



Mark Scheme (Results)

Summer 2015

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
 - eeo – each error or omission
 - awrt – answer which rounds to

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If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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

Apart from Questions and 15d and 19b, where the mark scheme states otherwise, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Question	Working	Answer	Mark	Notes
1 (i)		{i, a}	2	B1 Brackets and commas not needed.
		(ii)		{c, h, i, n, a, t, l, y}
				Total 2 marks

2	$\frac{638}{2.75}$ or $\frac{638}{2\frac{3}{4}}$ or $\frac{638}{11\frac{1}{4}}$ or $\frac{638}{11} \times 4$ or $\frac{638}{165} \times 60$ oe	232	3	M2 M1 for $638 \div 2.45$ or 260(.408...) rounded or truncated to 3 or more significant figures or $638 \div 165$ or 3.86(6666...) rounded or truncated to 3 or more significant figures.
				A1 cao
				Total 3 marks

3 (a)	Eg $\frac{7\frac{1}{2}}{100} \times 15000$ or 0.075×15000 oe or 1125 or $0.075 \times 15000 + 15000$ or 15000×1.075 oe	16125	2	M1 For finding 7.5% of 15000 or for a complete method to increase 15000 by 7.5% (eg 1.075×15000) A1 cao
(b)	Eg $\frac{1800}{8} \times 108$ or $\frac{1800}{0.08} \times 1.08$ or 22500×1.08 or $\frac{1800}{0.08} + 1800$ or $\frac{1800}{8} \times 100 + 1800$ or $225 \times 100 + 1800$ or $22500 + 1800$	24300	3	M2 For a complete method M1 for 8% = 1800 or $0.08x = 1800$ or $\frac{1800}{8}$ or 225 or $\frac{1800}{0.08}$ or 22500 or A1 $\frac{x}{1800} = \frac{108}{8}$ oe
Total 5 marks				

<p>4 (a)</p>	<p>$(-2, -4), (-1, -1), (0, 2), (1, 5), (2, 8), (3, 11)$</p>	<p>correct line drawn from between $x = -2$ and $x = 3$</p>	<p>3</p>	<p>B3 For a correct line between $x = -2$ and $x = 3$.</p> <p>B2 If not B3, then B2 for:</p> <ul style="list-style-type: none"> • at least 2 correct points plotted or • for a line passing through at least 2 correct points or • for a line drawn with positive gradient through $(0, 2)$ and clear intention to use a gradient of 3 (eg. a line through $(0, 2)$ and $(0.5, 5)$) <p>B1 If not B2 then B1 for:</p> <ul style="list-style-type: none"> • at least 2 correct points stated (may be in a table) or • for a line drawn with a positive gradient through $(0, 2)$ or • for a line with gradient 3.
<p>(b)</p>				<p>M1 fit for a point marked above their $y = 3x + 2$ if at least B1 scored in (a) or for a point to the right of $x = 2$</p>

		correct point		A1	Point marked above $y = 3x + 2$ and to the right of $x = 2$ (not on lines). Label P may be omitted if unambiguous. SCB1 for the correct region identified by either shading in or shading out.
			2		
					Total 5 marks

5	(a)	$\frac{4+9+7+1+6+3}{2}$ or $\frac{(4+9+7+1+6+3)+1}{2}$ or $\frac{30}{2}$ or $\frac{31}{2}$ or 15 or $15\frac{1}{2}$			M1	Condone 1 omission Eg $\frac{9+7+1+6+3}{2}$ Accept a clear intention to list the numbers in order and find the centre of the list.
			2	2	A1	
	(b)	$\frac{4+9+7+1+6+3}{4}$ or $\frac{(4+9+7+1+6+3)+1}{4}$ or $\frac{30}{4}$ oe (=7.5) or $\frac{31}{4}$ oe (= 7.75) or 8 or $3 \times \frac{30}{4}$ oe (= 22.5) or $3 \times \frac{31}{4}$ oe (= 23.25) or 23			M2	For Lower quartile = 1 AND Upper quartile = 4 Accept a correct ordered list of the 30 numbers with both quartiles clearly identified in the correct position. M1 for Lower quartile = 1 or Upper quartile = 4 or Accept a correct ordered list of the 30 numbers with the position of one of the quartiles clearly identified in the correct position.
			3	3	A1	
					Total 5 marks	

