Cambridge Assessment International Education

Cambridge IGCSE™

MATHEMATICS **0580/43**

Paper 4 (Extended) **May/June 2023**

MARK SCHEME

Maximum Mark: 130

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

[Turn over

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Maths-Specific Marking Principles	
1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
3	Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
4	Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
5	Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread.
6	Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

Abbreviations

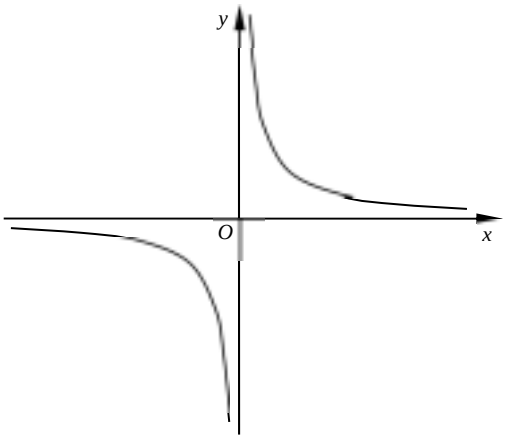
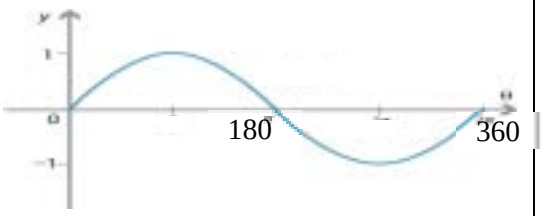
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfww	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)(i)	22.5	**2**	**M1** for $\frac{9}{14+17+9}$ [×100]
1(a)(ii)	238	**2**	**FT** *their* 14 + 17 + 9 = *N* seen in **(a)(i)** **M1** for $\frac{560}{\textit{their}\ (14+17+9)} \times k$, where k = 1, 9, 14 or 17
1(a)(iii)	<u>METHOD 1</u> 1.25 × 195 oe	**M2**	**M1** for $\frac{25}{100} \times 195$
	243[.75] and No oe	**A1**	Strict **FT** yes if *their* **(a)(ii)** > 243.75 If M0 scored, then **SC1** for 243.75 and a correct conclusion.
	<u>METHOD 2</u> $\frac{\textit{their}\ 238}{195} - 1 = 0.22\ldots$ oe	**(M2)**	**M1** for $\frac{\textit{their}\ 238}{195} = 1.22...$ oe
	22[%] (or better) and No oe	**(A1)**	Strict **FT** yes if *their* **(a)(ii)** gives answer > 25 If M0 scored, then **SC1** for 22.05 and a correct conclusion.
	<u>METHOD 3</u> 195 × 0.25 = 48.75 oe **and** *their* 238 – 195 = 43	**(M2)**	**M1** for 0.25 × 195
	43 **and** 48.75 and NO	**(A1)**	Strict **FT** yes if *their* **(a)(ii)** gives profit > 48.75 If M0 scored, then **SC1** for 43 and 48.75 and a correct conclusion.
	<u>METHOD 4</u> $\frac{\textit{their}\ 238}{125} \times 100$	**(M2)**	**M1** for $x \times \left(1+\frac{25}{100}\right) = \textit{their}\ 238$
	190.4 and NO	**(A1)**	Strict **FT** yes if *their* **(a)(ii)** gives answer > 195 If M0 scored then **SC1** for 190.4 and a correct conclusion.
1(b)	56.55	**2**	**M1** for $\frac{725 \times 1.3[\times 6]}{100}$ oe

