

GCSE Mathematics (1MA1) – Higher Tier Paper 1H

Aiming for Grade 9 – Spring 2020 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 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{1}{2}(n^2 + n + n^2 + n + 2n + 2)$	1	This mark is given for expanding the brackets
	$= \frac{1}{2}(2n^2 + 4n + 2) = n^2 + 2n + 1$ $= (n + 1)^2$ which is square for all integer values of n	1	This mark is given for a complete proof with reference to $(n + 1)^2$ being square for all integers n

Question 2 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\overrightarrow{OX} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c}$	P1	This mark is given for the first step to solve the problem
	$\overrightarrow{OD} = \overrightarrow{OX} + \overrightarrow{XD} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c} + 3\mathbf{c} - \frac{1}{2}\mathbf{a}$ $\overrightarrow{CD} = \overrightarrow{OD} - \overrightarrow{OC} = 3.5\mathbf{c} - \mathbf{c} = 2.5\mathbf{c}$	P1	This mark is given for a process to find a vector expression for $\overrightarrow{CD}$
	$\overrightarrow{OC} : \overrightarrow{CD} = k : 1 = \mathbf{c} : 2.5\mathbf{c}$	P1	This mark is given for a process to find the value of k (using ratios)
	$k = \frac{1}{2.5} = \frac{2}{5}$	A1	This mark is given for the correct answer only

Question 3 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$B = (12, 0), E = (0, 6)$ Gradient of $\mathbf{L} = -\frac{1}{2}$	1	This mark is given for rearranging to find a gradient or positions of B and E
	$A = (-12, 12)$	1	This mark is given for finding the position of A
	Gradient of $\mathbf{M} = 2$	1	This mark is given for a finding the gradient of $\mathbf{M}$
	Equation of $\mathbf{M}$ is $y = 2x + 36$	1	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
	$y - 3x = 13$, so $y = 3x + 13$ $x^2 + (3x + 13)^2 = 25$	M1	This mark is given for the substitution of $y = 3x + 13$ into $x^2 + y^2 = 25$
	$x^2 + 9x^2 + 39x + 39x + 169 = 25$	M1	This mark is given for the expansion of $x^2 + (3x + 13)^2 = 25$
	$10x^2 + 78x + 144 = 0$	M1	This mark is given for forming a quadratic equation equal to zero
	$2(5x^2 + 39x + 72) = 0$ $2(5x + 24)(x + 3) = 0$	M1	This mark is given for a method to solve the quadratic equation
	$x = -3$, $y = 4$ $x = -\frac{24}{5}$, $y = -\frac{7}{5}$	A1	This mark is given for a pair of correct solutions only

Question 5 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{x^2}{3x + 5} = \frac{1}{2}$	P1	This mark is given for a process to form an equation
	$2x^2 = 3x + 5$ $2x^2 - 3x - 5 = 0$	P1	This mark is given for a process to write a quadratic equation to be solved
	$(2x - 5)(x + 1) = 0$	P1	This mark is given for a process to factorise the quadratic equation
	$x = 2.5$, $x = -1$	A1	This mark is given for the correct answers only

Question 6 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Ratio of lengths of containers = $\sqrt{4} : \sqrt{9} = 2 : 3$	P1	This mark is given for a process to find corresponding lengths of the containers
	Ratio of volumes of containers = $2^3 : 3^3 = 8 : 27$	P1	This mark is given for a process to find corresponding volumes of the containers
	$\frac{27}{8}$	P1	This mark is given for a process to find how much bigger container B is than container A
	$\frac{27}{8} = 3.375$ so 4 times	C1	This mark is given for the correct number of times Tyler fills container A

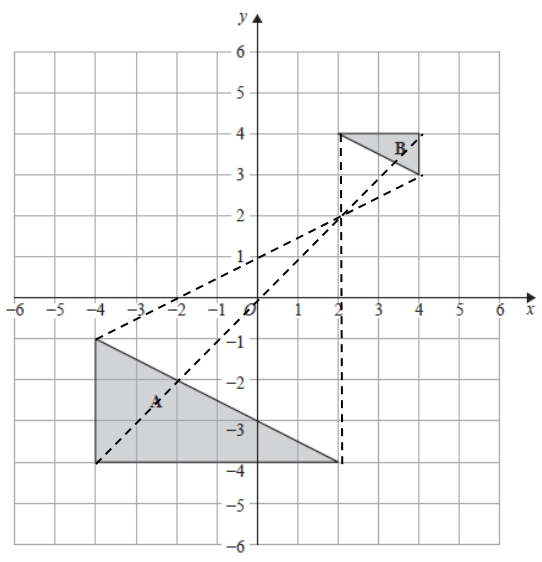
Question 7 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{3}{3+7} \times \frac{4}{4+5} = \frac{3}{10} \times \frac{4}{9} = \frac{12}{90} = \frac{2}{15}$	P1	This mark is given for a process to find the proportion of shapes which are white circles
	$\frac{7}{3+7} \times \frac{2}{2+5} = \frac{7}{10} \times \frac{2}{7} = \frac{2}{10} = \frac{1}{5}$	P1	This mark is given for a process to find the proportion of shapes which are black circles
	$\frac{2}{15} + \frac{1}{5}$	P1	This mark is given for a process to find the proportion of all shapes which are circles
	$\frac{1}{3}$	A1	This mark is given for the correct answer only