6	(a)	$1 - 0.44 - 0.42 - 0.04$ or $1 - 0.9$	0.1 oe	2	M1 A1 Accept $\frac{1}{10}$ oe or 10 %
	(b)		0.86 oe	1	B1 Accept $\frac{86}{100}$ or $\frac{43}{50}$ oe or 86 %
	(c)	1200×0.04	48	2	M1 A1 Accept 48 out of 1200 Note: M1A0 for 48/1200
					Total 5 marks

7.		$180 + 43$ or $360 - (180 - 43)$ or $360 - 137$	223	2	M1 For a complete method. A1
					Total 2 marks

8 (a)	Eg $\frac{175}{7} \times 9$	225	2	M1 For a complete method A1
(b)	$\frac{400}{27+14+9} \times 27$ oe or $\frac{400}{27+14+9}$ or $\frac{400}{50}$ or 8	216	2	M1 A1
(c)	<p>$(9 : 7 =) 27 : 21$ or $9 : \frac{14}{3}$</p> <p>Or Flaky: (flour x), fat $\frac{7}{9}x$ and Sweet: (flour x), fat $\frac{14}{27}x$</p> <p>where x may also be any positive value</p>	3 : 2 oe	2	<p>M1 For $\frac{7}{9}x$ and $\frac{14}{27}x$ where x may also be any positive value Eg $\frac{7}{9}$ and $\frac{14}{27}$ Eg $\frac{7}{9} \times 270$ and $\frac{14}{27} \times 270$ ($x = 270$) or For $\frac{14}{27} \times \frac{9}{7}$ oe</p> <p>A1 Eg $\frac{7}{9} : \frac{14}{27}$ or $21 : 14$ or $189 : 126$ or $1 : \frac{2}{3}$ or $1.5 : 1$ ISW only if answer is incorrectly simplified SCB1 for answer of 2:3 oe</p>
Total 6 marks				

9.	(a)		$10p - 15$	1	B1	Accept $10 \times p - 15$
	(b)	$9 - 3 < 2x$ or $6 < 2x$ or $-2x < 3 - 9$ or $-2x < -6$	$x > 3$	2	M1	Allow equals sign (Eg $6 = 2x$) or condone incorrect inequality sign (eg $6 > 2x$)
	(c)	$6 = (-2)^3 - k(-2) + 5$ or $6 = -8 + 2k + 5$ Eg $6 + 8 - 5 = 2k$ or $-2k = -8 + 5 - 6$ or $9 = 2k$ or $-9 = -2k$ or $k = \frac{(-2)^3 - 6 + 5}{-2}$ or $-k = \frac{6 - (-2)^3 - 5}{-2}$ or $-k = -4.5$	4.5	3	M1	For correct substitution Allow omission of brackets.
	(d)	$1 = 3(f + 2)$ or $1 = 3f + 6$ or $\frac{1}{3} = f + 2$	$-1\frac{2}{3}$ oe	2	M1	For correctly isolating $2k$ or $-2k$ or k or $-k$ in a correct equation.
					A1	Accept $4\frac{1}{2}, \frac{9}{2}$
					A1	Accept $-1.66(666\dots)$ correctly rounded or truncated to at least 3 significant figures.
						Total 8 marks

10.	$\cos 56^\circ = \frac{7.4}{x}$ or $7.4 = x \cos 56$ or $\sin(90 - 56) = \frac{7.4}{x}$ or $7.4 = x \sin(90 - 56)$ $(x =) \frac{7.4}{\cos 56}$ or $\frac{7.4}{\sin(90 - 56)}$	13.2	3	M1	Correct equation for x^2 eg $x^2 = 7.4^2 + (7.4 \tan 56^\circ)^2$	Correct statement of Sine rule eg $\frac{x}{\sin 90} = \frac{7.4}{\sin(90 - 56)}$
				M1	Correct expression for x eg $x = \sqrt{7.4^2 + (7.4 \tan 56^\circ)^2}$	Correct expression for x eg $(x) = \frac{7.4}{\sin(90 - 56)} \times \sin(90)$
				A1	awrt 13.2	
Total 3 marks						

11.	$2\pi \times 3.5 \times 8.2 + 2\pi \times 3.5^2$ or $57.4\pi + 24.5\pi$ or 81.9π or $180(.327..) + 76.9(690...)$ or $2\pi \times 3.5 \times 8.2 + \pi \times 3.5^2$ or $180(.327..) + 38.4(845...)$ or $218(.81...)$			257	3	M2	Allow 76.9(690...), 180(.327...), 38.4(845...) and 218(.81...) if rounded or truncated to at least 3 significant figures. M1 for $2 \times \pi \times 3.5 \times 8.2$ or 57.4π or $180(.3274...)$ or $2 \times \pi \times 3.5^2$ or 24.5π or 77 or 76.9(690...)
						A1	awrt 257
Total 3 marks							