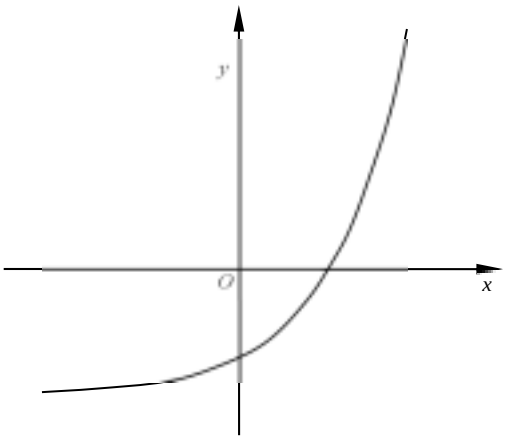
Question	Answer	Marks	Partial Marks
1(c)	48.5[0]	**2**	**M1** for $x \times \left(1-\frac{24}{100}\right) = 36.86$ oe
2(a)(i)	1 | 3 5 7 8 2 | 1 1 2 7 8 9 3 | 1 1 1 8 1 | 7 represents 17 [messages]	**3**	**B2** for fully correct stem-and-leaf diagram OR **B1** for two rows correct or for fully correct unordered stem-and-leaf diagram or for a correct diagram with one error or omission **B1** for correct key
2(a)(ii)	24.5	**1**	
2(a)(iii)	31	**1**	
2(a)(iv)	25	**1**	
2(b)	$\frac{14}{33}$ oe	**2**	**M1** for $\frac{8}{12}\times\frac{7}{11}$
3(a)(i)	118	**1**	
3(a)(ii)	X is 8.3 cm from B	**2**	**M1** for (332 ÷ 200) × 5 oe
3(a)(iii)	1 : 4000	**2**	**M1** for 200 ÷ 5 or 200 × 100, both soi
3(b)	1.13 or 1.128 to 1.129	**5**	**M4** for $4.5 \times \sqrt[3]{\frac{0.385\times 8000}{195200}}$ oe or $\sqrt[3]{\frac{4.5^3\times 0.385\times 8000}{195200}}$ oe or **M3** for $\sqrt[3]{\frac{0.385}{their\,24.4}}$ or $\sqrt[3]{\frac{their\,3080}{195200}}$ or $\frac{0.385}{their\,24.4}=\frac{l^3}{4.5^3}$ oe or **M2** for $\frac{their\,24.4}{0.385}$ or $\frac{0.385}{their\,24.4}$ oe or **B2** for 24.4 or 3080 seen or **M1** for 195 200 ÷ 8000 or for 0.385 × 8000

Question	Answer	Marks	Partial Marks
4(a)	246	**3**	**B2** for *BCS*(outh) = 66 or *BCA* = 48 **and** *ACN*(orth) = 66 or *BCW*(est) = 24 or *ACS*(outh) = 114 or **B1** for *ABC* = 66 or *BAC* = 66 or *BCA* = 48 or *ACN*(orth) = 66
4(b)(i)	58	**1**	
4(b)(ii)	106	**1**	
4(b)(iii)	47	**2**	**B1** for *PRQ* = 27 or **B1FT** for *SPR*, either = 48 or = 106 – *their* **(b)(i)** or **B1FT** for *RPQ* = *their* **(b)(i)** – 11
4(c)	Radius perpendicular to tangent	**1**	
	Tangents to circle from a/same point oe	**1**	
	RHS	**1**	
	68 angles on a [straight] line add up/sum to 180 oe	**1**	
	56 [base angles of] isosceles triangle	**1**	
	OBC = *BOT* Alternate angles	**1**	Angles and reason required and dependent on *OBC* and *BOT* correct
5(a)(i)	2[.00] or 2.002 to 2.003 nfww	**3**	**M2** for $\sqrt{4.8^2 + 5.6^2 - 2 \times 4.8 \times 5.6 \times \cos 20.4}$ OR **M1** for $4.8^2 + 5.6^2 - 2 \times 4.8 \times 5.6 \times \cos 20.4$ **A1** for 4.01[17…] or 4.012
5(a)(ii)	4.1[0] or 4.11 or 4.100 to 4.107 cao	**2**	**M1** for $\tan 64 = \frac{AX}{\textit{their}\ \textbf{(a)(i)}}$ or for $\frac{AX}{\sin 64} = \frac{\textit{their}\ \textbf{(a)(i)}}{\sin(90-64)}$ oe
5(a)(iii)	6.96	**2**	**M1** for $\frac{1}{2} \times 4.8 \times 2.9$ oe