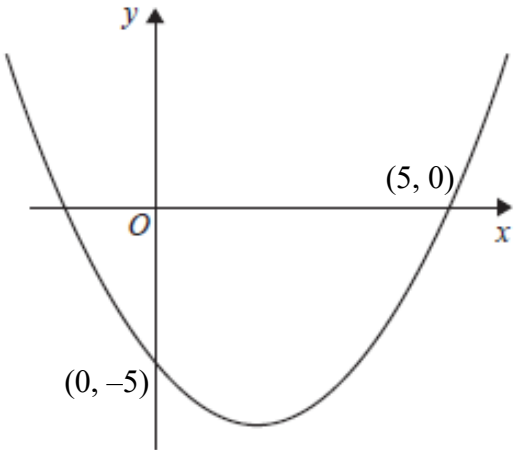
Question 8 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\sqrt{4} : \sqrt{25}$ $= 2 : 5$	P1	This mark is given for a process to find the ratio of the lengths A:B
	$\sqrt[3]{27} : \sqrt[3]{64}$ $= 3 : 4$	P1	This mark is given for a process to find the ratio of the lengths B:C
	$6 : 15 : 20$	P1	This mark is given for a process to find the ratio of the lengths A:B:C
	$3 : 10$	A1	This mark is given for the correct answer only

Question 9 (Total 2 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	 Enlargement of scale factor $-\frac{1}{3}$ with centre (2, 2)	C1 C1	This mark is given for all two parts of the transformation described This mark is given for all three parts of the transformation described

Question 10 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	 When $x = 0$ and $y = -5$, $-5 = 0^2 + (a \times 0) + b$ $b = -5$	P1	This mark is given for a process to substitute to find the value of b
	When $x = 5$ and $y = 0$, $0 = 5^2 + 5a - 5$ $a = -4$	P1	This mark is given for a process to substitute to find the value of a
	$y = x^2 - 4x - 5 = (x + 1)(x - 5)$ Thus the other intercept is at $(-1, 0)$	P1	This mark is given for a complete process to find the turning point
	Midpoint x-coordinate is 2 When $x = 2$, y-coordinate is -9 Turning point is $(2, -9)$	A1	This mark is given for the correct answer only

Question 11 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$ABC = BCD$	C1	This mark is given for comparing triangles ABC and BCD (given in the diagram)
	$AB = CD$	C1	This mark is given for stating that line $AB = CD$ (given in the diagram)
	$BC = BC$ (common)	C1	This mark is given for stating that line BC is common to both triangles ABC and BCD
	$ABC \equiv DCB$ [SAS] and thus $AC = BD$	C1	This mark is given for a conclusion to the proof showing that the two triangles have a common angle and two common sides; thus $AC = BD$

Question 12 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$x = \frac{- -8 \pm \sqrt{(-8)^2 - 4 \times 2 \times -5}}{2 \times 2}$	M1	This mark is given for a method to find the roots of $y = 0$
	$x = 2 + \sqrt{\frac{13}{2}}, \quad 2 - \sqrt{\frac{13}{2}}$	M1	This mark is given for finding the roots of $y = 0$
	x-coordinate for turning point = $\frac{1}{2} \left(2 + \sqrt{\frac{13}{2}} + 2 - \sqrt{\frac{13}{2}} \right) = 2$ When $x = 2, y = -13$	M1	This mark is given for the turning point of $y = 2x^2 - 8x - 5$
		C2	These marks are given for a fully correct parabola drawn with axes labelled, a turning point at $(2, -13)$ and intercepts at $(0, -5)$, $(2 + \sqrt{\frac{13}{2}}, 0)$ and $(2 - \sqrt{\frac{13}{2}}, 0)$ clearly shown

