



Mark Scheme (Results)

January 2023

Pearson Edexcel International GCSE
In Mathematics A (4MA1) Paper 2H

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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
- awrt – answer which rounds to
- 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.

If a candidate misreads a number from the question. Eg. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review. If there is a choice of methods shown, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.

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.

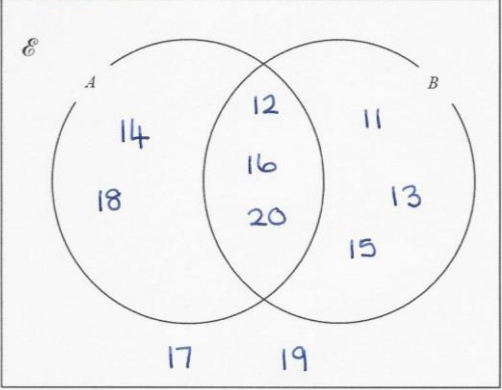
It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

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 to another.

Question	Working	Answer	Mark	Notes	
2	$90 \times 1000 (=90\ 000)$ or $\frac{90}{60 \times 60} (= 0.025 \text{ or } \frac{1}{40})$ or $\frac{1000}{60 \times 60} (= \frac{5}{18} = 0.277\dots)$ or sight of 1500		3	M1 For one of $\times 1000$ (eg sight of 90 000) or $(\div 60 \div 60)$ or $\div 3600$ oe ie correct conversion of distance units or of time units	M2 for $90 \div 3.6$ or $90 \times \frac{5}{18}$
	$\frac{90 \times 1000}{60 \times 60}$ oe eg $(1.5 \times 1000) \div 60$			M1 For a fully correct method with correct use of brackets eg $90\ 000 \div 60 \times 60$ is M1 only if not recovered	
	Working required	25		A1 dep on M1	
				Total 3 marks	

Question	Working	Answer	Mark	Notes
3			3	B3 Fully correct (B2 for 2 or 3 'regions' correct, B1 for one 'region' correct)
				Total 3 marks

Question	Working	Answer	Mark	Notes
4	eg $5x - 1 = 3x + 7.4$ oe or eg $10x - 2 + 48$ or $6x + 14.8 + 48$ or $24 + 24 + 5x - 1 + 3x + 7.4$ oe		4	M1 a correct equation to find x or a correct expression for the perimeter in terms of x
	$x = 4.2$			A1 the correct value of x (implies previous mark)
	$2 \times 24 + 2(5 \times "4.2" - 1)$ oe or $2 \times 24 + 2(3 \times "4.2" + 7.4)$ oe or $2 \times 24 + (5 \times 4.2 - 1) + (3 \times 4.2 + 7.4)$ oe eg $24 + 24 + 20 + 20$ oe			M1dep on a correct method to find the perimeter – use of positive x from correct working (1 st M1 awarded for an equation) and only if used the same measurement for AD and BC
	<i>working required</i>	88		A1 cao dep on either M1 or $x = 4.2$
				Total 4 marks

Question	Working	Answer	Mark	Notes
5 (a)		2.745	1	B1
(b)		2.755	1	B1 allow 2.7549
(c)	$(80 \times 60) \div 2^2$		2	M1 For two of 80, 60, 2 or 4 rather than 2^2 oe
	eg $(80 \times 60) \div 2^2 = 1200$ oe <i>working with rounded values seen required</i>	1200		A1 dep on M1 for answer coming from use of the 3 rounded numbers – if 1200 seen then ignore any other working and comments
				Total 4 marks

Question	Working	Answer	Mark	Notes
6	$[k =] \frac{6+17}{2} \text{ or } [k =] 6 + \frac{17-6}{2} \text{ oe or }$ $[j =] 4 + 2(15-4) \text{ or } [j =] 15 + (15-4) \text{ or } \frac{4+j}{2} = 15 \text{ oe}$		3	M1
	<i>Correct answers score full marks (unless from obvious incorrect working)</i> <i>1 correct answer will score M1A1 and both will score M1A1A1</i>	26		A1
		11.5		A1 oe eg $\frac{23}{2}$ both answers the wrong way round scores M1A1 unless the correct answers are clearly labelled in working space
				Total 3 marks

