Cambridge Assessment International Education

Cambridge O Level

MATHEMATICS (SYLLABUS D) **4024/22**

Paper 2 **May/June 2023**

MARK SCHEME

Maximum Mark: 100

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.

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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.

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Mathematics 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

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Question	Answer	Marks	Partial Marks
1(a)(i)	$p = 97.2[0]$ $q = 66.3[0]$ $r = 34$ $s = 1.14$	**4**	**B1** for $p = 97.2[0]$ **B1FT** for $q = 66.3[0]$ or $q = 163.5 - $ *their* p **B1FT** for $r = 34$ or $r =$ *their* $q \div 1.95$ **B1** for $s = 1.14$
1(a)(ii)	35.2 or 35.24 to 35.25	**2**	**M1** for $\frac{325 - 240.30}{240.30}[\times 100]$ oe or $\frac{325}{240.30} \times 100$ [– 100] oe
1(b)(i)(a)	98	**2**	**M1** for $\frac{9520.70}{34974}[\times 360]$ or $\frac{360}{34974}[\times 9520.70]$ After 0 scored, **SC1** for answer 27.2[2… %]
1(b)(i)(b)	4468.9[0]	**2**	**M1** for $\frac{46}{360}[\times 34974]$ or $\frac{34974}{360}[\times 46]$ or $\frac{46}{\textit{their}98} \times 9520.7$
1(b)(ii)	33 500	**2**	**M1** for $\left(\frac{100 + 4.4}{100}\right)x = 34974$ soi
2(a)	$5p + 8\times75 = 910$ or $5p = 910 - 8\times75$ or $\frac{5p}{100} + 8 \times \frac{75}{100} = 9.1[0]$ or $\frac{5p}{100} = 9.1[0] - 8 \times \frac{75}{100}$	**B1**	
	62	**B2**	**M1** for correctly rearranging *their* equation to $p = \ldots$ After 0 scored, **SC1** for answer [$]0.62
2(b)	$3c(2a - 9)$ or $-3c(9 - 2a)$ final answer	**2**	**B1** for $3c(2a - 9)$ seen and spoilt or final answer $3(2ac - 9c)$ or $c(6a - 27)$
2(c)	$\frac{mn^2}{6}$ final answer	**2**	**B1** for $\frac{mn^2}{6}$ seen and spoilt or answer with two of $\frac{1}{6}$, m and n^2

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Question	Answer	Marks	Partial Marks
2(d)	$[\pm]\sqrt{\frac{5y}{3}}$ or $[\pm]\left(\frac{5y}{3}\right)^{\frac{1}{2}}$ oe final answer	**2**	**B1** for $[\pm]\sqrt{\frac{5y}{3}}$ seen and spoilt or $x^2 = \frac{5y}{3}$
2(e)	15	**4**	**B3** for $56.8k - 56.5k = 56.5 - 52$ or better or **B2** for $\frac{56.8k + 52}{k+1} = 56.5$ oe or **B1** for $56.8k$ or $56.5(k + 1)$ oe seen
			Alternative method **B3** for $56.8x - 56.5x = (56.5 - 52)\times 56.8$ or better or **B2** for $\frac{x}{56.8} = \frac{x - 56.5 + 52}{56.5}$ oe or **B1** for $k = \frac{x}{56.8}$ or $\frac{x \pm 52}{k+1} = 56.5$ oe seen
3(a)(i)	135	**1**	
3(a)(ii)	24	**2**	**M1** for $\frac{180(n-2)}{n}[=165]$ oe or $[n =]\ \frac{360}{180-165}$ oe or **B1** for exterior angle = 15

