

Mark Scheme (Results)

January 2013

International GCSE Mathematics A
(4MA0) Paper 4H

Level 1 / Level 2 Certificate in Mathematics
(KMA0) Paper 4H

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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.

- **Follow through marks**

Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.

Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

- **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 10, 14, 18 and 26 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Q	Working	Answer	Mark	Notes
1. (a)	11.5 or 1.96 seen		2	M1 Also award for $5\frac{85}{98}$ or $\frac{575}{98}$ or answer of 5.9 or 5.87
		5.8673(46939...)		A1 for at least first 5 figures (ignore figures after the first five)
(b)		5.9	1	B1 ft from (a) if non-trivial
				Total 3 marks

2.	$\pi \times 7.6$		2	M1 or $2 \times \pi \times \frac{7.6}{2}$
		23.9		A1 for answer which rounds to 23.9
				Total 2 marks

3.	$6 \times 2 + 7 \times 4 + 8 \times 5 + 9 \times 8 + 10 \times 1$ or $12 + 28 + 40 + 72 + 10$ or 162		3	M1 for at least 3 correct products and summing them
	"162" \div 20			M1 (dep) for division by 20
		8.1		A1 Accept 8 if $162 \div 20$ seen NB: Award A0 if 8.1 clearly comes from incorrect figures
				Total 3 marks

4.	$0.2 + 0.7$		2	M1
		0.9 oe		A1 oe inc $\frac{9}{10}$, 90%
				Total 2 marks

5.	(a)	4, 8 & one even number other than 2, 6 or 10	2	B2 B1 for 4, 8 alone or for 4, 8 and one odd number or for 4, 8 and more than one other even number (any extra even numbers must not be 2 or 6 or 10) Accept 0 as an even number
	(b)	3 even numbers other than 2, 4, 6, 8 or 10 eg 12, 14, 16	1	B1
				Total 3 marks

6.	(a)	$1 - \frac{5}{9}$ or $\frac{4}{9}$ seen	3	M1 $\frac{4}{9}$ oe
		" $\frac{4}{9}$ " \times $\frac{5}{6}$ oe or $\frac{5}{9} \times \frac{5}{6}$ oe		M1
		$\frac{20}{54}$ or $\frac{10}{27}$		A1
	(b)	27	2	B2 cao B1 for 18 or 54 or any multiple of 27
				Total 5 marks

7.	Splits shape appropriately eg rectangle + triangle or rectangle + trapezium or 'completing the rectangle'		4	B1 If lines not present on diagram then can be implied by correct method for at least two areas (areas must not overlap and must not be contradictory)
	eg. 9×10 or 90 or 9×4 or 36 or 9×6 or 54 or $\frac{1}{2} \times 7 \times 6$ or 21 or $\frac{1}{2} \times (16+9) \times 6$ or 75 16×10 or 160 or $\frac{1}{2} \times (4+10) \times 7$ or 49			M1 for area of one appropriate rectangle, triangle or trapezium
	eg. $\frac{1}{2} \times 7 \times 6 + 9 \times 10$ $\frac{1}{2} \times 7 \times 6 + 9 \times 4 + 9 \times 6$ $9 \times 4 + \frac{1}{2} \times (16+9) \times 6$ $16 \times 10 - \frac{1}{2} \times (4+10) \times 7$			M1 for complete method
		111		A1 cao
				Total 4 marks

8.	(a)		$n(n + 8)$	2	B2 Award B2 also for $(n \pm 0)(n + 8)$ B1 for factors which, when expanded & simplified, give two terms, one of which is correct SC B1 for $n(n + 8n)$
	(b)	$6x - 15 - 4x - 12$		2	M1 for 3 correct terms
			$2x - 27$		A1 cao
	(c)	$y^2 + 2y + 7y + 14$		2	M1 for 3 correct terms out of 4 or for 4 correct terms ignoring signs or for $y^2 + 9y + c$ for any non-zero value of c or for $\dots + 9y + 14$
			$y^2 + 9y + 14$		A1 cao
					Total 6 marks

9.		$8.6^2 - 6.9^2$ or $73.96 - 47.61$ or 26.35		3	M1 for squaring and subtracting
		$\sqrt{8.6^2 - 6.9^2}$ or $\sqrt{26.35}$			M1 (dep) for square root
			5.13		A1 for answer which rounds to 5.13
					Total 3 marks

