

GCSE Mathematics (1MA1) – Higher Tier Paper 2H

Aiming for Grade 9 – Spring 2020 student-friendly mark scheme

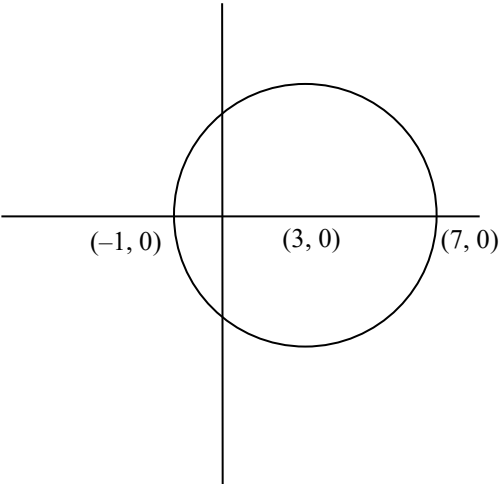
Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn't show follow-through marks (marks that are awarded despite errors being made) or special cases.

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 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	The curve cuts the y axis at $x = 0$ $y = a^x = a^0 = 1$ $(0, 1)$	B1	This mark is given for the correct answer only
(b)		M1	This mark is given for any one of a circle with radius 4, centre $(3, 0)$ or points $(-1, 0)$ and $(7, 0)$ labelled
		M1	This mark is given for any further element of a circle with radius 4, centre $(3, 0)$ or points $(-1, 0)$ and $(7, 0)$ labelled
		A1	This mark is given for a fully correct sketch only: a circle with radius 4 and centre $(3, 0)$ and with the points $(-1, 0)$ and $(7, 0)$ labelled

Question 2 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$0.5 \times 5 \times 2 = 5$ or $0.5 \times 5 \times (2 + 5) = 17.5$ or $0.5 \times 5 \times (5 + 10) = 37.5$ or $0.5 \times 5 \times (10 + 18) = 70$	1	This mark is given for splitting the area into 4 strips and finding the area of one triangle or trapezium
	$5 + 17.5 + 37.5 + 70$	1	This mark is given for a method to find and add up the totals of the four shapes
	130	1	This mark is given for the correct answer only
(b)	My answer to part (a) is an overestimate because the area measured is greater than the area below the curve	1	This mark is given for a correct statement

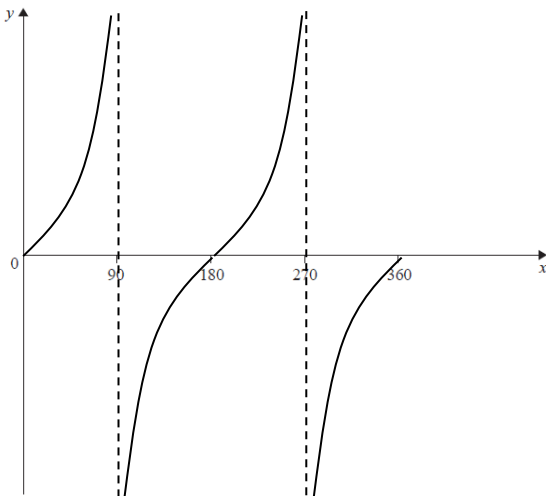
Question 3 (Total 1 mark)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$1 - 0.02 = 0.98$	1	This mark is given for the correct answer only

Question 4 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$OAB = 90^\circ$; $OCB = 90^\circ$	1	This mark is given for identifying a right angle in the diagram
	$AB = CB = 10 \times \tan 60^\circ = 10\sqrt{3}$	1	This mark is given for finding the length of AB or CB
	$\text{Area } OAC = \frac{120}{360} \times \pi \times 10^2 = 104.72\dots$	1	This mark is given finding the area of the sector
	$\text{Area } OAB = OBC$ $= \frac{1}{2} \times 10 \times 10\sqrt{3} = 50\sqrt{3}$	1	This mark is given for finding the area of the right angled triangle OAB or OBC
	$\text{Shaded area} = \text{area } OABC - \text{area } OAC$ $= (2 \times 50\sqrt{3}) - 104.72 = 68.5$	1	This mark is given for a correct answer in the range 68.4 – 68.6