Question	Working		Answer	Mark	Notes
7	eg $5x + 4y = -2$ $+ 8x - 4y = 17.6$ $(13x = 15.6)$ eg $[x = \frac{4.4 + y}{2}]$ oe $5\left(\frac{4.4 + y}{2}\right) + 4y = -2$ oe	eg $10x + 8y = -4$ $- 10x - 5y = 22$ $(13y = -26)$ eg $[y = 2x - 4.4]$ oe $5x + 4(2x - 4.4) = -2$ oe		3	M1 multiplication of one or both equation(s) with correct operation selected (allow one arithmetic error) (if + or – is not shown then assume it is the operation that at least 2 of the 3 terms have been calculated for) or correct rearrangement of one equation with substitution into second
	eg $5 \times "1.2" + 4y = -2$ or $2 \times "1.2" - y = 4.4$	eg $5x + 2 \times "-2" = 4.4$ or $2x - "-2" = 4.4$			M1 (dep on previous M1 but not on a correct first value) correct method to find second unknown – this could be a correct substitution into one of the equations given or calculated or starting again with the same style of working as for the first method mark
	<i>Working required</i>		$x = 1.2$ $y = -2$		A1 oe eg $x = \frac{6}{5}$ for both solutions dependent on first M1
					Total 3 marks

Question	Working		Answer	Mark	Notes	
8	$\frac{2.9}{100} \times 5000 (= 145)$ oe or $1.029 \times 5000 (= 5145)$ oe or $1.029^2 \times 5000 (= 5294....)$ oe or $0.058 \times 5000 (= 290)$ oe or $1.058 \times 5000 (= 5290)$				M1 Bank H	
	5000×0.016 oe (= 80) oe or 5000×1.016 oe (= 5080) oe or $5000 \times 0.032 (= 160)$ oe or $5000 \times 1.032 (= 5160)$ oe	M2 for 5000×1.016^2 (= 5161.28)		4	M1 Bank G	
	$(80 + 5000) \times 0.016 (= 81.28)$ oe or $5080 \times 1.016 (= 5161.28)$ oe				M1 Bank G	
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>		16.28		A1	
					Total 4 marks	

Question	Working	Answer	Mark	Notes
9 (a)		1	1	B1
(b)		$27a^6b^{12}$	2	B2 (B1 for 2 of 3 parts in a product)
(c)		$7x^2y^2(2y^2 + 3x)$	2	B2 B1 for a correct factorisation with at least 2 factors outside (eg $7x$, x^2 , xy , etc) eg $7x(2xy^4 + 3x^2y^2)$ eg $x^2y^2(14y^2 + 21x)$ or for the correct common factor with just one mistake inside the bracket eg $7x^2y^2(2y + 3x)$ which is missing the squared on the y term
(d)	$y = mx + 4$ where $m \neq 0$ oe (eg $y = 2x + 4$) or $y = -2x + c$ or $y + 2x = c$ oe or $-2x + 4$ or $f(x) = -2x + 4$ oe		2	M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$y = -2x + 4$		A1 oe eg $y + 2x = 4$
				Total 7 marks

Question	Working	Answer	Mark	Notes	
10	$(54 - 24) \div 2 (=15)$ [may be marked on diagram]		5	M1	
	$"15" - (24 \div 2)^2 (= 81)$			M1	ft their "15" (if > 12)
	[height =] $\sqrt{"15" - (24 \div 2)^2} (= 9)$			M1	ft their "15" (if > 12)
	$(24 \times "9") \div 2$ oe			M1	figures must be from correct working
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	108		A1	allow 107.9 – 108.1
	ALTERNATIVES BELOW			Total 5 marks	
10	$(54 - 24) \div 2 (=15)$ [may be marked on diagram]		5	M1	
	<p>or $x = \cos^{-1}\left(\frac{"12"}{"15"}\right) (= 36.86\dots)$</p> <p>or $y = \sin^{-1}\left(\frac{24 \div 2}{"15"}\right) (= 53.13\dots)$</p> <p>or $A = \cos^{-1}\left(\frac{15^2 + 15^2 - 24^2}{2 \times 15 \times 15}\right) (= 106.2\dots)$</p> <p>or $B = \cos^{-1}\left(\frac{15^2 + 24^2 - 15^2}{2 \times 15 \times 24}\right) (= 36.8\dots)$</p>			M1	ft their "15" (if > 12)
	<p>or "12"tan"36.86..." (= 9) (allow 8.9... for these)</p> <p>"12" ÷ tan"53.13..." (= 9)</p> <p>or "15" × sin "36.86..." (= 9)</p> <p>or "15" × cos "53.13..." (= 9)</p>			M1	ft their "15" (if > 12)
	$(24 \times "9") \div 2$ oe			M1	
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	108		A1	allow 107.9 – 108.1
				Total 5 marks	