10.	$5x = -15$ or $5x = 1 - 16$ or $3x + 2x = -15$ or $5x + 15 = 0$		3	M2 for correct rearrangement with x terms on one side and numbers on the other AND correct collection of terms on at least one side M2 also for $-5x = 15$, $-5x = 16 - 1$ or $-2x - 3x = 15$ M1 for correct rearrangement with x terms on one side and numbers on the other eg. $3x + 2x = 1 - 16$ or $16 - 1 = -2x - 3x$ or correct collection and simplification of either numbers or x terms eg. $5x + 16 = 1$ or $5x = a$ or $5x - a = 0$ or $nx = -15$ ($n \neq 5$)
		-3		A1 Award 3 marks if M1 scored and answer correct.
				Total 3 marks

11.	$5 + 9$ or 14 seen or or $\frac{n}{14}$ oe (provided no evidence of 14 from incorrect method)		3	M1 or $\frac{5+9}{5+9+6} \times x = 56$
	$56 \div "14"$ or 4 or $\frac{6}{14} \times 56$			M1 dep or $56 \div \frac{14}{20}$ or 80
		24		A1 Also accept 20 : 36 : 24 as final answer
				Total 3 marks

12.	arc centre B cutting BA and BC at (say) P and Q		2	M1
	arcs centres P and Q of equal radii which intersect at R (say) and BR joined (overlay)			A1 dep
				Total 2 marks

13.	$-2 \leq x \leq 4 \quad 1 \leq y \leq 3$ or $x \geq -2 \quad x \leq 4 \quad y \geq 1 \quad y \leq 3$	3	B3 B2 for 3 correct inequalities B1 for 2 correct inequalities (Treat double-ended inequalities as two separate inequalities) Accept < and > throughout
			Total 3 marks

14.	$\frac{2(6x+1)}{(5x-2)(6x+1)} = \frac{3(5x-2)}{(5x-2)(6x+1)}$		4	M1 Need to see both expressions in an equation May be implied by second M1; NB: Denominators must be correct
	$\frac{12x+2}{(5x-2)(6x+1)} = \frac{15x-6}{(5x-2)(6x+1)}$			M1 Need to see both expressions in an equation NB: Denominators must be correct
	$3x = 8 \text{ or } -3x = -8 \text{ or}$ $3x = 2 + 6 \text{ or } -3x = -6 - 2$ or $15x - 12x = 8$ or $12x - 15x = -8$ or $3x - 8 = 0$			M1 dep on awarding first two method marks for correct rearrangement with x terms on one side and numbers on the other AND correct collection of terms on at least one side or for $3x - 8 = 0$
		$2\frac{2}{3}$ oe		A1 for $2\frac{2}{3}$ oe including decimal equivalent rounded or truncated to at least 2 decimal places Award 4 marks if first two method marks scored and answer correct.
			Total 4 marks	

15.	(a)		$5x^3y^2$	2	B2 B1 for 2 of 5, x^3 , y^2 correct in a single product with no additional terms or $5x^{5-2}y^{6-4}$
	(b)		$8n^{12}$	2	B2 B1 for 8 or n^{12} in a product
					Total 4 marks

16.	(a)	4 12 28 60 132 160		1	B1 cao
	(b)		Points correct	2	B1 $\pm \frac{1}{2}$ sq ft from sensible table ie clear attempt to add frequencies
			Curve or line segments		B1 ft from points if 4 or 5 correct or if all points are plotted consistently within each interval at the correct heights Accept curve which is not joined to the origin
	(c)	80 (or 80.5) indicated on cf graph or stated		2	M1 for 80 (or 80.5) indicated on cf axis or stated
			approx 4.3		A1 If M1 scored, ft from cf graph If no indication of method, ft only from correct curve & if answer is correct ($\pm \frac{1}{2}$ sq tolerance) award M1 A1
					Total 5 marks

17.	(a)	$\frac{BC}{5.2} = \frac{7}{5.6}$ oe or $\frac{BC}{7} = \frac{5.2}{5.6}$ oe		2	M1	for correct, relevant proportionality statement with 3 values substituted
			6.5		A1	cao
	(b)	$\frac{DE}{7.5} = \frac{5.6}{7}$ oe or $\frac{DE}{5.6} = \frac{7.5}{7}$ oe or $\frac{DE}{5.2} = \frac{7.5}{\text{"6.5"}}$ oe or $\frac{DE}{7.5} = \frac{5.2}{\text{"6.5"}}$		2	M1	for correct, relevant proportionality statement with 3 values substituted
			6		A1	cao
	(c)	(scale factor) eg $\frac{7}{5.6}$ or $\frac{5.6}{7}$ or $\frac{4}{5}$ oe or $\frac{5}{4}$ oe (May be implied by second M1) allow ratio notation		3	M1	Also award M1 for ht of $\triangle CDE$ $= \frac{4}{5} \times \frac{21}{\frac{1}{2} \times 7.5}$ (= 4.48)
		(scale factor) ² eg $\left(\frac{4}{5}\right)^2$ oe or 0.64 or $\left(\frac{5}{4}\right)^2$ oe 1.5625 allow ratio notation			M1	Also award M1 for $\frac{1}{2} \times 6 \times 4.48$
						M2 for eg. (Area $\triangle ABC$ =) $\frac{1}{2} \times 7 \times 6.5 \sin C = 21$ and (Area $\triangle CDE$ =) $\frac{1}{2} \times 5.2 \times 5.6 \sin C$
						Also award M2 for $s = \frac{5.2 + 5.6 + 6}{2}$ (= 8.4) and Area = $\sqrt{8.4(8.4-5.2)(8.4-5.6)(8.4-6)}$
			13.44		A1	Also accept 13.4 if both method marks scored
Total 7 marks						