Question	Answer	Marks	Partial Marks
5(b)	11.3 or 11.31..	**5**	**M4** for $2\times\frac{8}{\sin(45)}\times\sin 30$ or **B4** for *PM* = 5.65[685...] or 5.66 or better OR **B1** for *angle RPM* = 45° **M2** for $\frac{8}{\sin(their\ 45)}\times\sin 30$ or **M1** for implicit form
6(a)(i)	Correct curve	**3**	**B1** for correct horizontal placement for 6 plots **B1** for correct vertical placement for 6 plots **B1 dep on at least B1** for reasonable increasing curve through *their* 6 points If 0 scored, **SC1** for 4 out of 6 points correctly plotted
6(a)(ii)(a)	87 to 89.5	**1**	
6(a)(ii)(b)	12.5 to 14	**2**	**B1** for [LQ =] 80.5 to 81.5 or [UQ =] 94 to 94.5
6(a)(ii)(c)	Strict FT, 200 – *their* cumul freq reading from *their* graph at 110 given to nearest integer	**2**	**B1FT** for correct cumul freq at 110 seen or for non-integer answer
6(b)(i)	3576	**4**	**M1** for midpoints soi **M1** for use of $\sum fx$ where x is in the correct interval including boundaries **M1** (dep on 2nd **M1**) for $\sum fx \div 50$
6(b)(ii)	5 3.2 3	**3**	**B1** for each If 0 scored, **SC1** for 3 frequency densities $\frac{12}{600}, \frac{15}{900}, \frac{16}{1500}, \frac{7}{700}$ seen oe to 3sf or better or multiplier 3 or 300
7(a)	Cubic	**1**	

Question	Answer	Marks	Partial Marks
7(b)(i)	Correct sketch 	**2**	**B1** for one branch correct or an attempt at the correct shape Maximum 1 mark if sketch crosses *x*-axis or *y*-axis
7(b)(ii)	$\pm\frac{1}{2}$ **nfww**	**2**	**M1** for $4x^2 = 1$ oe or **B1** for $\frac{1}{2}$ or $-\frac{1}{2}$ nfww
7(c)(i)	Correct sketch through (0, 0) (180, 0) and (360, 0) with max and min at 1 and –1 resp. 	**2**	**B1** for correct sine curve shape, starting at the origin, with minimum of 1 cycle.
7(c)(ii)	199.5 or 199.47... and 340.5...	**3**	**B2** for one correct or **M1** for sin *x* = $-\frac{1}{3}$ oe If 0 scored, **SC1** for two reflex angles with a sum of 540 or 2 non-reflex angles with a sum of 180
8(a)	$4x + 3(x + 27) = 194.75$ or $4x + 3x + 81 = 194.75$	**M1**	
	16.25 cao	**B2**	**M1** for $7x = k$ where $k < 194.75$ or **B1** for answer 16.3
8(b)	$x^2 - 20x - 69 [= 0]$ oe or $y^2 + 116y - 861 [= 0]$ oe	**M2**	**M1** for $x^2 + 4(-8 - 5x) = 37$ oe or for $37 - 4y = \left(\frac{-8 - y}{5}\right)^2$ oe or for $x^2 + 4y = 37$ and $20x + 4y = -32$ subtracted with no more than one error