Question 5 (Total 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
		C2	These marks are given for a fully correct sketch between 0° and 360° (C1 is given for a partially correct shape drawn)

Question 6 (Total 4 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$\frac{2(x-3)(x+3) - (x+2)(x+3) - (x-6)(x-3)}{(x-3)(x+3)}$	M1	This mark is given for at least two correct terms in rearranging the equation
	$\frac{2x^2 - 18 - (x^2 + 5x + 6) - (x^2 - 9x + 18)}{(x-3)(x+3)}$	M1	This mark is given for the correct expansion of at least two expressions
	$\frac{2x^2 - 18x - x^2 - 5x - 6 - x^2 + 9x - 18}{(x-3)(x+3)}$	M1	This mark is given for collecting terms
	$= \frac{4x - 42}{(x^2 - 9)}, \text{ so } a = 4, b = -42$	A1	This mark is given for the correct answer only

Question 7 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$16 = 2^4 \quad \text{or} \quad 8 = 2^3$	P1	This mark is given for converting to a common base with at least one correct conversion
	$(2^4)^{\frac{1}{5}} \times 2^x = (2^3)^{\frac{3}{4}}$ $2^{\frac{4}{5}+x} = 2^{\frac{9}{4}}$	P1	This mark is given for a process to use of index laws to derive an equation
	$\frac{4}{5} + x = \frac{9}{4}$ $x = \frac{29}{20} = 1.45$	A1	This mark is given for the correct answer only

Question 8 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
		P1	This mark is given for drawing a tangent to the curve at time $t = 5$
	$\frac{70-0}{8-3} = \frac{70}{5}$	P1	This mark is given for a process to find the gradient
	14 m/s	A1	This mark is given for answer in the range 11 – 19 m/s

Question 9 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Volume shape A : volume shape B = $= (\sqrt{3})^3 : (\sqrt{4})^3$ $= \sqrt{27} : 8$	M1	This mark is given for a method to find the scale factors of volumes
	Volume shape A = $\sqrt{27} \times \frac{10}{8}$	M1	This mark is given for a method to use the ratio of volumes to find the volume of shape A
	6.5	A1	This mark is given for the correct answer only

Question 10 (Total 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\sqrt[4]{\frac{16}{81}} = \frac{2}{3}$	M1	This mark is given for a method to find the probability of throwing one head
	Probability of getting 4 tails = $\left(1 - \frac{2}{3}\right)^4$ $\frac{1}{81}$	A1	This mark is given for the correct answer only

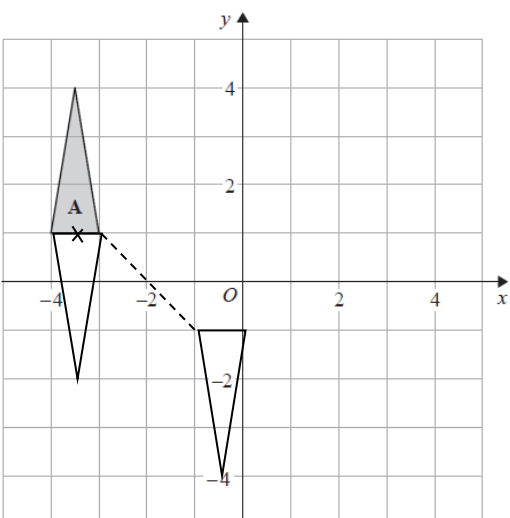
Question 11 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	(angle) $BAE =$ (angle) CDE <u>angles</u> in the same <u>segment</u> are equal or <u>angles</u> at the circumference <u>subtended</u> on the same <u>arc</u> are equal	C1	This mark is given for identifying one pair of equal angles with a correct reason
	(angle) $AEB =$ (angle) DEC <u>opposite angles</u> or <u>vertically opposite</u> angles are equal	C1	This mark is given for identifying a second pair of equal angles with a correct reason
	Thus the two triangles have three pairs of equal angles and so are similar	C1	This mark is given for a correct conclusion with supporting reasons

