

## GCSE Mathematics (1MA1) – Aiming for 9 Paper 3H

### Student-friendly mark scheme

**Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn't show follow-through marks (marks that are awarded despite errors being made) or special cases.**

**It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme.**

### NOTES ON MARKING PRINCIPLES

#### Guidance on the use of codes within this mark scheme

M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.

P1 – process mark. This mark is generally given for setting up an appropriate process to find a solution in the context of the question.

A1 – accuracy mark. This mark is generally given for a correct answer following correct working.

B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.

C1 – communication mark. This mark is given for explaining your answer or giving a conclusion in context supported by your working.

Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

**Question 1 (Total 3 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	Probability of a green counter = $\frac{8}{15} \times 0.6$	P1	This mark is given for a process to use the ratio to work out the probability of choosing a green counter
	$\frac{8}{15} \times 0.6 \times 50$	P1	This mark is given for a process to work out an estimate for the number of green counters
	16	A1	This mark is given for the correct answer only

**Question 2 (Total 4 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	$4(x^2 - 14x)$ or $(2x - 14)^2 + c$	P1	This mark is given for factorising the equation of the curve
	$4((x - 7)^2 - 49)$ or $(2x - 14)^2 - 196$	P1	This mark is given for a method to find the gradient of the tangent
	(7, -196)	A1	This mark is given for a full answer supported by correct working

**Question 3 (Total 3 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{17010}{0.875 \times 0.9 \times 0.9}$	P1	This mark is given for a process to use either 0.875 or $0.9 \times 0.9$ (or $0.9^2$ )
		P1	These marks are given for a process to find out the original value of the car
	24000	A1	This mark is given for the correct answer only

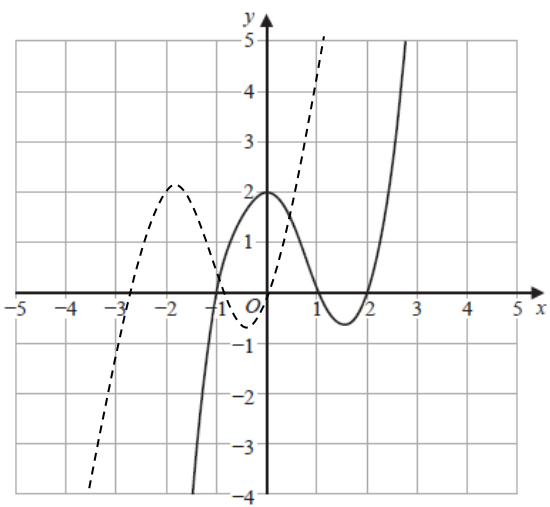
**Question 4 (Total 4 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	$29\,600 = 24\,000a + 800$ $a = \frac{29\,600 - 800}{24\,000} = 1.2$	P1	This mark is given for a process to find the value of $a$
	$P_{2020} = 1.2 \times 29\,600 + 800 = 36\,320$	P1	This mark is given for a process to find the profit made by the shop in 2020
	$P_{2021} = 1.2 \times 36\,320 + 800$	P1	This mark is given for a process to find the profit made by the shop in 2021
	44384	A1	This mark is given for the correct answer only

**Question 5 (Total 4 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	$EAB + BDE = 180, ABD + AED = 180$ $ABD = 120$ so $AED = 60$	M1	This mark is given for a method to use the properties of a cyclic quadrilateral
	Let $EAB = 2x$ and $BCD = x$	M1	This mark is given for a method to use the ratio 2 : 1
	$EAB + BCD + AED = 180$ $2x + x + 60 = 180$ $3x + 60 = 180$ $3x = 120$	M1	This mark is given for a method to find the size of angle $BCD$
	40	A1	This mark is given for the correct answer only