Question	Answer	Marks	Partial Marks
3(b)(i)	Angle $AOC = 2x$ angle at centre is twice angle at circumference Angle $OAC = \frac{180-2x}{2} = 90-x$ isosceles triangle	**3**	**B2** for angle $AOC = 2x$ and angle AOC is angle at centre is twice angle at circumference OR **B1** for angle $AOC = 2x$ **B1** for angle $OAC = \frac{180-their\,2x}{2}$ and isosceles triangle
	AOY is diameter. Angle $AYC = x$ angles in same segment are equal Angle $YCA = 90$ angles in a semicircle Angle $OAC = 90 - x$ angles in a triangle		**B1** for angle $AYC = x$ angles in same segment are equal **B1** for angle $YCA = 90$ angles in a semicircle **B1** for angle $OAC = 90 - x$ angles in a triangle
3(b)(ii)	43	**2**	**B1** for angle $BCA = 90 - x - 11$ oe or angle $OBC = 11$ or angle $BDA = 180 - 54 - x$ oe or angle $ADC = x + 54$ oe or angle $ODC = 180 - 2x - 11$ oe or **M1** for a correct equation
4(a)	3.2 oe	**1**	
4(b)	Correct smooth curve	**3**	**B2FT** for 5 or 6 points correctly plotted or **B1FT** for 3 or 4 points correctly plotted
4(c)	Ruled line $y = 1.2$	**B1**	
	2.5 to 2.7	**B1**	After 0 scored, **SC1** for $y = 1.2$ soi
4(d)(i)	–0.25, 1.25 oe	**1**	
4(d)(ii)	Ruled line from (–1, –0.25) to (4, 2.25)	**1**	
4(d)(iii)	x-coordinates where ruled line $4y = 2x + 1$ crosses $y = \frac{2^x}{5}$	**1**	**FT** two x-coordinates where *their* ruled line and *their* curve cross
4(d)(iv)	$\frac{2^x}{5} = \frac{2x+1}{4}$ oe seen	**M1**	
	$A = 4$, $B = -10$, $C = -5$ OR $A = -4$, $B = 10$, $C = 5$	**A2**	**A1** for A correct and either B or C correct or $4\times2^x - 10x - 5$ [=0] or $-4\times2^x + 10x + 5$ [=0] or Ak, Bk and Ck where k is not an integer
5(a)(i)	2.18×10^7 or 21 800 000	**1**	

Question	Answer	Marks	Partial Marks
5(a)(ii)	8.16×10^5 or 8.164×10^5 cao	**1**	
5(a)(iii)	517 or 5.17×10^2 cao	**2**	**B1** for one correct population density
5(b)(i)	8.45×10^n final answer	**1**	
5(b)(ii)	1.29×10^{2n} final answer	**2**	**B1** for $12.9 \times 10^{2n-1}$ oe seen
6(a)	21 : 10 : 6 final answer	**2**	**B1** for 6300 : 3000 : 1800 oe
6(b)	[0]9 50[am]	**3**	**B2** for 75 [minutes] or 1 hour 15 minutes or 1.25 [hours] or **M1** for $\frac{\text{figs63}}{\text{speed}}$ After 0 scored, **SC1** for answer 10 44[am] or 10 29[am] or [0]8 53[am]
6(c)	6.75 nfww or 6.752 to 6.753 or $6\frac{67}{89}$	**3**	**B1** for 3005 and 445 seen **M1** for $\frac{\textit{their}3005}{\textit{their}445}$
7(a)(i)	15	**1**	
7(a)(ii)	Completed histogram	**3**	**B1** for each bar After 0 scored, **SC1** for 2.4, 1.9 and 0.8 soi
7(a)(iii)	$\frac{43}{100}$ or 0.43 or 43%	**1**	**FT** $\frac{43}{85+\textit{their}\textbf{(a)(i)}}$ provided *their* **(a)(i)** is a positive integer
7(b)(i)	42.8[0] or 42.78 to 42.79	**3**	**B1** for correct midpoints soi **M1** for $\frac{22\times15+16\times35+24\times45+19\times55+14\times75}{22+16+24+19+14}$
7(b)(ii)	41 is in $40 < m \leqslant 50$ so mid-value of 45 would have been used to estimate the mean which is higher than the estimated mean oe	**1**	
8(a)(i)	length = 6.8 width = 3.4	**2**	**B1** for length = 6.8 or width = 3.4 After 0 scored **SC1** for length = 3.4 and width = 6.8