Question	Working	Answer	Mark	Notes
11		B	3	B1
		A		B1
		F		B1
				Total 3 marks

Question	Working	Answer	Mark	Notes																
12 (a)		43.5 - 44.5	1	B1 ±0.5 small square																
(b)	eg reading of 48 - 49		2	M1 For correct method to start the question eg a vertical line from 55 up to the line and a horizontal line from the correct point on the curve or a mark on the curve at the correct point and a mark on the vertical axis at the correct point or a correct reading of 48 to 49																
	Correct answer scores full marks (unless from obvious incorrect working)	11 or 12		A1 Allow an answer of 11 or 12 (ie must be whole number)																
(c)	<table><tr><th>Time taken to shop in the market (m minutes)</th><th>Frequency</th></tr><tr><td>$0 < m \leq 10$</td><td>3</td></tr><tr><td>$10 < m \leq 20$</td><td>5</td></tr><tr><td>$20 < m \leq 30$</td><td>7</td></tr><tr><td>$30 < m \leq 40$</td><td>10</td></tr><tr><td>$40 < m \leq 50$</td><td>15</td></tr><tr><td>$50 < m \leq 60$</td><td>15</td></tr><tr><td>$60 < m \leq 70$</td><td>5</td></tr></table>	Time taken to shop in the market (m minutes)	Frequency	$0 < m \leq 10$	3	$10 < m \leq 20$	5	$20 < m \leq 30$	7	$30 < m \leq 40$	10	$40 < m \leq 50$	15	$50 < m \leq 60$	15	$60 < m \leq 70$	5		2	B2 All values correctly filled in (NB: first 2 are already completed) (B1 for 3 or 4 correct values from 7, 10, 15, 15, 5)
Time taken to shop in the market (m minutes)	Frequency																			
$0 < m \leq 10$	3																			
$10 < m \leq 20$	5																			
$20 < m \leq 30$	7																			
$30 < m \leq 40$	10																			
$40 < m \leq 50$	15																			
$50 < m \leq 60$	15																			
$60 < m \leq 70$	5																			
				Total 5 marks																

Question	Working	Answer	Mark	Notes
13	eg $20 \times \frac{x+3}{4} - 20 \times \frac{7-x}{5} = 20 \times 4.3$ or eg $5(x+3) - 4(7-x) = 20 \times 4.3$ or eg $\frac{5(x+3)}{20} - \frac{4(7-x)}{20} (= 4.3)$ or eg $\frac{5(x+3) - 4(7-x)}{20} (= 4.3)$		3	M1 For clear intention to multiply all terms by 20 (or 4×5) or a multiple of 20 oe or to express LHS as two fractions over 20 (or 4×5) or a multiple of 20 oe or as a single fraction with a denominator of 20 (or 4×5) or a multiple of 20 oe if expanded numerator, allow one error
	eg $5x + 15 - 28 + 4x = 4.3 \times 20$ oe eg $9x - 13 = 86$ eg $9x = 99$			M1 Expanding brackets and multiplying by denominator with no more than one error in total from multiplying out brackets [we must see 4.3×20 or 86 accurately]
	<i>Working required</i>	11		A1 dep on M1
				Total 3 marks