Question 12 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	The terms of $2n^2 - 1$ are 1, 7, 17, 31, 49...	M1	This mark is given for a method to generate at least three terms of the first sequence
	The terms of $40 - n^2$ are 39, 36, 31, 24, 15...	M1	This mark is given for a method to generate at least three terms of the second sequence
	31	A1	This mark is given for a correctly identifying the only number in both sequence

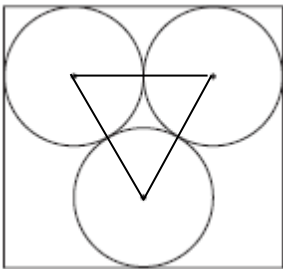
Question 13 (Total 2 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
		M1	This mark is given for showing a rotation of 180° about $(-2, 0)$ followed by a translation $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$
	$(-3.5, 1)$	A1	This mark is given for the correct answer only

Question 14 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{x}{4x-1} = \frac{6x+5}{12x+31}$	P1	This mark is given for a process to derive an equation in x
	$(4x-1)(6x+5) = x(12x+31)$	P1	This mark is given for a process to remove fractions from the equation
	$24x^2 + 14x - 5 = 12x^2 + 31x$ $24x^2 + 14x - 5 - 12x^2 - 31x = 0$ $12x^2 - 17x - 5 = 0$	P1	This mark is given for a process to form a quadratic equation
	$(4x+1)(3x-5) = 0$ or $\frac{-(-17) \pm \sqrt{289 - (4 \times 12 \times -5)}}{24}$ $= \frac{17 \pm \sqrt{529}}{24}$	P1	This mark is given for a process to solve the quadratic equation, either by factorising or by using the quadratic formula
	$x = \frac{5}{3}$ (rejecting $x = -\frac{1}{4}$)	A1	This mark is given for the correct answer only

Question 15 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$24 \times 4 = 96$	P1	This mark is given for a process to find the length of the rectangle
	 $48 \sin 60^\circ = 48 \times \frac{\sqrt{3}}{2} = 24\sqrt{3}$ or $\sqrt{(48^2 - 24^2)} = 24\sqrt{3}$	P1	This mark is given for a process to find the perpendicular height of an equilateral triangle of side 48 cm
	$24 + 24 + 24\sqrt{3} = 89.569\dots$	P1	This mark is given for a complete process to find the width of rectangle
	8600 (to 3 significant figures)	A1	This mark is given for a correct answer only

Question 16 (Total 5 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$ABC = 360^\circ - 150^\circ - 143^\circ = 67^\circ$	P1	This mark is given for a process to find the angle ABC
	$AC^2 = 9^2 + 8^2 - (2 \times 9 \times 8 \times \cos 67^\circ)$ $AC^2 = 88.734\dots$	P1	This mark is given for a process to use the cosine rule $AC^2 = AB^2 + BC^2 - 2 \times AB \times BC \cos ABC$ to find AC
	$AC = 9.412$	P1	This mark is given for correctly finding the distance AC
	$\frac{\sin BAC}{9} = \frac{\sin 67^\circ}{9.412}$ $\sin BAC = \frac{9 \sin 67^\circ}{9.412} = 0.8802$ $BAC = 61.6^\circ$	P1	This mark is given for a process to use the sine rule to find the angle BAC
	$37 + 62.6 = 098.6$	A1	This mark is given for a correct answer in the range 098.5 to 098.6