**Question 6 (Total 2 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
(a)		B1	This mark is given for a sketch which crosses the $x$ -axis at $(-3, 0)$ , $(-1, 0)$ , $(0, 0)$ and passes through $(-2, 2)$
(b)	$y = -g(x)$	B1	This mark is given for the correct answer only

**Question 7 (Total 3 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\frac{(2x+3)(x+5) + (x-4)(x-5)}{(x-5)(x+5)} - \frac{3(x-5)(x+5)}{(x-5)(x+5)}$ $= \frac{(2x+3)(x+5) + (x-4)(x-5) - 3(x-5)(x+5)}{(x-5)(x+5)}$	M1	This mark is given for a method to use a common denominator
	$= \frac{2x^2 + 3x + 10x + 15 + x^2 - 9x + 20 - 3x^2 + 75}{x^2 - 25}$	M1	This mark is given for a method to find the numerator
	$= \frac{4x - 110}{x^2 - 25}$ $a = 4 \text{ and } b = 110$	A1	This mark is given for the correct answers only

**Question 8 (Total 5 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	$TC = 14 \times \frac{3}{3+4} = 6$	P1	This mark is given for a process to find the length of $TC$
	$TD = \sqrt{14^2 + 6^2} = \sqrt{232} = 15.23\dots$	P1	This mark is given for a process to find the length of $TD$
	$147 = 0.5 \times (SD + 12) \times 14$ $SD = \frac{147}{7} - 12 = 9$	P1	This mark is given for a process to use the area of a trapezium to find the length of $SD$
	$\tan^{-1}\left(\frac{9}{15.23\dots}\right) = \tan^{-1} 0.59$	P1	This mark is given for a process to find the size of the angle between the line $ST$ and the base $ABCD$
	30.6 (to one decimal place)	A1	This mark is given for a correct answer in the range 30.4 to 30.7

**Question 9 (Total 5 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	$92.8 \div 2.9 = 32 \text{ cm}^3$	P1	This mark is given for a process to find the volume of the top
	$92.8 + 972.8 = 1065.6$	P1	This mark is given for a process to find the total mass of <b>P</b>
	$\frac{1065.6}{4.7} = 226.7234$	P1	This mark is given for a process to find the total volume of <b>P</b>
	$\frac{32}{226.7234} \times 100$	P1	This mark is given for a process to find the volume of the top as a percentage of the volume of the total volume <b>P</b>
	14.1	A1	This mark is given for a correct answer to one decimal place in the range 14.1 to 14.2

**Question 10 (Total 3 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	For example: $\frac{7}{50}$ or $\frac{14}{100}$	M1	This mark is given for a method to find the gradient
	0.14	A1	This mark is given for correct answer in the range 0.135 to 0.145
(b)	For example: the cost per unit of electricity	C1	This mark is given for a valid explanation of what the gradient represents

**Question 11 (Total 5 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)		B3	<p>These marks are given for a fully correct histogram drawn with relative height 90, 96, 44, 8 and 6</p> <p>(B2 are given for 4 correct blocks <b>or</b> all 5 frequency <math>\div</math> class interval and one correct block)</p> <p>(B1 is given for at least 2 correct blocks of different widths or for frequency <math>\div</math> class interval for at least 3 different frequencies)</p>
(b)	For example: height of 1–2 bar = 3.0 units and height of 3–5 bar = 0.6 unit (so areas = 6 and 2.4 respectively)  area of 1–2 bar = 150 small squares and area of 3–5 bar = 60 small squares	M1	This mark is given for a method to compare the heights or areas of the bars of the two intervals 1–2 and 3–5
	0.4n	A1	This mark is given for a correct answer only (or equivalent)