Question	Working	Answer	Mark	Notes
14 (a)(i)		140	1	B1
(a)(ii)		<u>opposite angles</u> of a <u>cyclic quadrilateral</u> (add to 180°) oe	1	B1 dep on B1 in (a)(i) or seeing 180 – 40 with no contradiction oe eg <u>angle at centre</u> is <u>double (2 ×)</u> angle at <u>circumference</u> oe AND <u>angles around a point</u> (or <u>point 360</u>)
(b)	$ADB = 66$ or $ABO = 90 - 66 (=24)$ or $BAO = 90 - 66 (=24)$ or $ODB = \frac{180-80}{2} (=50)$ or $DOB \text{ reflex} = 280$		3	M1 Clearly labelled in working or shown on diagram
	For 2 of: $ADB = 66$ or $ABO = 90 - 66 (=24)$ or $BAO = 90 - 66 (=24)$ or $ODB = \frac{180-80}{2} (=50)$ $DOB \text{ reflex} = 280$			M1 (award M2 for $360 - (280 + 40 + 24)$ oe
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	16		A1
				Total 5 marks

Question	Working	Answer	Mark	Notes
15			3	M1 4 and 34 clearly indicated – either in list or in working (condone 26 also indicated in list)
				A1 For IQR for team A = $34 - 4 (= 30)$
		<p>The IQR for Team B was higher than the IQR for Team A oe</p> <p>or</p> <p>Team B had an interquartile range of “12” more than team A</p> <p>or</p> <p>The runs scored were more spread out for Team B than for Team A oe</p> <p>or</p> <p>The runs for Team A were more consistent oe</p>		<p>B1ft Must fit dep on IQR stated for team A</p> <p>Either comparing the IQR correctly or for giving a comparison in context about spread as long as not contradicted by further statements as this would be choice</p> <p><u>NOT</u></p> <p>Team B scored more runs than team A</p> <p>The average score of B is higher than the average score of A</p> <p>The IQR of A was 30 while the IQR of B was 42</p> <p>The range of B was more than the range of A</p>
				Total 3 marks

Question	Working	Answer	Mark	Notes
16	eg $1000x = 438.38\ldots$ $\underline{10x = 4.38\ldots}$ or $100x = 43.838\ldots$ $\underline{x = 0.438\ldots}$ oe		2	M1 For selecting 2 correct recurring decimals that when subtracted give a whole number or terminating decimal (43.4 or 434 etc) eg $1000x = 438.38\ldots$ and $10x = 4.38\ldots$ or $100x = 43.838\ldots$ and $x = 0.438\ldots$ with intention to subtract. (if recurring dots not shown then showing at least one of the numbers to at least 5sf) or $0.4 + 0.0\dot{3}\dot{8}$ and eg $1000x = 38.38\ldots$ & $10x = 0.3838\ldots$, with intention to subtract.
	eg $1000x - 10x = 438.38\ldots - 4.38\ldots = 434$ and $\frac{434}{990} = \frac{217}{495}$ or eg $100x - x = 43.838\ldots - 0.438\ldots = 43.4$ and $\frac{43.4}{99} = \frac{217}{495}$ or eg $1000x - 10x = 38.38\ldots - 0.3838 = 38$ and $0.4 + \frac{38}{990} = \frac{4 \times 99 + 38}{990} = \frac{434}{990} = \frac{217}{495}$ oe <i>working required</i>	Clearly shown		A1 For completion to $\frac{217}{495}$ dep on M1 and use of some algebra
				Total 2 marks

Question	Working	Answer	Mark	Notes
17 (a)		12	1	B1
(b)	$\frac{5-\sqrt{18}}{1-\sqrt{2}} \times \frac{1+\sqrt{2}}{1+\sqrt{2}}$ or $\frac{5-\sqrt{18}}{1-\sqrt{2}} \times \frac{-1-\sqrt{2}}{-1-\sqrt{2}}$ oe		3	M1 Multiplying numerator and denominator by $1+\sqrt{2}$
	$\frac{5-\sqrt{36}+5\sqrt{2}-\sqrt{18}}{1+\sqrt{2}-\sqrt{2}-2}$ or $\frac{5-6-3\sqrt{2}+5\sqrt{2}}{-1}$ or $\frac{-5+6+3\sqrt{2}-5\sqrt{2}}{1}$ oe NB:allow $\sqrt{18}$ or $3\sqrt{2}$ $\sqrt{36}$ or 6 or $\sqrt{6}\sqrt{6}$			M1 Showing correct expansions (not necessarily as a fraction)
	<i>working required</i>	$1-2\sqrt{2}$		A1 dep on M2 (ie all stages of working must be shown convincingly) or for stating $a = 1$ and $b = -2$
				Total 4 marks

