1 for Angle between tangent and radius is 90^o (accept right-angle or perpendicular)
(b)	**Using angle *CGF* = angle *FGE* + angle *CGE*** $\angle FGE = 90 - 34$ (=56)			M1 may be on diagram
	$\angle CGE$ = "54" ÷ 2 (=27) **or** $\frac{180-(180-"54")}{2}$ (=27)			M1 may be on diagram
		83	3	A1 cao
	Alternative: **Using angles in a cyclic quadrilateral = 180^o** **Angle *CGF* = 180 – (angle *CEO* + angle *FEG*)** Angle *CEO* = (180 – "54")÷2 (=63) **and** angle *FEG* = 180 – (180 – 70) – 36) (=34)			M1 may be on diagram
	Angle *CGF* = 180 – ("34" + "63")			M1 **dep on previous M1**
		83	3	A1 cao
				Total 5 marks

Question	Working	Answer	Mark	Notes	
19	$(BC^2 =)3.8^2 + 6.4^2 - 2\times3.8\times6.4\cos120^o$ ($= 79.72$)			M1 correct use of Cosine rule to find BC	Award M2 A1 for $BC = 8.9 - 8.93$ **or** $\sqrt{79.72}$ **or** $\sqrt{\frac{1993}{25}}$ oe
	$(BC^2 =)$ 14.44 + 40.96 + 24.32 (=79.72)			M1 correct order of operations	
				A1 for $BC = 8.9 - 8.93$ **or** $\sqrt{79.72}$ **or** $\sqrt{\frac{1993}{25}}$ oe	
	$\frac{\sin C}{6.4} = \frac{\sin 120}{"8.92.."}$ **or** $6.4^2 = 3.8^2 + "8.92"^2 - 2\times3.8\times"8.92"\times\cos C$			M1 correct use of Sine rule or Cosine rule to find angle C	Award M2 for $C = 38 - 38.5$ Award M2 for $B = 21.5 - 22$ **and** $C = 180 - 120 - B$
	$\sin C = \frac{6.4\times0.866...}{"8.92.."} (= 0.62\ldots)$ **or** $\cos C = \frac{3.8^2 + "8.92"^2 - 6.4^2}{2\times3.8\times"8.92"}$ (=0.78…) $C = 38 - 38.5$			M1 correct rearrangement	
		068	6	A1 (0)68 − (0)68.4	
	Alternative CD is the perpendicular from C to BA produced. $\angle CAD = 60^o$ **or** $ACD = 30^o$			M1 uses triangle CAD and $\angle CAD = 60^o$ **or** $ACD = 30^o$ ***CD* may not be drawn in but can be implied**	
	$AD = 3.8\cos60^o$ **or** 3.8sin30 (= 1.9)			M1 for correct method to find horizontal length	
	$BD = 6.4+1.9$ (= 8.3)			A1 for $BD = 8.3$	
	$CD = 3.8\sin60$ **or** 3.8cos30 (=3.29)			M1	
	$\tan BCD = \frac{8.3}{3.8\sin 60}$ oe			M1	
		068		A1 (0)68 − (0)68.4	
					Total 6 marks

Question	Working	Answer	Mark	Notes
20	(Slant Height =) $\sqrt{(5a)^2+(12a)^2}$ (= $13a$)			M1 correct use of Pythagoras – condone missing brackets
	(total surface area =) $\pi \times (5a)^2 + \pi \times 5a \times$ "$13a$" oe **or** $\pi \times (5a)^2 + \pi \times 5a \times \sqrt{(5a)^2+(12a)^2}$ (=$90\pi a^2$)			M1 dep on first M1 – must have either $25a^2$ or $(5a)^2$
	eg. $90\pi a^2 = 360\pi$ oe **or** $\pi \times (5a)^2 + \pi \times 5a \times$ "$13a$" $= 360\pi$ oe			M1 dep on first M1 for equation formed (need not be simplified) – must have either $25a^2$ or $(5a)^2$
				A1 $a = 2$
	$V = \frac{1}{3} \times \pi \times (5 \times "2")^2 \times 12 \times "2"$ (=$100\pi a^3$) **or** $V = \frac{1}{3} \times \pi \times 10^2 \times 24$ oe **or** $k = \frac{1}{3} \times (5 \times "2")^2 \times 12 \times "2"$			M1 dep on first M1 NB. For the award of this mark, brackets must be present or the value for r^2 evaluated correctly for the candidate's value of a
		800	6	A1 cao
				Total 6 marks

Question		Working	Answer	Mark	Notes
21	(a)	LHS $a^2c^2 + a^2 + c^2 + 1$			M1 for correct expansion of LHS
		RHS $a^2c^2 - 2ac + 1 + a^2 + 2ac + c^2$			M1 for correct expansion of RHS
			Shown	3	A1 for convincing progression and conclusion
		Alternative (i): LHS $a^2c^2 + a^2 + c^2 + 1$			M1 for correct expansion of LHS
		$a^2c^2 - 2ac + 1 + a^2 + 2ac + c^2$			M1 for introduction of $+2ac$ and $-2ac$
			Shown	3	A1 for convincing progression and conclusion
		Alternative (ii) RHS $a^2c^2 - 2ac + 1 + a^2 + 2ac + c^2$			M1 for correct expansion of RHS
		$a^2c^2 - 2ac + 1 + a^2 + 2ac + c^2 = a^2c^2 + a^2 + c^2 + 1$ $= a^2(c^2 + 1) + (c^2 + 1)$			M1 for correct simplification and convincing factorisation
			Shown	3	A1 for convincing progression and conclusion
	(b)	65×10001 $a = 8$, $c = 100$ $ac - 1 = 8 \times 100 - 1$ $a + c = 8 + 100$			M1 for 65×10001
					A1 $a = 8$, $c = 100$ **or** $a = 100$ and $c = 8$ **or** 108 and 799
			108^2 , 799^2	3	A1 108^2 , 799^2 or 11664 and 638401
					Total 6 marks

TOTAL FOR PAPER: 100 MARKS

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