**Question 12 (Total 4 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\overrightarrow{CE} = 2\mathbf{a} - \mathbf{b}$	C1	This mark is given for a finding a vector expression of $\overrightarrow{CE}$
	$\overrightarrow{EP} = 2\mathbf{a} - \mathbf{b}$ $\overrightarrow{CP} = 4\mathbf{a} - 2\mathbf{b}$	C1	This mark is given for a finding a vector expression of $\overrightarrow{EP}$ or $\overrightarrow{CP}$
	$\overrightarrow{CF} = \mathbf{a} - \mathbf{b}$	C1	This mark is given for a finding a vector expression of $\overrightarrow{CF}$
	$\overrightarrow{CF} = \mathbf{a} - \mathbf{b}$ and $\overrightarrow{DP} = 2\mathbf{a} - 2\mathbf{b}$ $\overrightarrow{DP} = 2\overrightarrow{CF}$ so are parallel	C1	This mark is given for a full proof and correct conclusion

**Question 13 (Total 5 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	$(2x - 5)^2 = 6x^2 - 25x - 8$	M1	This mark is given for a method to equate two expressions for $y^2$
	$4x^2 - 20x + 25 = 6x^2 - 25x - 8$	M1	This mark is given for a method to expand the squared term
	$2x^2 - 5x - 33 = 0$ $(2x - 11)(x + 3) = 0$	M1	This mark is given for rearranging and finding a quadratic to be solved
	$(-3, -11)$	A1	This mark is given for the correct answer only
	$(5.5, 6)$	A1	This mark is given for the correct answer only

**Question 14 (Total 4 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	For example: $\frac{3x(x-2)}{x^2-4}$ or $\frac{(x+2)(2x+1)}{x^2-4}$ or $\frac{x^2-4}{x^2-4}$	M1	This mark is given for a method to write one of the three terms with a denominator of $(x^2 - 4)$
	$\frac{3x(x-2)}{x^2-4} - \frac{(x+2)(2x+1)}{x^2-4} - \frac{x^2-4}{x^2-4}$	M1	This mark is given for a method to find the expression with a common denominator
	$\frac{3x^2 - 6x - 2x^2 - 5x - 2 - x^2 + 4}{x^2 - 4}$	M1	This mark is given for a method to find a single numerator
	$\frac{-11x + 2}{x^2 - 4}$	A1	This mark is given for the correct answer only (or $a = -11$ and $b = 2$ )

**Question 15 (Total 4 marks)**

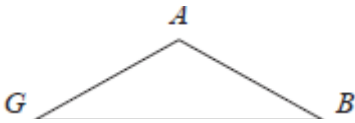
Part	Working or answer an examiner might expect to see	Mark	Notes
	<b>A : B = 2 : 3</b> <b>C : D = 3 : 4</b> <b>A + B : C + D = 3 : 1</b>	P1	This mark is given for a first step in a process to write at least one relationship between two weights
		P1	This mark is given for process to write all three relationships between the weights
	For <b>A : B</b> , multiply by $(3 + 4)$ to get <b>14 : 21</b> For <b>C : D</b> , multiply by $(2 + 3)$ to get <b>15 : 20</b> But <b>A + B : C + D = 3 : 1</b> so ratio is $(3 \times 14) : (3 \times 21) : 15 : 20$	P1	This mark is given for process to use ratios to compare <b>A + B</b> and <b>C + D</b> and link all four weights
	<b>42 : 63 : 15 : 20</b>	A1	This mark is given for the correct answer only



**Question 16 (Total 2 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	For example: 40 is missing from the frequency scale	C1	This mark is given for a mistake identified on the frequency polygon
	For example: An incorrect point (50, 5) is mapped	C1	This mark is given for a mistake identified on the frequency polygon