Question	Working	Answer	Mark	Notes
	USE OVERLAY PROVIDED			
18 (a)	FD are: 6, 7, 5, 4, 1.8		3	M1 For at least two frequency densities correct or at least two correct bars
				M1 For at least 4 correct frequency densities or 4 correct bars
	<i>A fully correct histogram gains full marks</i>	Correct histogram		A1 Fully correct histogram SCB2 for all five bars of correct width with heights in the correct ratio (eg drawn at 0.6, 0.7, 0.5, 0.4, 0.18) SCB1 for three bars of correct width with heights in the correct ratio
(b)	$(9 + \frac{2}{3} \times 12) (= 17)$ oe eg $9 + 8 (= 17)$ or $55 - (12 + 7 + 15 + \frac{1}{3} \times 12)$		2	M1 may be seen as numerator of fraction (ft their graph dep on M1 in (a))
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{17}{55}$		A1cao Or 0.30909...or 30.909....% (to at least 2 sf) SCB1 for $\frac{38}{55}$ (0.6909...)
				Total 5 marks

Question	Working	Answer	Mark	Notes
19	eg $\sqrt{\frac{25}{64}} \left(= \frac{5}{8} = 0.625 \right)$ or $\sqrt{\frac{64}{25}} \left(= \frac{8}{5} = 1.6 \right)$ or $\sqrt{25}:\sqrt{64} \text{ (5:8) or } \sqrt{64}:\sqrt{25} \text{ (8:5) or}$ $\frac{(\sqrt{25})^3}{(\sqrt{64})^3} = \left(\frac{125}{512} = 0.244140625 \right)$ oe or $\frac{512}{125} = 4.096$ $\frac{25^3}{64^3} = \frac{(\text{vol of B})^2}{(\text{vol of B} + 541.8)^2}$ or $\frac{25}{64} = \frac{(\text{vol of B})^{\frac{2}{3}}}{(\text{vol of B} + 541.8)^{\frac{2}{3}}}$ oe		4	M1 for a correct scale factor for length – may be given as a fraction or decimal or ratio or a correct scale factor for volume given as a fraction or decimal or ratio or a correct equation for the volume of vase B
	eg $\mathbf{B} \left(\frac{512}{125} - 1 \right) = 541.8$ or $3.096\mathbf{B} = 541.8$ oe or eg $\mathbf{A} \left(1 - \frac{125}{512} \right) = 541.8$ or $\frac{387}{512}\mathbf{A} = 541.8$ $(8^3)k - (5^3)k (= 387k) = 541.8$ or eg $(k =) \frac{541.8}{387} \left(= \frac{7}{5} \right)$			M1 For a correct equation for the volume of B or a correct equation for the volume of A
	eg $(\mathbf{B}) 541.8 \div \frac{387}{125}$ " or $541.8 \div 3.096$ " or eg $125 \times \frac{7}{5}$ " or $(\mathbf{A}) 541.8 \div \frac{387}{512}$ "(= 716.8) oe			M1 For a completely correct method to find the volume of vase B or vase A
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	175		A1 cao
				Total 4 marks