12.	(Gradient =) $-\frac{3}{5}$ or ($m =$) $-\frac{3}{5}$	$y = -\frac{3}{5}x + 3$ oe	3	<p>M1 Allow (gradient or m) = $\frac{3}{5}$ or $(y =) -\frac{3}{5}x + c$ (c may be a number)</p> <p>M1 Indep $(y =) mx + 3$ (m may be a number except 0) Allow y intercept or $c = 3$ stated</p> <p>A1 oe Eg Accept $5y + 3x = 15$ or $y - 3 = -\frac{3}{5}(x - 0)$ or $y - 0 = -\frac{3}{5}(x - 5)$</p> <p>SC B2 for $-\frac{3}{5}x + 3$ or $L = -\frac{3}{5}x + 3$</p>
Total 3 marks				

<p>13. (a)</p>	<p>Eg. $\frac{12}{12+8}$ or $\frac{3}{5}$ or 0.6 or $\frac{12+8}{12}$ or $\frac{5}{3}$ or 1.66(66...) or</p> $\frac{MN}{13.5} = \frac{12}{12+8} \text{ oe or } (MN =) \frac{12}{12+8} \times 13.5 \text{ oe}$	<p>8.1</p>	<p>2</p>	<p>M1 for correct scale factor or correct equation involving MN or correct expression for MN</p> <p>Allow use of 1.66(66...) in place of $\frac{5}{3}$ if rounded or truncated to at least 3 significant figures</p> <p>A1 oe</p>
<p>(b)</p>	<p>Eg $\frac{PQ}{9} = \frac{12+8}{12}$ oe or $\frac{PQ}{9} = \frac{13.5}{\text{"8.1"}}$ or $PQ = 9 \times \frac{12+8}{12}$ oe or</p> $PQ = 9 \times \frac{13.5}{\text{"8.1"}}$ oe or $PQ = 15$ <p>or $\frac{LQ}{9} = \frac{8}{12}$ oe or $(LQ =) 9 \times \frac{8}{12}$ oe</p>	<p>6</p>	<p>2</p>	<p>M1 Correct expression for PQ or LQ (eg $9 \times \frac{5}{3}$ oe or $9 \times \frac{2}{3}$ oe)</p> <p>Correct equation involving PQ or LQ (eg $\frac{PQ}{9} = \frac{5}{3}$ oe or $\frac{LQ}{9} = \frac{2}{3}$ oe)</p> <p>Allow use of 1.66(66...) in place of $\frac{5}{3}$ or 0.666(66...) in place of $\frac{2}{3}$ if rounded or truncated to at least 3 significant figures</p> <p>A1</p>
<p>(c)</p>		<p>$\frac{25}{9}$ oe</p>	<p>1</p>	<p>B1</p> <p>Accept $2\frac{7}{9}$</p> <p>Accept 2.77(777...) rounded or truncated to at least 3 significant figures</p> <p>Also accept $\left(\frac{20}{12}\right)^2$ or $\left(\frac{5}{3}\right)^2$</p>

(d)	<p>Eg $\left(\frac{25}{9}\right)A - A = 105.6$ or $A\left(\left(\frac{25}{9}\right) - 1\right) = 105.6$ or $A\left(\left(\frac{16}{9}\right)\right) = 105.6$ or $\left(\frac{25}{9}\right)A = 105.6 + A$ or</p> $\frac{105.6+A}{\left(\frac{25}{9}\right)} = A$ <p>$(A =) \frac{105.6}{\frac{25}{9}-1}$ or $(A =) \frac{105.6}{1.77\dots}$ or $(A =) \frac{105.6 \times 9}{16}$</p>	59.4	3	<p>M1 For a correct equation involving A ft from part (c)</p> <p>M1 For correct expression for A. Decimal values should be rounded or truncated correct to at least 3SF</p> <p>A1 oe</p>
Total 8 marks				