Question 17 (Total 6 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$(2x - 1)(10 - x) \times \sin 150^\circ$	M1	This mark is given for a method to find the area of the parallelogram
	$\frac{1}{2}(2x - 1)(10 - x) > 15$	M1	This mark is given for a method to form an inequality
	$(2x - 1)(10 - x) > 30$ $-2x^2 + 21x - 10 > 30$ $-2x^2 + 21x - 40 > 0$ $2x^2 - 21x + 40 < 0$	C1	This mark is given for a completely correct chain of reasoning leading to $2x^2 - 21x + 40 < 0$
(b)	$(2x - 5)(x - 8) < 0$	M1	This mark is given for a method to factorise $2x^2 - 21x + 40 < 0$
	$x = 2.5, x = 8$	M1	This mark is given for a method to find the critical values 2.5 and 8
	$2.5 < x < 8$	A1	This mark is given for the correct range of values for x

Question 18 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{1}{2} \times AE \times 24 \sin 30^\circ = 6AE$	P1	This mark is given for a process to find the area of one of triangle AFE (and thus the area of triangle BCD)
	$2 \times 6AE = 12AE$	P1	This mark is given for a process to find the area of the rectangle $ABDE$
	Let $AB = x$ and $AE = 3x$ Then $12 \times 3x = 3x \times x$ $36x = 3x^2$	P1	This mark is given for a process to use the ratio $AB:AE = 1:3$ and use the area of the rectangle $ABDE$ to find the length AE
	$36 = 3x$ $AE = 36$	A1	This mark is given for the correct answer only

Question 19 (Total 4 marks)

Part	Working an or answer examiner might expect to see	Mark	Notes
	$OA = 16 \sin 30^\circ = 8$	P1	This mark is given for a process to find the length OA
	$x^2 + y^2 = 64$	P1	This mark is for a process to use the equation of the circle $x^2 + y^2 = r^2$
	$9p^2 + p^2 = 64$ $10p^2 = 64$ $p = \sqrt{6.4}$	P1	This mark is given for a process to substitute $3p$ and p into the equation for a circle to solve for p
	2.53	A1	This mark is given for a correct answer in the range 2.52 to 2.53

Question 20 (Total 2 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Rotation 180° or Rotation 90° clockwise or Rotation 90° anticlockwise	C1	This mark is given for finding an angle of the rotation
	about $(-1, 2)$ or $(-1, 4)$ or about $(-1, 0)$ or about $(-1, 6)$	C1	This mark is given for finding the corresponding centre of rotation

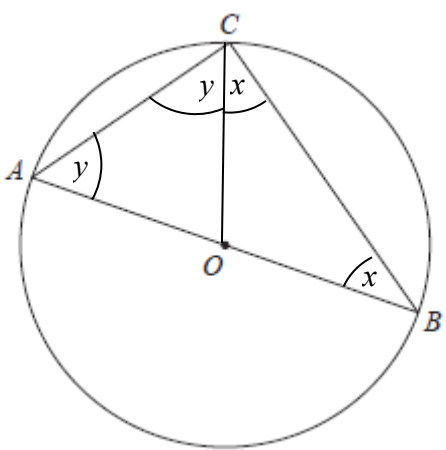
Question 21 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Gradient $\frac{y}{x} = \frac{\sqrt{7}}{2} \div \frac{3}{2} = \frac{\sqrt{7}}{3}$	M1	This mark is given for a method to find gradient of OP
	$\frac{\sqrt{7}}{3} \times m = -1$, so $m = \frac{-3}{\sqrt{7}}$	M1	This mark is given for a method to find gradient m of the tangent to OP
	Gradient of tangent to OP, $y = \frac{-3}{\sqrt{7}}x + c$ $\frac{\sqrt{7}}{2} = \frac{-3}{\sqrt{7}} \times \frac{3}{2} + c$ $\text{so } c = \frac{\sqrt{7}}{2} + \frac{9}{2\sqrt{7}} = \frac{16}{2\sqrt{7}} = \frac{8}{\sqrt{7}}$ Thus equation of the tangent to L is $y = \frac{-3}{\sqrt{7}}x + \frac{8}{\sqrt{7}}$	A1	This mark is given for the correct answer only

