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Mark Scheme (Results)

June 2016

Pearson Edexcel International GCSE
Mathematics A (4MA0)
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**
    - 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.

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Apart from questions 2a, 10, 14a 16, 20 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method						
Ques	**Spec**	**Grade**	**Working**	**Answer**	**Mark**	**Notes**
1	a			Vertices at (3,5)(7,5)(7,7)(5,7) 2	B2	If not B2 then B1 for correct size shape in wrong position but correct orientation or 3 correct coordinates, or for enlargement SF3 centre (1,1)
	b			Enlargement SF 0.5, centre (1,1) 1	B1	Single transformations only
						Total 3 marks

2	a	Eg $6t - 2t = 5 + 9$ or $4t = 14$ or $-4t = -14$ oe		3	M2	For all t terms on one side and all numbers on the other side of a correct equation or M1 for all t terms on one side **or** all numbers on one side of a correct equation eg $4t - 5 = 9$ or $6t = 2t + 14$ or $6t - 2t - 5 = 9$ or $6t = 2t + 9 + 5$ etc
			3.5		A1	oe dep on M1
	b	$6y + 6 + 2y - 8$	$8y - 2$	2	M1 A1	For 3 correct terms oe eg $2(4y - 1)$
	c		$\frac{w}{2}$	2	B2	oe eg $0.5w$ B1 for partial, but correct, simplification with at least 2 correct cancellations, eg $\frac{4w}{8}$, $\frac{wx}{2x}$, $\frac{2w}{4}$, $\frac{wy}{2y}$ $w(4\div8)$ etc **or** kw where k is a number and $k \neq ½$
						Total 7 marks

3	a	$\frac{1.75}{2.1}\times 100$ oe	83.3	2	M1 A1	Fully correct method to find % 83.3 or better
	b	54.99 × 5.52 (= 303.(54...)) or 343 ÷ 5.52 (=62.(137...))		3	M1	
		343 − (54.99 × 5.52)(=39.(45..)) or (343 ÷ 5.52) – 54.99 (=7.(14...))			M1	
			39		A1	(also accept answers in range 39.45 to 39.5)
	c	7h 24 min = 7.4 h $\left(or 7\frac{24}{60} \right)$ oe or 444 (mins) or 26640 (secs)		3	B1	
		$\frac{5522}{7.4}$ or $\frac{5522}{444}$ × 60 or $\frac{5522}{26640}\times 3600$			M1	use of d/t, allow $\frac{5522}{7.24}$
			746		A1	746 - 746.22
						Total 8 marks

4	a	$360 - 2 \times 111 - 90$	48	2	M1 A1	A complete method to find angle *ABC*
	b	$111 - 90$	21	2	M1 A1	
	c	$540 - 90 - 90 - 111 - 111$ **or** $180 - 2 \times$ '21' **or** $2 \times (180 - 111)$ **or** $360 - 111 = 249$ $180 - (360 - $ '21' $- 249 - 48)$ oe	138	3	M2 A1	For a fully correct method to find angle *y* or M1 if using pentagon for $(5-2)\times180$ (=540) or for an isosceles triangle drawn with *y* at apex or for showing use of parallel lines on diagram
						Total 7 marks

5	a		7, −1, −2, 7	2	B2 B1	all correct for 2 or 3 correct
	b		Correct curve	2	M1 A1	for plotting at least 6 points correctly from their table (dep on B1 earned in (a)) fully correct curve
	c		4.4 – 4.5	1	B1	ft any parabola with 2 intersections with $y = 4$, 1 value for *x* only. Condone eg (4.4, 4)
						Total 5 marks

6			$x = 10$	3	B1	
		$3 + 6 + x + y = 4 \times 11$ oe			M1	Showing that the total of the 4 numbers is 4×11 oe, eg $x + y = 35$ (ft incorrect x for M1) or values of x and y that total 35 (where $x \neq 10$, $y \neq 25$)
			$y = 25$		A1	
						Total 3 marks