14. (a)	$V = \frac{k}{t^2}$ $28 = \frac{k}{2.5^2} \text{ oe or}$ $k = 28 \times 2.5^2 \text{ or}$ $k = 175$	$V = \frac{175}{t^2}$	3	<p>M1 Allow $Vt^2 = k$ or $t^2 = \frac{k}{V}$ Do not allow $V = \frac{1}{t^2}$</p> <p>M1 For correct substitution in a correct equation Implies first M1 Award M2 if $k = 175$ stated unambiguously in (a) or (b)</p> <p>A1 Only award if V is the subject. Award M2A1 if $V = \frac{k}{t^2}$ on answer line and k evaluated as 175 in part (a) or part (b)</p>
(b)	$V = \frac{"175"}{6.25^2}$	4.48	2	<p>M1 ft for k if $k > 1$</p> <p>A1</p>
				Total 5 marks

15.	(a)		1, 5, 21	1	B1
	(b)		correct curve	1	B1 Correct curve through (1,3), (2, 1), (3, 5), and (4, 21).
	(c)		-1.1	1	B1 Accept $-1.15 \leq x \leq -1.05$
	(d)	$y = 1 - 2x$ drawn			M2 Line must be long enough to cross curve and verify accuracy. M1 for $x^3 - 3x^2 + 5 = -2x + 1$ or $y = -2x + 1$ oe
			-0.8	3	A1 dep on M2 Accept $-0.9 \leq x \leq -0.7$
					Total 6 marks

16.		$4\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^3 + 6\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^2 + 4\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right) + \left(\frac{1}{6}\right)^4$ or $\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right) \times \left(\frac{1}{6}\right) + \left(\frac{5}{6}\right) \times \left(\frac{5}{6}\right) \times \left(\frac{1}{6}\right) + \left(\frac{5}{6}\right) \times \left(\frac{5}{6}\right) \times \left(\frac{5}{6}\right) \times \left(\frac{1}{6}\right)$ or $1 - \left(\frac{5}{6}\right)^4$			M2
					Accept use of 0.16(666..) in place of $\frac{1}{6}$ and 0.83(3333...) in place of $\frac{5}{6}$ rounded or truncated to at least 2 decimal places.
					M1 for $\left(\frac{1}{6}\right) \times \left(\frac{5}{6}\right)^3$ or $\left(\frac{1}{6}\right)^2 \times \left(\frac{5}{6}\right)^2$ or $\left(\frac{1}{6}\right)^3 \times \left(\frac{5}{6}\right)$ or $\left(\frac{1}{6}\right)^4$ or $P(\text{no sixes}) = \left(\frac{5}{6}\right)^4$
			$\frac{671}{1296}$	3	A1 Accept awrt 0.518
					Total 3 marks

17.	(a)		21	1	B1
	(b)		62	1	B1
	(c)	$\angle KJL = 37^\circ$ or $\angle PJM = 60^\circ$ or $\angle LKM = 60^\circ$ or $\angle LMP = 37^\circ$ or $\angle MPJ = 58^\circ$ or $MPL = 122^\circ$ or $JPK = 122^\circ$			M2 If not M2 then M1 for: $\angle GJL = 81^\circ$ or $\angle GMJ = 81^\circ$ or $JKL = 81^\circ$ or $JML = 99^\circ$ Angles may be marked on the diagram or labelled in the working.
			58	3	A1
					Total 5 marks

18.	$\frac{90}{0.6}$ or 150 or $\frac{120}{0.4}$ or 300 or $\frac{95}{0.5}$ or 190 or $\frac{45}{1.5}$ or 30 Frequency density = 150, 300, 190, 30 heights 3, 6, 3.8, 0.6 cm				M1 For one correct bar drawn or one correct frequency density, not including $0 \leq w \leq 1$ or 1 small square = 1 or 1 large (cm) square = 25 M1 For three correct bars drawn or three frequency densities, not including $0 \leq w \leq 1$ A1 All bars correct.
		correct bars		3	
					Total 3 marks