Question 22 (Total 3 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$OAD = 90$	B1	This mark is given for a finding the size of the angle OAD
	$AOB = 90 + 32 = 122$ $OAB = \frac{180 - 122}{2} = 29$	M1	This mark is given for a method to find the size of the angle OAB
	$CAB = 180 - 90 - 29 = 61$	A1	This mark is given for the correct answer only

Question 23 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	 base angles of an isosceles triangle are equal	1	This mark is given for drawing the line OC to make an isosceles triangles OBC and AOC
	$x + x + y + y = 180^\circ$ angles in a triangle add up to 180	1	This mark is given for finding the sum of the angles in triangle ABC
	$2x + 2y = 2(x + y) = 180,$ so $x + y = \text{angle } ACB = 90^\circ$	1	This mark is given for a complete proof to show $ACB = 90^\circ$
		1	This mark is given for a complete proof with all reasons given

Qn	Skill tested	Mean score	Max score	Edexcel averages: scores of candidates who achieved grade:						
				ALL	9	8	7	6	5	4
1	Graphs of exponential functions / translations and reflections of a function	0.96	4	0.96	3.47	2.50	1.32	0.54	0.19	0.07
2	Area under graph	0.15	4	0.15	3.38	2.27	1.29	0.67	0.24	0.05
3	Rates of change	0.04	1	0.04	0.75	0.65	0.32	0.15	0.06	0.00
4	Areas of composite shapes	0.26	5	0.26	3.38	2.65	1.59	0.96	0.43	0.15
5	Graphs of trigonometric functions	0.10	2	0.10	1.90	1.47	0.61	0.22	0.04	0.01
6	Simplify and manipulate algebraic expressions and fractions	0.79	4	0.79	2.40	1.71	1.18	0.64	0.25	0.07
7	Index notation	0.71	3	0.71	2.08	1.32	0.88	0.58	0.38	0.22
8	Gradient at a point on a curve as the instantaneous rate of change	0.63	3	0.63	2.55	1.70	0.87	0.33	0.09	0.02
9	Relationships between lengths, areas and volumes in similar figures	0.61	3	0.61	2.60	1.74	0.85	0.28	0.07	0.01
10	Independent and dependent combined events	0.09	2	0.09	1.56	0.76	0.52	0.17	0.02	0.01
11	Circle theorems	0.60	3	0.60	1.91	1.21	0.76	0.47	0.27	0.12
12	Generate terms of a sequence	0.60	3	0.60	1.00	0.49	0.75	0.73	0.76	0.67
13	Transformations	0.21	2	0.21	1.30	0.68	0.48	0.38	0.28	0.15
14	Translate situations or procedures into algebraic expressions, formulae or equations	0.92	5	0.92	4.27	2.64	1.15	0.40	0.11	0.03
15	Pythagoras' Theorem and Trigonometry	0.74	4	0.74	1.98	1.16	0.85	0.68	0.50	0.31
16	Sine and cosine rule	0.86	5	0.86	3.74	2.15	0.98	0.38	0.15	0.06
17	Solve quadratic inequalities	0.29	6	0.29	3.55	3.03	1.10	0.57	0.26	0.04
18	Area of a triangle using the angle formula	0.65	4	0.65	2.98	1.50	0.67	0.32	0.15	0.07
19	Equation of a circle	0.42	4	0.42	2.12	0.90	0.45	0.21	0.08	0.03
20	Combinations of transformations	0.08	2	0.08	0.78	0.32	0.21	0.14	0.09	0.04
21	Equation of a circle	0.26	3	0.26	1.89	0.73	0.18	0.04	0.01	0.00
22	Solve two simultaneous equations	0.06	4	0.06	2.22	0.78	0.21	0.1	0.02	0.01
23	Circle theorems	0.03	4	0.03	2.75	0.82	0.08	0.08	0.03	0.01
	TOTAL	10.06	80	10.06	54.56	33.18	17.30	9.04	4.48	2.15

Grade 9 students averaged about 55 marks on this set of questions in examinations.