18.	$\frac{-2 \pm \sqrt{2^2 - 4 \times 5 \times (-4)}}{2 \times 5}$ or for this expression with one or more of 2^2 , $4 \times 5 \times (-4)$, 2×5 or $2^2 - 4 \times 5 \times (-4)$ evaluated eg $\frac{-2 \pm \sqrt{84}}{10}$		3	M1 for correct substitution (brackets not necessary)
	$\sqrt{84}$ or $\sqrt{4 + 80}$ or $2\sqrt{21}$ or 9.165...			M1 (independent) for correct simplification of discriminant (if evaluated, at least 3sf rounded or truncated)
		-1.12, 0.717		A1 for values rounding to -1.12 and 0.717 (-1.11651..., 0.71651...) Award 3 marks if first M1 scored and answer correct.
				Total 3 marks

19.	$12 + 3\sqrt{a} + 4\sqrt{a} + a$ or $12 + 7\sqrt{a} + a$		3	M1 Accept $\sqrt{a}\sqrt{a}$ or $(\sqrt{a})^2$ instead of a
		$a = 5$	A1	Award B3 for $a = 25, k = 11$ or $a = 1, k = 3$
		$k = 7$	B1	
				Total 3 marks

20.	(a)	$\frac{4}{5} \times \frac{3}{5}$		2	M1 or probability of $\frac{3}{5}$ clearly associated with box Y (eg may be on tree diagram or by box)
			$\frac{12}{25}$ oe		A1
	(b)	$\frac{4}{5} \times \frac{2}{5}$, $\frac{1}{5} \times \frac{3}{5}$ or 0.32 oe or 0.12oe		3	M1 for $\frac{4}{5} \times \frac{2}{5}$ or $\frac{1}{5} \times \frac{3}{5}$
		$\frac{4}{5} \times \frac{2}{5} + \frac{1}{5} \times \frac{3}{5}$			M1 for sum of both products
			$\frac{11}{25}$ oe		A1
Total 5 marks					

21.	(a)	$t = kf^2$		3	M1 for $t = kf^2$ but not for $t = f^2$ Also award for correct equation in t, f^2 and a constant or for $t =$ some numerical value $\times f^2$
		$0.02 = k \times 8^2$ or $k = \frac{1}{3200}$ or $k = 0.0003125$ or 3.125×10^{-4}			M1 for $0.02 = k \times 8^2$ or for correct substitution into an equation which scores the first method mark (may be implied by correct evaluation of the constant)
			$t = 0.0003125f^2$ or $t = \frac{1}{3200} f^2$		A1 Award 3 marks if answer is $t = kf^2$ but k is evaluated in part (b)
	(b)	$f^2 = \frac{0.0098}{0.0003125}$ or $f^2 = \frac{0.0098}{0.02} \times 8^2$		2	M1 for substitution and rearrangement into form $f^2 = \frac{0.0098}{k}$ with their value of k except for $k = 1$ or $f^2 = \frac{0.0098}{0.02} \times 8^2$
			5.6 oe		A1
Total 5 marks					

22.	$\angle PAO = 90^\circ$ or $\angle PBO = 90^\circ$		4	M1	or M2 for $\angle PBA = 76^\circ$ or $\angle PAB = 76^\circ$ implies previous two marks	Angles may be stated or marked on diagram or used in calculations provided any use is not ambiguous
	$\angle AOB = 2 \times 76^\circ$ or 152° or $\angle POA = 76^\circ$ or $\angle POB = 76^\circ$			M1		
	$360 - ("152" + 90 + 90)$ or $2 \times (180 - 76 - 90)$ or $180 - 2 \times 76$			M1		
		28		A1		
						Total 4 marks