19.	(a) (i)		-3	1	B1
	(a) (ii)		0	1	B1
	(a)(iii)		$\frac{3}{2}$	1	B1 1.5, $1\frac{1}{2}$
	(b)	<p>Eg $\sqrt{245} = \sqrt{49} \times \sqrt{5}$ or $\sqrt{245} = \sqrt{49 \times 5}$ or</p> $\frac{14}{\sqrt{49 \times 5}} \text{ or } \frac{14}{\sqrt{49} \times \sqrt{5}}$ $\frac{14}{\sqrt{245}} \times \frac{\sqrt{245}}{\sqrt{245}} \text{ or } \frac{14\sqrt{245}}{245} \text{ or } \frac{14 \times 7\sqrt{5}}{245}$ <p>Note:</p> <p>To rationalise $\frac{14}{\sqrt{245}}$ accept $\frac{14}{\sqrt{245}} \times \frac{\sqrt{245}}{\sqrt{245}}$ or $\frac{14\sqrt{245}}{245}$</p> <p>To rationalise $\frac{2}{\sqrt{5}}$ or $\frac{14}{7\sqrt{5}}$, etc, only accept</p> $\frac{2}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} \text{ or } \frac{14}{7\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} \text{ etc.}$	$\frac{2\sqrt{5}}{5}$	2	<p>M1 For simplifying $\sqrt{245}$ or for rationalising the denominator.</p> <p>A1 For simplifying $\sqrt{245}$ and for rationalising the denominator. NB: The solution must be fully correct (cso)</p> <p>NB: Do not accept $\frac{2}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$ as sufficient method for rationalising the denominator.</p>
	(c)	$e^2 - 2e\sqrt{3} - 2e\sqrt{3} + (2\sqrt{3})^2 \text{ or}$ $e^2 - 4e\sqrt{3} + 12$	$e = 5$ $f = 37$	3	<p>M1 Expand brackets with 3 correct terms with correct signs Eg $e^2 - 4e\sqrt{3}$ or $e^2 - 2e\sqrt{3} - 2e\sqrt{3}$ or $e^2 - 2e\sqrt{3} + 12$, etc or all 4 correct terms with signs missing eg $e^2, 4e\sqrt{3}, 12$ or $e^2, 2e\sqrt{3}, 2e\sqrt{3}, 12$</p> <p>A1 cao</p> <p>A1 cao</p>
					Total 8 marks

<p>20.</p>	<p> $(AC^2 =) 8^2 + 8^2 - 2 \times 8 \times 8 \cos 120^\circ$ or $(AC^2 =) 192$ oe or $\frac{AC}{\sin 120^\circ} = \frac{8}{\sin 30^\circ}$ oe or $8 \cos(30^\circ)$ or $8 \sin(60^\circ)$ or $4\sqrt{3}$ or $6.92(820\dots)$ oe $(AC =) 2 \times 8 \sin(60^\circ)$ oe or $(AC =) 2 \times 8 \cos(30^\circ)$ oe or $(AC =) \frac{8}{\sin 30^\circ} \times \sin 120^\circ$ oe or $(AC =) \sqrt{8^2 + 8^2 - 2 \times 8 \times 8 \cos 120^\circ}$ or $\sqrt{128 + 64}$ or $\sqrt{192}$ or $8\sqrt{3}$ or $13.8(56\dots)$ oe $(\text{arc } ABC) = \frac{120}{360} \times 2\pi \times 8$ or $(\text{arc } ABC) = \frac{120}{360} \times \pi \times 16$ or $(\text{arc } ABC) = \frac{2\pi \times 8}{3}$ or $\frac{\pi \times 16}{3}$ oe or $16.7(55\dots)$ “13.8(56...)” + “16.7(55...)” </p>	<p>30.6</p>	<p>5</p>	<p>M1 M1 M1 A1</p>	<p> Allow 6.92(820...) rounded or truncated to at least 3 significant figures. Allow 13.8(5640646) rounded or truncated to at least 3 significant figures. Implies first M1 For attempting to find the length of arc ABC Allow 16.7(5516082) rounded or truncated to at least 3 significant figures. dep on first and third method marks Accept 30.6 - 30.7 inclusive </p>
Total 5 marks					

21. (a)	$(-)\frac{16}{x} = (-)16x^{-1}$	$2x + \frac{16}{x^2}$	3	<p>M1 For $16x^{-1}$ or $-16x^{-1}$</p> <p>M1 For $\pm 16x^{-2}$ or $\pm \frac{16}{x^2}$ or $2x$</p> <p>A1 Allow $2x + 16x^{-2}$ M2A0 for an incorrect answer that includes $16x^{-2}$</p>
(b)	$2x + \frac{16}{x^2} = 0$ $2x^3 = -16 \text{ or } x^3 = -8$ $x = -2$	$(-2, 12)$	4	<p>M1 ft from (a) Do not accept $x^2 - 16x^{-1} = 0$ oe</p> <p>M1 For a correct equation in x^3 NB: No ft allowed</p> <p>A1 For $x = -2$ Accept as part of an incorrect coordinate, eg $(-2, 10)$</p> <p>A1 Accept $x = -2, y = 12$</p>
				Total 7 marks