**Question 17 (Total 5 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	Exterior angle = $360 \div 7 = 51.43\dots$ Interior angle = $180 - (360 \div 7) = 128.57\dots$	P1	This mark is given for a process to find an exterior or interior angle
	$\frac{1}{2} \times AB \times AG \times \sin GAB = 30$	P1	This mark is given for a process to find the length of one side by using the formula for the area of a triangle
	$AB \times AG = \frac{2 \times 30}{\sin 128.57\dots}$ Since $AB = AG$ , $AB = AG = \sqrt{\frac{2 \times 30}{\sin 128.57\dots}} = 8.76\dots$	P1	This mark is given for a process to find the length of a side of the polygon
	 $GB = 2 \times \sin \frac{128.57\dots}{2} \times 8.76\dots$	P1	This mark is given for a complete process to use the cosine rule to find the length $GB$
	15.8	A1	This mark is given for a correct answer to one decimal place in the range 15.7 to 15.8

**Question 18 (Total 3 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	For example: angle $PXQ = \text{angle } SXR$ since vertically opposite angles are equal	C1	This mark is given for identifying one pair of corresponding equal angles with a correct reason given
	For example: angle $QPX = \text{angle } RSX$ since angles in the same segment are equal	C1	This mark is given for identifying two pairs of corresponding equal angles with correct reasons given
	For example: angle $PQX = \text{angle } SRX$ since angles in the same segment are equal  The triangles are similar because all three pairs of corresponding angles are equal	C1	This mark is given for a fully correct proof

**Question 19 (Total 4 marks)**

Part	Working an or answer examiner might expect to see	Mark	Notes
	For example: $\frac{a}{9} \times \frac{b}{8} \times \frac{c}{7}$ where $a, b$ and $c$ are $< 9$	P1	This mark is given for a process to form any triple product of probabilities of the form
	Odd, odd, even: $\frac{5}{9} \times \frac{4}{8} \times \frac{4}{7} = \frac{80}{504}$  Odd, even, odd: $\frac{5}{9} \times \frac{4}{8} \times \frac{4}{7} = \frac{80}{504}$  Even, odd, odd: $\frac{4}{9} \times \frac{5}{8} \times \frac{4}{7} = \frac{80}{504}$  Even, even, even: $\frac{4}{9} \times \frac{3}{8} \times \frac{2}{7} = \frac{24}{504}$	P1	This mark is given for at least one of the four products of three probabilities of cards which will give an even sum
	$\frac{80}{504} + \frac{80}{504} + \frac{80}{504} + \frac{24}{504}$	P1	This mark is given for finding the sum of at least three of the four correct probabilities of cards which will give an even sum
	$\frac{264}{504} = \frac{11}{21}$	A1	This mark is given for the correct answer only (or equivalent)

**Question 20 (Total 2 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	For example: The label on the horizontal axis is missing	C1	This mark is given for a valid criticism of the graph
	For example: The graph has not been plotted at the top end of the class intervals	C1	This mark is given for a valid criticism of the graph

**Question 21 (Total 3 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	angle $EAD = \text{angle } ADE$ base angles of an isosceles triangle are equal	C1	This mark is given for a finding equal angles with a valid reason
	$AB + BC = BC + CD$	C1	This mark is given for use of the ratio 1 : 2: 1
	Thus $ACE$ is congruent to $DBE$ (using SAS)	C1	This mark is given for a complete proof

**Question 22 (Total 2 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	$1.2 \leq P < 1.3$	B1	This mark is given for a 1.2 in the correct position
		B1	This mark is given for a 1.3 in the correct position

**Question 23 (Total 2 marks)**

Part	Working or answer an examiner might expect to see	Mark	Notes
	translation of $\begin{pmatrix} 8 \\ 0 \end{pmatrix}$	C1	This mark is given for translation stated
		A1	This mark is given for the correct vector