20	$x^2 + (7 - 2x)^2 = 34$	$\left(\frac{7-y}{2}\right)^2 + y^2 = 34$		5	M1	substitution of linear equation into quadratic
	$5x^2 - 28x + 15 [= 0]$ oe	$5y^2 - 14y - 87 [= 0]$ oe			M1	dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2 + bx + c (= 0)$ where at least 2 coefficients (a or b or c) are correct and all are non-zero
	$(5x - 3)(x - 5) [= 0]$ or $\frac{-(-28) \pm \sqrt{(-28)^2 - 4 \times 5 \times 15}}{2 \times 5}$ or $5\left(x - \frac{28}{10}\right)^2 - \frac{784}{100} + 15 = 0$ oe or $x = 0.6$ and $x = 5$ (allow incorrect labels for x/y)	$(5y - 29)(y + 3) [= 0]$ or $\frac{-(-14) \pm \sqrt{(-14)^2 - 4 \times 5 \times (-87)}}{2 \times 5}$ or $5\left(y - \frac{14}{10}\right)^2 - \frac{196}{100} - 87 = 0$ oe or $y = 5.8$ and $y = -3$ (allow incorrect labels for x/y)			M1ft	dep on M1 for solving <i>their</i> 3 term quadratic equation using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error and some simplification – allow as far as $\frac{28 \pm \sqrt{784 - 300}}{10}$ or $\frac{14 \pm \sqrt{196 + 1740}}{10}$) (if completing the square allow as far as shown) or correct values for x or correct values for y dep on correct quadratic
	eg $y = 7 - 2 \times 5$ and $y = 7 - 2 \times 0.6$ (correct labels for x/y)	eg $5.8 = 7 - 2x$ and $-3 = 7 - 2x$ (correct labels for x/y)			M1ft	dep on previous M1 for substituting their 2 found values of x or y in a suitable equation or correct values for the other variable
	<i>Working must be shown</i>		$x = 0.6, y = 5.8$ $x = 5, y = -3$		A1	dep on M1 and the correct quadratic (allow coordinates) must be paired correctly

				Total 5 marks

Question	Working	Answer	Mark	Notes
21	$r = \sqrt{\frac{49\pi}{4\pi}}$ oe (= 3.5)		3	M1
	[volume =] $\frac{4}{3} \times \pi \times "3.5" ^3$			M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	180		A1 awrt 180
				Total 3 marks

Question	Working	Answer	Mark	Notes
22	$(6x - 5)(x + 7) = 0$ or $\frac{-37 \pm \sqrt{37^2 - 4 \times 6 \times -35}}{2 \times 6}$ $6 \left[\left(x + \frac{37}{12} \right)^2 - \left(\frac{37}{12} \right)^2 \right] \dots$ oe		3	M1 A correct method to solve the quadratic equation $6x^2 + 37x - 35 = 0$ using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error in substitution and some simplification – allow as far as $\frac{-37 \pm \sqrt{1369 + 840}}{12}$) or completing the square as far as shown on left
	$\frac{5}{6}$ oe and -7			A1 dep on M1 correct critical values (allow 0.83...)
	<i>Working must be seen for both accuracy marks as asked for in question</i>	$-7 \leq x \leq \frac{5}{6}$		A1 dep on M1 oe eg $-7 \leq x \leq 0.83\dots$, $\left[-7, \frac{5}{6} \right]$ Accept $x \leq \frac{5}{6}, x \geq -7$
				Total 3 marks

Q	Working	Answer	Mark	Notes
23	$[DN =]8\sin 30$ or $8\cos 60 (= 4)$ oe [where N is the midpoint of EC] or $[x =]8\cos 30$ or $8\sin 60 (= 4\sqrt{3} = 6.928\dots)$ or $2x = \sqrt{8^2 + 8^2 - 2 \times 8 \times 8 \times \cos 120} (= \sqrt{192} = 8\sqrt{3} = 13.85\dots)$		5	M1
	$[DN =]8\sin 30$ or $8\cos 60 (= 4)$ oe eg $\sqrt{8^2 - (4\sqrt{3})^2} (= 4)$ And 1 of $[x =]8\cos 30$ or $8\sin 60 (= 4\sqrt{3} = 6.928\dots)$ oe or $\sqrt{8^2 - "4"'^2} (= 4\sqrt{3} = 6.928\dots)$ or $2x = \sqrt{8^2 + 8^2 - 2 \times 8 \times 8 \times \cos 120} (= 8\sqrt{3} = 13.85\dots)$			M1 [($JM =$) $4 + 4\sqrt{3}$ implies M2]
	$[AM =]\sqrt{12^2 + ("4\sqrt{3}"')^2} (= \sqrt{192} = 8\sqrt{3} = 13.856\dots)$ oe [where M is the midpoint of GH]			M1 Clear intention to be AM (not EC)
	$\tan MAJ = \left(\frac{"4" + "4\sqrt{3}"'}{"8\sqrt{3}"} \right)$ oe eg $\tan MAJ = \left(\frac{10.928\dots}{13.856\dots} \right)$ if student uses sin or cos, then $AJ = 17.647\dots$ to award marks this must come from a correct method or be correct			M1
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	38.3		A1 Accept 38.1 – 38.4 If no marks scored then award SCB2 for $\tan MAJ = \frac{4+x}{\sqrt{x^2+12^2}}$ or SCB1 for $AM = \sqrt{x^2+12^2}$
				Total 5 marks