23.	(a)		$\frac{4}{5}$ oe	1	B1	
	(b)	$\frac{1}{(\sqrt{x-1})^2 + 1}$ or $\frac{1}{x-1+1}$		2	M1	
			$\frac{1}{x}$		A1 Also accept x^{-1}	
						Total 3 marks

24.	$\frac{1}{1.25}$ oe eg $\frac{1}{5}, \frac{4}{5}, 0.8(0), \frac{100}{125}, 80\%$ $t_1 = \frac{d}{s}$ and $t_2 = \frac{d}{(1+0.25)s}$ or $\frac{t_1}{t_2} = 0.8$			3	M1	Alternative method (assigns values to distance and average speed) M1 for calculating both times correctly M1 (dep) for finding $\frac{\text{Mon time} - \text{Tues time}}{\text{Mon time}}$
	$1 - 0.8$ oe eg $1 - \frac{4}{5}, 100\% - 80\%$				M1	
			20		A1	cao
						Total 3 marks

25.	$\angle ADC = 149^\circ$ or $\angle CAD = 21^\circ$		6	B1	May be stated or marked on diagram
	$\frac{AC}{\sin 149^\circ} = \frac{16.5}{\sin 10^\circ}$	$\frac{CD}{\sin 21^\circ} = \frac{16.5}{\sin 10^\circ}$		M1	for correct substitution in Sine Rule
	$(AC =) \frac{16.5 \sin 149^\circ}{\sin 10^\circ}$	$(CD =) \frac{16.5 \sin 21^\circ}{\sin 10^\circ}$		M1	for correct rearrangement
	$(AC =) 48.938\dots$	$(CD =) 34.052\dots$		A1	for correct length of AC or CD (rounded or truncated to at least 3 sf)
	$(AB =) "48.938\dots" \times \sin 69^\circ$ or $45.6(88\dots)$	$(BD =) "34.052\dots" \times \sin 59^\circ$ or $29.1(88\dots)$		M1	rounded or truncated to at least 3 sf
		45.7		A1	for ans which rounds to 45.7
					Total 6 marks

Alternative scheme	$(BD =) BC \tan 59^\circ$ oe		6	M1	Accept any clear notation throughout
	$BD + 16.5 = BC \tan 69^\circ$ oe			M1	
	$BD + 16.5 = \frac{\tan 69^\circ}{\tan 59^\circ} BD$ oe			M1	for equation in one variable
	$\left(\frac{\tan 69^\circ}{\tan 59^\circ} - 1\right) BD = 16.5$ or $0.5652\dots BD = 16.5$ oe			M1	for correct equation for one variable in the form $ax = b$
	$(BD =) 29.188\dots$			A1	for value which rounds to 29.2
		45.7		A1	for ans which rounds to 45.7
					Total 6 marks

26.	$x^2 + (3x + 2)^2 = 20$		6	M1 $\left(\frac{y-2}{3}\right)^2 + y^2 = 20$	
	$x^2 + 9x^2 + 6x + 6x + 4 = 20$ or $x^2 + 9x^2 + 12x + 4 = 20$			$\left(\frac{y^2 - 4y + 4}{9}\right) + y^2 = 20$ or $\left(\frac{y^2 - 2y - 2y + 4}{9}\right) + y^2 = 20$	
				M1 (indep) for correct expansion of $(3x + 2)^2$ or $\left(\frac{y-2}{3}\right)^2$ even if unsimplified	
	$5x^2 + 6x - 8 (= 0)$ or $10x^2 + 12x - 16 (= 0)$			A1 $5y^2 - 2y - 88 (= 0)$ oe Condone omission of '= 0'	
	$(5x - 4)(x + 2) (= 0)$ or $(10x - 8)(x + 2) (= 0)$ or $(5x - 4)(2x + 4) (= 0)$ or $5x(x + 2) - 4(x + 2) (= 0)$ or $x(5x - 4) + 2(5x - 4) (= 0)$ or $\frac{-6 \pm \sqrt{6^2 - 4 \times 5 \times -8}}{2 \times 5}$ or better or $\frac{-12 \pm \sqrt{12^2 - 4 \times 10 \times -16}}{2 \times 10}$ or better			M1 $(5y - 22)(y + 4) (= 0)$ oe or $\frac{2 \pm \sqrt{(-2)^2 - 4 \times 5 \times -88}}{2 \times 5}$ or better Condone omission of '= 0'	
	$x = \frac{4}{5}$ or $x = -2$			A1 $y = 4\frac{2}{5}$ or $y = -4$	dep on all preceding marks
		$x = \frac{4}{5}, y = 4\frac{2}{5}$ $x = -2, y = -4$		A1 No marks for $x = -2, y = -4$ with no working	
				Total 6 marks	

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