Question 13 (Total 2 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	For even numbers $2n$: $(2n)^2 - 2n = 4n^2 - 2n = 2(2n^2 - n)$ so even For odd numbers $2n + 1$: $(2n + 1)^2 - 2n + 1 = 4n^2 + 4n + 1 - (2n + 1)$ $= 4n^2 + 2n$ $= 2(n^2 + n)$ so even Thus for all integer value of n, $n^2 - n$ is never an odd number	C2	This mark is given for a fully correct proof (C1 is given for a partial explanation)

Question 14 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	When $x = 90$, $a \cos x^\circ = 0$ so $b = 1$	1	This mark is given for finding the value of b
	When $x = 0$, $a \cos x^\circ = 2$ so $a = 2$	1	This mark is given for finding the value of a
	When $x = 45$, $2 \cos x^\circ + 1 = 2 \times \frac{1}{\sqrt{2}} + 1$	1	This mark is given for finding an expression for $2 \cos x^\circ + 1$ when $x = 45$
	$1 + \sqrt{2}$	1	This mark is given for the correct answer only

Question 15 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$(y + x) = k(y - x)$	1	This mark is given for setting up an equations from the information given
	$ky - y = x + kx$	1	This mark is given for isolating x and y on opposite sides
	$y(k - 1) = k(x + 1)$ so $y = \frac{k(x + 1)}{k - 1}$	1	This mark is given for using correct algebra to reach a conclusion

Question 16 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$AB = \mathbf{b} - \mathbf{a}$	P1	This mark is given for the start to a process by finding the vector AB
	$OM = OA + \frac{1}{2}AB$ $= \mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a})$	P1	This mark is given for a process to find the vector OM
	$AP = AO + \frac{3}{5}OM$ $= -\mathbf{a} + \frac{3}{5}(\mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a}))$ $= -\mathbf{a} + \frac{3}{5}(\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b})$ $= -\frac{7}{10}\mathbf{a} + \frac{3}{10}\mathbf{b}$	P1	This mark is given for a process to find the vector AP
	$AN = -\mathbf{a} + k\mathbf{b} = \frac{10}{7}AP$ $= \frac{10}{7}(-\frac{7}{10}\mathbf{a} + \frac{3}{10}\mathbf{b}) = -\mathbf{a} + \frac{3}{7}\mathbf{b}$	P1	This mark is given for a process to find $k = \frac{3}{7}$ using AN as a multiple of AP
	Thus $ON : NB = 3 : 4$	A1	This mark is given for the correct answer only

Question 17 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\angle ACB = \angle ADB = 60^\circ$ Angles in the same segment are equal $\angle DBC = \angle DAC = 60^\circ$ Angles in the same segment are equal Thus $\angle ACB = \angle DBC = 60^\circ$	C1	This mark is given for arguments to show that $\angle ACB = \angle ADB$ and $\angle DBC = \angle DAC$ with reasons given to show that $\angle ACB = \angle DBC$
	$\angle ABC = 60 + \angle ABD = 60 + \angle ACD = \angle DCB$ Angles in the same segment are equal	C1	This mark is given for an argument to show that $\angle ABC = \angle DCB$
	BC is common to both triangles	C1	This mark is given for finding a side common to both triangles
	Thus triangles ABC and DCB are congruent (AAS)	C1	This mark is given for a correct conclusion with reference to AAS

Question 18 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{g}{r+g} = \frac{3}{7}$	P1	This mark is given for a process to find an initial relationship between r and g
	$\frac{g+3}{r+2+g+3} = \frac{6}{13}$	P1	This mark is given for a process to find a second relationship between r and g
	$7g = 3(r+g) = 3r + 3g$ $4g = 3r$ $13(g+3) = 6(r+g+5)$ $13g + 39 = 6r + 6g + 30$ $7g + 9 = 6r$	P1	This mark is given for simplifying the expressions for the relationships found
	$4g = 3r$ $7g + 9 = 6r$ $7g + 9 = 8g$	P1	This mark is given for a process to form simultaneous equations to be solved
	$g = 9$ $r = 12$	A1	This mark is given for the correct answer only (12 red, 9 green)

Question 19 (Total 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\cos 30^\circ = \frac{\sqrt{3}}{2}$	B1	This mark is given for a correct statement about the value of $\cos 30^\circ$ (seen anywhere)
	$PQ^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \times \cos PBQ$ $= 200 - 200 \cos PBQ$	M1	This mark is given for applying the cosine rule to find an expression for PQ^2
	$AC^2 = x^2 + x^2 - 2 \times x \times x \times \cos 30^\circ$ $= 2x^2 - 2x^2 \frac{\sqrt{3}}{2}$ $= 2x^2(1 - \frac{\sqrt{3}}{2})$ $= (2 - \sqrt{3})x^2$	M1	This mark is given for applying the cosine rule to find an expression for AC^2
	$\cos PBQ = \frac{200 - PQ^2}{200} = 1 - \frac{PQ^2}{200}$	M1	This mark is given for rearranging to find an expression for $\cos PBQ$
	$\cos PBQ = 1 - \frac{PQ^2}{200} = 1 - \frac{AC^2}{200}$ $= 1 - \frac{(2 - \sqrt{3})}{200} x^2$	A1	This mark is given for a conclusion of proof with all working seen