Question	Answer	Marks	Partial Marks
	$(x + 3)(x – 23)$ [= 0] oe or $(y – 7)(y + 123)$ [= 0] oe	**M1**	correct method to solve *their* quadratic e.g. $x = \frac{-(-20) \pm \sqrt{(-20)^2 - 4 \times 1 \times (-69)}}{2 \times 1}$ or $x – 10 = \pm 13$ or $x – 10 = \pm\sqrt{169}$
	$x = -3$ $y = 7$ $x = 23$ $y = -123$ final answer	**B2**	**B1** for one correct pair or two correct x values or two correct y values
8(c)	$2\pi x \times 6x + 2\pi x^2$ or $2\pi x(6x + x)$	**M2**	or **M1** for $2\pi x \times 6x$ or $2\pi x^2$
	Their $(2\pi x \times 6x + 2\pi x^2) = 4\pi r^2$	**M1**	Dep on at least on M1 earned *Their* LHS must be an area in terms of x only
	At least one further stage of working leading to $r^2 = \frac{7}{2}x^2$	**A1**	with no error seen
9(a)(i)	311 or 311.0 to 311.1	**3**	**M2** for $11 \times 11 + 2 \times \frac{1}{4} \times \pi \times 11^2$ oe or **M1** for [2 ×] $\frac{1}{4} \times \pi \times 11^2$ or 11×11 oe
9(a)(ii)	78.6 or 78.55 to 78.56...	**3**	**M2** for $4 \times 11 + 2 \times \frac{1}{4} \times 2 \times \pi \times 11$ oe or **M1** for [2 ×] $\frac{1}{4} \times 2 \times \pi \times 11$ or 4×11 oe
9(b)	35.2 or 35.3 or 35.239… to 35.28	**4**	**M3** for [tan =] $\frac{7}{\sqrt{7^2 + 7^2}}$ or [sin =] $\frac{7}{\sqrt{7^2 + 7^2 + 7^2}}$ or [cos =] $\frac{\sqrt{7^2 + 7^2}}{\sqrt{7^2 + 7^2 + 7^2}}$ OR **M2** for $AG = \sqrt{7^2 + 7^2 + 7^2}$ or for $\sqrt{7^2 + \left(\frac{7}{\sin 45}\right)^2}$ oe or for $AC = \sqrt{7^2 + 7^2}$ or $\frac{7}{\sin 45}$ oe OR **M1** for $7^2 + 7^2$ or for implicit trigonometry or identifying correct angle

Question	Answer	Marks	Partial Marks
10(a)	–2.5 –2 –1	**3**	**B1** for each
10(b)	Correct curve  	**4**	**B3 FT** for 8 or 7 correct plots **B2 FT** for 6 or 5 correct plots **B1 FT** for 4 or 3 correct plots
10(c)	2.3 to 2.4	**1**	
10(d)	ruled line $y = x - 1.5$	**M2**	**M1** for $y = x - 1.5$ soi or for $2^x - 3 = x - 1.5$ seen. or $y = x + k$ or $y = kx - 1.5$ drawn Do not accept $y = -1.5$
	–1 and 1.55 to 1.7	**A2**	**A1** for each
11(a)	10	**3**	**M2** for $(1 - -7)^2 + (4 - -2)^2$ oe or **M1** for $(1 - -7)$ or $(4 - -2)$ oe
11(b)	$\frac{4}{3}$ or $\frac{8}{6}$	**2**	**M1** for $\frac{1 - -7}{4 - -2}$ oe
11(c)	$y = -\frac{3}{4}x - \frac{9}{4}$ or $4y + 3x + 9 = 0$ oe **final answers**	**4**	**B3** for $-\frac{3}{4}x - \frac{9}{4}$ OR **B1** for midpoint (1, − 3) **M1** for gradient $-\frac{3}{4}$ or $-\frac{1}{\textit{their}}$ **(b)** **M1** for substituting *their* (1, −3) into $y = (\textit{their } m)x + c$ or for *their m* = $\frac{y - -3}{x - 1}$ oe
12(a)	$4x^3 - 16x$ cao	**2**	**M1** for $4x^3 + kx$ or $kx^3 - 16x$ or $4x^3 - 16x + k$ or $4x^3 - 16$ as final answers

Question	Answer	Marks	Partial Marks
12b	*Their* $\frac{dy}{dx} = 0$ or stating $\frac{dy}{dx} = 0$	**B1**	
	Correct method to solve *their* $4x^3 - 16x = 0$	**M1**	e.g. $4x(x^2 - 4)$ or $4x(x - 2)(x + 2)$ oe
	$[x =]$ 0, –2, 2	**A1**	Or **B1** for (–2, –11) and (2, –11)
	(0, 5) (–2, –11) (2, –11)	**A1**	
12(c)	(0, 5) with correct reasoning	**2**	**M1** for any of • correct use of 2nd derivative $12x^2 - 16$ • evaluates correctly both values of y on either side • evaluates correctly the gradient on either side • reasonable correct sketch