Q	Working	Answer	Mark	Notes
24		3	2	B1
		0.5		B1 oe
				Total 2 marks

Q	Working	Answer	Mark	Notes	
25	$y = 3(x^2 - 4x) + 7$ or $y = 3\left(x^2 - 4x + \frac{7}{3}\right)$ or $\frac{y-7}{3} = x^2 - 4x$ or $y = 3(x-2)^2 \dots$		4	M1	for a correct equation for a first step to complete the square
	eg $y = 3\left((x-2)^2 - 2^2\right) + 7$ or $y = 3\left((x-2)^2 - 2^2 + \frac{7}{3}\right)$ or $y = 3(x-2)^2 - 5$ oe or			M1	
	$(x-2)^2 = \frac{y+5}{3}$ oe eg $(x-2)^2 = \frac{y-7}{3} + 4$ or $x-2 = (\pm)\sqrt{\frac{y+5}{3}}$ oe			M1	
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$2 - \sqrt{\frac{x+5}{3}}$		A1 oe	NB: note only negative square root. Must be in terms of x any equivalent form
	Note: Allow candidates to swap x and y when finding the inverse			Total 4 marks	
25 Alt	$3x^2 - 12x + (7 - y) = 0$		4	M1	for a correct first step
	$(x =) \frac{12 \pm \sqrt{144 - 12(7 - y)}}{6}$			M1	
	$(x =) 2 \pm \sqrt{\frac{60 + 12y}{36}}$ oe			M1	
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$2 - \sqrt{\frac{x+5}{3}}$		A1 oe	NB: note only negative square root. Must be in terms of x any equivalent form
				Total 4 marks	

Q	Working	Answer	Mark	Notes
26	For one of: $10^{4n} = (5 \times 2)^{4n}$ or $5^{4n} \times 2^{4n}$ or oe $20^2 = (5 \times 2^2)^2$ or $5^2 \times 2^4$ or $5^2 \times 2^2 \times 2^2$ or cancelling 5^2 on numerator with 20^2 to get 16 or 2^4		5	M1 for writing 10^{4n} correctly as a product of 5 and 2 to the power $4n$ oe or writing 20^2 correctly as a product of 5 and 2^2 to the power 2 oe or cancelling 5^2 on numerator with 20^2 to get 16 or 2^4
	for getting numerator to the stage (this scores M1M1) $2^{4n} \times 2^{3n^2-15n} \times 5^2$ oe eg $2^{3n^2-11n} \times 5^{-4n+4n+2}$ oe or for two of $10^{4n} = (5 \times 2)^{4n}$ or $5^{4n} \times 2^{4n}$ or oe $20^2 = (5 \times 2^2)^2$ or $5^2 \times 2^4$ or $5^2 \times 2^2 \times 2^2$ or cancelling 5^2 on numerator with 20^2 to get 16 or 2^4 or getting the numerator to the stage			M1
	$\frac{2^{4n} \times 2^{3n^2} \times 2^{-15n}}{2^4} [= 1 \text{ or } 2^0]$ or $2^{4n} \times 2^{3n^2} \times 2^{-15n} = 2^4$ oe			M1 For writing the equation in powers of 2 only
	$3n^2 - 11n - 4 [= 0]$			A1 Correct quadratic equation dep on M1
	<i>working required</i>	$-\frac{1}{3}, 4$		A1 Both answers required dep on M1
				Total 5 marks