Question 20 (Total 6 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Let x be the number of green pens in the box The probability of taking two green pens is $\frac{x}{2x+3} \times \frac{x-1}{2x+2}$ The probability of taking two blue pens is $\frac{x+3}{2x+3} \times \frac{x+2}{2x+2}$	P1	This mark is given for a process to find the probability of taking two green pens or the probability of taking two blue pens
	The probability of taking two pens of the same colour is $\frac{x}{2x+3} \times \frac{x-1}{2x+2} + \frac{x+3}{2x+3} \times \frac{x+2}{2x+2} = \frac{27}{55}$	P1	This mark is given for forming an equation for the probability Simon takes two pens of the same colour
	$55(x(x-1) + (x+3)(x+2)) = 27(2x+3)(2x+2)$	P1	This mark is given for a process to eliminate fractions from the algebraic expression
	$55(2x^2 + 4x + 6) = 27(4x^2 + 10x + 6)$ $110x^2 + 22x + 330 = 108x^2 + 270x + 162$ $2x^2 - 50x + 168 = 0$ $x^2 - 25x + 84 = 0$	P1	This mark is given for reducing the expression to a quadratic equation
	$(x-21)(x-4) = 0$	P1	This mark is given for finding a method to solve the quadratic equation
	21	A1	This mark is given for the correct answer only

Qn	Skill tested	Mean score	Max score	Edexcel averages: scores of candidates who achieved grade:						
				ALL	9	8	7	6	5	4
1	Mathematical arguments and proofs	0.12	2	0.12	1.75	1.35	0.71	0.36	0.21	0.07
2	Vectors	0.98	4	0.98	3.15	2.10	1.25	0.72	0.39	0.20
3	Graphs and equations of lines	0.11	4	0.11	3.62	2.38	1.21	0.40	0.12	0.02
4	Solve two simultaneous equations	1.02	5	1.02	3.62	2.36	1.45	0.72	0.26	0.07
5	Solve quadratic equations	0.92	4	0.92	3.64	2.50	1.16	0.38	0.12	0.04
6	Relationships between lengths, areas and volumes in similar figures	0.23	4	0.23	3.33	2.51	1.11	0.42	0.11	0.02
7	Relate ratios to fractions and to linear functions	0.84	4	0.84	3.03	1.86	1.05	0.57	0.29	0.12
8	Relationships between lengths, areas and volumes in similar figures	0.21	4	0.21	3.90	2.15	1.01	0.39	0.21	0.06
9	Transformations	0.14	2	0.14	1.00	0.67	0.50	0.33	0.19	0.06
10	Roots, intercepts, turning points of quadratic functions	0.20	4	0.20	4.00	3.18	0.99	0.39	0.14	0.03
11	Basic congruence criteria for triangles (SSS, SAS, ASA, RHS)	0.85	4	0.85	2.24	1.44	0.98	0.72	0.54	0.39
12	Graphs of quadratic functions	0.23	5	0.23	4.11	2.05	1.03	0.37	0.18	0.03
13	Mathematical arguments and proofs	0.34	2	0.34	1.29	0.72	0.41	0.23	0.10	0.03
14	Exact values of sin, cos and tan	0.11	4	0.11	3.12	1.91	0.71	0.34	0.12	0.04
15	Relate ratios to fractions and to linear functions	0.06	3	0.06	2.25	1.59	0.51	0.22	0.05	0.02
16	Vectors	0.18	5	0.18	2.50	0.82	0.71	0.30	0.15	0.11
17	Basic congruence criteria for triangles (SSS, SAS, ASA, RHS)	0.17	4	0.17	1.78	0.76	0.50	0.33	0.16	0.08
18	Independent and dependent combined events	0.62	5	0.62	3.61	1.37	0.52	0.23	0.11	0.04
19	Sine and cosine rule	0.18	5	0.18	1.12	0.39	0.18	0.08	0.03	0.01
20	Conditional probability	0.04	6	0.04	2.80	0.67	0.21	0.04	0.02	0.00
	TOTAL	7.55	80	7.55	55.86	32.78	16.20	7.54	3.50	1.44

Grade 9 students averaged 56 marks on this set of questions in examinations.