7		$\pi \times 3^2$ (= 9π = 28.27..) or $\pi \times (3+2)^2$ (=25π =78.53..)		3	M1	A correct calculation for the area of one of the circles
		$\pi \times 5^2 - \pi \times 3^2$ oe eg 16π			M1	A correct calculation for the shaded area
			50.3		A1	50.2 – 50.3
						Total 3 marks

8	a	8000:50 or 50:8000 or $\frac{8000}{50}$ oe	160	2	M1 A1	
	b	$\frac{72}{80} \times 50$ oe | 72 × 100 ÷ '160'	45	2	M1	A correct method to find the length of the model, ft their answer to (a)
					A1	cao (If ans 1.6 in (a) then **do not** award marks for 72 ÷ 1.6 = 45)
						Total 4 marks

9		30 × 120 (= 3600) or 10 × 95 (= 950)		3	M1	30 × 120 or 10 × 95
		(“3600” + “950”) ÷ (30 + 10) (= “4550” ÷ “40”)			M1	a fully correct method to find the mean weight of the 40 apples
			113.75		A1	accept 113.8, 114 providing M2 scored
						Total 3 marks

10		$12x + 9y = 18$ $12x + 20y = -4$ $(11y = -22)$	$20x + 15y = 30$ $9x + 15y = -3$ $(11x = 33)$		4	M1	for coefficients of x or y the same with the correct operation to eliminate one variable (allow one error) **or** for correct rearrangement of one equation followed by substitution in the other.
		$y = -2$	$x = 3$			A1	(dep on M1)
		$4x + 3 \times -2 = 6$	$4 \times 3 + 3y = 6$			M1	(dep on M1) for substituting for the other variable or starting again to eliminate the other variable
				$x = 3, y = -2$		A1	(dep on M1, M1)
							Total 4 marks

11		$SR = (60 \div 15) \times 2$ (=8)		4	M1	
		$\tan SQR = \frac{'8'}{15}$			M1ft	(or M1 for $\sin SQR = \frac{'8'}{'17'}$ or $\cos SQR = \frac{15}{'17'}$ where '17' comes from a fully correct method)
		$SQR = \tan^{-1}\left(\frac{'8'}{15}\right)$			M1ft	(or $\sin^{-1}\left(\frac{'8'}{'17'}\right)$ *or* $\cos^{-1}\left(\frac{15}{'17'}\right)$)
			28.1		A1	28.07 – 28.1
						Total 4 marks

12	a	12, 53, 78, 90, 96, 100	Correct table	1	B1	
	b		Correct cumulative frequency graph	2	B2	fully correct cf graph – points at ends of intervals and joined with curve or line segments If not B2 then B1(ft from a table with only one arithmetic error) for 4 or 5 of their points from table plotted consistently within each interval at their correct heights and joined with smooth curve or line segments
	ci		18000-20000	3	B1 ft	from their cumulative frequency graph
					M1ft	For use of 25 and 75, or 25.25 and 75.75, or 28000(27000-29000) and 13000 (12000 – 14000) stated or indicated on graph. Ft from a cf graph provided method is shown.
	ii		13000 – 17000		A1ft	from their cf graph
						Total 6 marks

13	a		2.5×10^5	1	B1 cao	
	b	$\frac{4\pi}{3} \times (6.99 \times 10^7)^3 \div \left[\frac{4\pi}{3} \times (6.37 \times 10^6)^3\right]$ or $(1.43... \times 10^{24}) \div (1.08... \times 10^{21})$	1320	3	M1 for $\frac{4\pi}{3} \times (6.99 \times 10^7)^3$ or $\left[\frac{4\pi}{3} \times (6.37 \times 10^6)^3\right]$ M1 for a complete method A1 accept answers which round to 1320 or 1.32×10^3	M2 $\frac{(6.99 \times 10^7)^3}{(6.37 \times 10^6)^3}$ oe
						Total 4 marks