Qn		Mean score	Max score	Mean %	Edexcel averages: mean scores of students who achieved grade								
					ALL	9	8	7	6	5	4	3	U
1	Probabilities of an exhaustive set of outcomes	1.05	3	35	1.05	2.91	2.41	2.03	1.70	1.23	0.49	0.20	0.04
2	Algebraic manipulation	0.35	3	12	0.35	2.91	2.06	1.10	0.51	0.06	0.02	0.00	0.00
3	Use a multiplier to increase or decrease by a percentage in any scenario where percentages are used	1.42	3	47	1.42	2.88	2.42	1.74	1.09	0.60	0.28	0.10	0.04
4	Find a specific term in a sequence using the position-to-term and term-to-term rules	1.34	4	34	1.34	3.82	3.04	1.66	0.55	0.13	0.02	0.00	0.00
5	Circle theorems	0.85	4	21	0.85	3.79	2.91	2.14	1.28	0.82	0.24	0.04	0.00
6	Translations and reflections of a function	0.39	2	20	0.39	1.85	1.35	1.10	0.60	0.29	0.14	0.04	0.00
7	Simplify and manipulate algebraic expressions and fractions	0.65	3	22	0.65	2.76	2.41	1.67	1.14	0.49	0.15	0.04	0.01
8	Find the angle between a line and a plane (but not the angle between two planes or between two skew lines)	1.69	5	34	1.69	4.53	3.49	2.06	0.89	0.32	0.10	0.02	0.00
9	Use compound units	0.96	5	19	0.96	4.36	2.24	2.24	1.44	0.85	0.43	0.24	0.04
10	Use index laws	1.52	3	51	1.52	2.60	2.29	1.93	1.40	0.75	0.30	0.09	0.05
11	Use and understand frequency density	2.04	5	41	2.04	4.32	3.38	2.48	1.61	0.85	0.36	0.12	0.04
12	Vectors	0.61	4	15	0.61	3.45	2.94	2.18	0.88	0.26	0.06	0.02	0.00
13	Select and apply algebraic and graphical techniques to solve simultaneous equations where one is linear and one quadratic	1.13	5	23	1.13	4.29	2.48	1.08	0.35	0.08	0.02	0.00	0.00
14	Simplify rational expressions by cancelling, adding, subtracting, and multiplying	1.01	4	25	1.01	3.15	1.93	1.11	0.55	0.20	0.06	0.02	0.00
15	Ratio in real context	0.65	4	16	0.65	3.06	1.94	1.38	0.93	0.65	0.29	0.08	0.04
16	Produce frequency polygons for grouped data	1.04	2	52	1.04	1.48	1.25	1.09	0.98	0.87	0.73	0.56	0.38
17	Sine and cosine rule	0.49	5	10	0.49	3.61	2.24	1.17	0.72	0.28	0.13	0.04	0.00
18	Complete a formal geometric proof of similarity of two given triangles	0.75	3	25	0.75	2.05	1.35	0.85	0.47	0.21	0.08	0.02	0.01
19	Understand selection with or without replacement	0.70	4	18	0.70	2.58	1.41	0.70	0.29	0.09	0.02	0.00	0.00
20	Cumulative frequency graphs	0.77	2	39	0.77	1.24	1.24	1.10	0.92	0.81	0.66	0.51	0.29
21	Basic congruence criteria for triangles (SSS, SAS, ASA, RHS)	0.19	3	6	0.19	1.70	0.97	0.45	0.28	0.11	0.02	0.00	0.00
22	Rounding; Inequality notation to specify error interval	0.33	2	17	0.33	0.94	0.59	0.58	0.26	0.33	0.27	0.31	0.19
23	Combinations of transformations	0.11	2	6	0.11	0.70	0.30	0.28	0.16	0.09	0.04	0.03	0.00
		<b>20.04</b>	<b>80</b>	<b>25</b>	<b>20.04</b>	<b>64.98</b>	<b>46.64</b>	<b>32.12</b>	<b>19.00</b>	<b>10.37</b>	<b>4.91</b>	<b>2.48</b>	<b>1.13</b>

### Suggested grade boundaries

<b>Grade</b>	<b>9</b>	<b>8</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>
<b>Mark</b>	<b>56</b>	<b>39</b>	<b>26</b>	<b>15</b>	<b>8</b>	<b>4</b>	<b>1</b>