Question	Answer	Marks	Partial Marks
8(a)(ii)	10.2 nfww	**2**	**FT** 1.5 × *their length* **B1** for $\left(\frac{30.6}{20.4}\right)\left[=\frac{\text{length}}{\text{length}}\right]$ oe or $\left(\frac{20.4}{30.6}\right)\left[=\frac{\text{length}}{\text{length}}\right]$ oe or **M1** for $\frac{20.4}{their 6.8}=\frac{30.6}{l}$ oe or $\frac{30.6}{6}\times 2$ oe
8(b)(i)	$\frac{10\pi}{3}$ or $\frac{10}{3}\pi$ or $3\frac{1}{3}\pi$ final answer	**2**	**M1** for $\frac{75}{360}\times 2\times\pi\times 8$ oe
8(b)(ii)	22.7 to 22.9	**5**	**M1** for $\frac{their\text{arc length}}{2\times\pi}$ or $\frac{\frac{75}{360}\times\pi\times 8^2}{\pi\times 8}$ oe **M2** for $\sqrt{8^2-their\,r^2}$ oe or **M1** for $8^2 - their\ r^2$ **M1** for $\frac{1}{3}\times\pi\times their\,r^2\times their 7.82$
9(a)	245 nfww or 244.8 to 244.9	**4**	**B1** for angle $BAC = 133$ **M2** for $\sqrt{170^2+95^2-2\times 170\times 95\cos(their 133)}$ oe OR **M1** for $170^2+95^2-2\times 170\times 95\cos(their 133)$ oe **A1** for 60000 or 59950 to 59960
9(b)	[0]25	**2**	**B1** for angle $CAS = 25$ or angle $ACN = 25$ or angle $NAC = 155$ or **M1** for 205 – 180
9(c)(i)	$\cos(their 25) = \frac{AD}{95}$ or $\sin(90 - their 25) = \frac{AD}{95}$ oe	**M1**	
	86.09[9…] or 86.10	**A1**	

Question	Answer	Marks	Partial Marks
9(c)(ii)	13.6 or 13.62 to 13.63 nfww	**4**	**M2** for $AX = 170\tan 7$ oe or **M1** for $\tan 7 = \frac{AX}{170}$ **M1** for $\tan[\ldots] = \frac{their AX}{86.1}$ oe
10(a)	10.3 or 10.29 to 10.30	**3**	Scheme 1: **B1** for $\left[\overrightarrow{FH} =\right]\begin{pmatrix}-9\\-5\end{pmatrix}$ oe **M1** for $their(-9)^2 + their(-5)^2$
			Scheme 2: **B1** for $[H =]\ (-3, -4)$ or $[\overrightarrow{OH} =]\begin{pmatrix}-3\\-4\end{pmatrix}$ **M1** for $(6 - their(-3))^2 + (1 - their(-4))^2$ oe
10(b)(i)	m (**a** + k**b**) or m**a** + mk**b** oe	**2**	**B1** for answer m**a** + …**b** or …**a** + mk**b** or $\overrightarrow{OC} = \mathbf{a} + k\mathbf{b}$ After 0 scored, SC1 for answer $-m\mathbf{a} - mk\mathbf{b}$ oe
10(b)(ii)	$\frac{5}{6}$	**3**	**B2** for $\frac{3}{5}\mathbf{a} - \frac{1}{2}\mathbf{b} = -\mathbf{b} + m\mathbf{a} + mk\mathbf{b}$ oe or **B1** for $\overrightarrow{BX} = \overrightarrow{BO} + \overrightarrow{OX}$ soi or $\overrightarrow{OX} = \overrightarrow{OB} + \overrightarrow{BX}$ soi

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