14	a	$4 \times 2y + 4 \times \frac{2-3y}{4} = 4 \times \frac{1}{4}$ or $\frac{8y}{4} + \frac{2-3y}{4} = \frac{1}{4}$ or $2y = \frac{1}{4} - \frac{2-3y}{4}$ oe		3	M1	For multiplying each term by 4 or writing all terms with 4 as a denominator or isolating terms with denominator 4 on one side of equation and 2y or −2y the other side
		$8y + (2-3y) = 1$ or $8y = -1 + 3y$ Or $5y = -1$ oe			M1	A correct equation with no fractions
			-0.2		A1	dep on at least M1 earned
	b		$(3x+1)(x-3)$	2	M1 A1	for $(3x \pm 1)(x \pm 3)$
	c	$4x^2 + 12x$ or $4x^2 - 12x + 9$ or $-4x^2 + 12x - 9$ oe		3	M1	For expansion of $4x(x + 3)$ or $(2x - 3)^2$ or $-(2x - 3)^2$
		$4x^2 + 12x - 4x^2 + 12x - 9$			M1	Fully correct expansions with correct removal of bracket (ie all signs correct)
			$24x - 9$ or $3(8x - 3)$		A1	
						Total 8 marks

15	a	$\frac{7}{10}\times\frac{5}{8}+\frac{3}{10}\times\frac{3}{8}$	$\frac{44}{80}$	3	M1 M1 A1oe	for one correct product for both correct products (and no others) added (55% or 0.55)
	b	$\frac{12}{18}\times\frac{11}{17}$	$\frac{132}{306}$	2	M1 A1oe	Correct product Accept 0.43(137...) rounded or truncated to at least 2SF
						Total 5 marks

16		$(x=)\frac{--6\pm\sqrt{(-6)^2-4\times2\times3}}{2\times2}$	0.634 & 2.37	3	M1	condone one sign error, brackets not necessary. Some simplification may already be done – if so this must be correct. (accept 6^2 for $(-6)^2$)
		$(x=)\frac{6\pm\sqrt{12}}{4}$			M1	
					A1	answers rounding to 2.37 & 0.634 dep on M1
						Total 3 marks

17				5	B1	Recognition of angle *LRM* as required angle either drawn on diagram or from working
		$PQ(ML) = 20\sin 30^o$ (=10) or $MR = \sqrt{12^2 + 20^2} = \sqrt{544} = 4\sqrt{34}$ =23.32..) $LR = \sqrt{12^2 + (RQ)^2}$ = $\sqrt{12^2 + (10\sqrt{3})^2} = \sqrt{444} = 2\sqrt{111} = 21.07..$			M2	For a correct method to calculate *PQ*(*ML*) & *MR* or *MR* & *LR* or *PQ*(*ML*) & *LR* (NB: *LR* requires use of *RQ* = $\sqrt{20^2 - 10^2}$ *or* $20\cos 30 = \sqrt{300} = 10\sqrt{3} = 17.32..$) Or M1 for a correct method to calculate one of the sides *PQ* or *MR* or *LR*
		$\sin MRL = \frac{10}{4\sqrt{34}}$ $\left(\frac{ML}{MR}\right)$ or $\cos MRL = \frac{2\sqrt{111}}{4\sqrt{34}}$ $\left(\frac{LR}{MR}\right)$ or $\tan MRL = \frac{10}{2\sqrt{111}}$ $\left(\frac{ML}{LR}\right)$			M1	(Dep on M2) Use of a correct trig ratio to find angle *MRL*
			25.4		A1	25.38 - 25.5
						Total 5 marks

18	a		5 and 6 in the correct regions of the Venn diagram	2	B2	Both correct, B1 for one correct
	bi ii		25 12	2	B1 B1	Correct or ft from their Venn Diagram dep on both values entered Correct or ft dep on a value for "5" in Venn diagram
						Total 4 marks

19	a	$\vec{BC} = -4\mathbf{a} + 2\mathbf{b} + 8\mathbf{a}$ **(=**$4\mathbf{a} + 2\mathbf{b}$**)**	$2\mathbf{a} + \mathbf{b}$	2	M1 A1	A correct method to find $\vec{BC}$ in terms of **a** and **b**
	b	$\vec{AM} = 4\mathbf{a} +$ '$2\mathbf{a} + \mathbf{b}$**'** (=$6\mathbf{a} + \mathbf{b}$) and $\vec{AN} = 2\mathbf{b} + 8\mathbf{a} + 4\mathbf{a}$ (=$12\mathbf{a} + 2\mathbf{b}$) **or** $\vec{AM} = 4\mathbf{a} +$ '$2\mathbf{a} + \mathbf{b}$**'** (=$6\mathbf{a} + \mathbf{b}$) and $\vec{MN} =$ '$\mathbf{b} + 2\mathbf{a}$**'** $+ 4\mathbf{a}$ (=$6\mathbf{a} + \mathbf{b}$) **or** $\vec{AN} = 2\mathbf{b} + 8\mathbf{a} + 4\mathbf{a}$ (=$12\mathbf{a} + 2\mathbf{b}$) and $\vec{MN} =$ '$\mathbf{b} + 2\mathbf{a}$**'** $+ 4\mathbf{a}$ (=$6\mathbf{a} + \mathbf{b}$) **oe**	Show	2	M1ft A1	Correct vectors for $\overrightarrow{AM}$ and $\overrightarrow{AN}$ or for $\overrightarrow{AM}$ and $\overrightarrow{MN}$ or for $\overrightarrow{AN}$ and $\overrightarrow{MN}$ (need not be simplified) ft their $\overrightarrow{BM}$ from (a) For $\overrightarrow{AN} = 2\overrightarrow{AM}$ or $\overrightarrow{AM} = \overrightarrow{MN}$ or $\overrightarrow{AN} = 2\overrightarrow{MN}$ oe **and** there is a common point. oe
						Total 4 marks

20		$x^2+4=x+10$		6	M1	Equations equal to each other
		$x^2-x-6(=0)$			M1	for reduction to 3 term quadratic
		$(x-3)(x+2)(=0)$			M1	Factorisation or correct use of quadratic formula
		$x=3, x=-2$			A1	Correct values for x dep on M2
		$x=3, y=13, x=-2, y=8$			M1	(y=)10 + 3 and (y=)10 − 2 or (y mid=) 10 + 0.5 dep on previous A1 awarded
			(0.5, 10.5)		A1	dep on previous A1 awarded
		or				**or**
		$x^2+4=x+10$		6	M1	Equations equal to each other
		$x^2-x-6(=0)$			M1	for reduction to 3 term quadratic
		Sum of roots = 1 so midpoint has x coordinate 0.5			M1	for Sum of roots = 1 and midpoint has x - coordinate = sum of roots ÷2
					A1	0.5 dep on M2
					M1	0.5 + 10 dep on previous A1 awarded
			(0.5, 10.5)		A1	10.5 dep on previous A1 awarded
		or				
		$y=(y-10)^2+4$		6	M1	Correct substitution of y – 10 for x
		$y^2-21y+104(=0)$			M1	for reduction to 3 term quadratic
		$(y-8)(y-13)(=0)$			M1	Factorisation or correct use of quadratic formula
		$y=8, y=13$			A1	Correct values for y dep on M2
		$x=3, y=13, x=-2, y=8$			M1	(x=)13 – 10 and (x=)8 – 10 or (x mid)=10.5 – 10 dep on previous A1 awarded
			(0.5, 10.5)		A1	dep on previous A1 awarded
						Total 6 marks

21		$\sqrt{t} = \frac{x}{2a}$ or $x^2 = (2a\sqrt{t})^2$ or $x^4 = (2a\sqrt{t})^4$ oe		4	M1	Correct rearrangement for $\sqrt{t}$ or correct expression for x^2 or x^4
		$t = \left(\frac{x}{2a}\right)^2$ oe or $t^2 = \frac{x^4}{16a^4}$ oe			M1	Correct expressions for t or t^2 or for at^2 or $2at$ in terms of x and a
		$y = a\left[\left(\frac{x}{2a}\right)^2\right]^2 - 2a\left(\frac{x}{2a}\right)^2$ oe			M1	For correct substitution of t and t^2 into expression for y
			$y = \frac{x^4}{16a^3} - \frac{x^2}{2a}$		A1	Fully correct answer in required form
						Total 4 marks

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