Cambridge Assessment International Education

Cambridge O Level

MATHEMATICS (SYLLABUS D) **4024/21**

Paper 2 **October/November 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.

Cambridge International is publishing the mark schemes for the October/November 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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[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.

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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, non-integer 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 or sign 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 A or B 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.

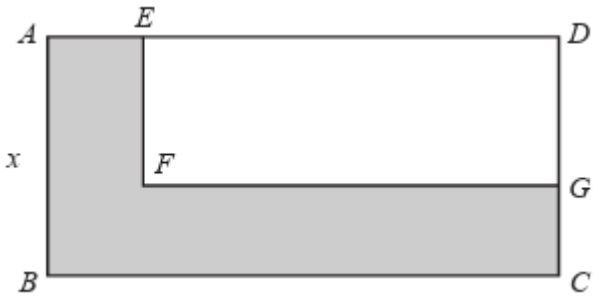
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Abbreviations

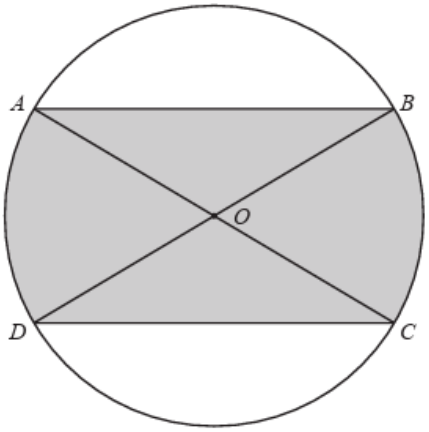
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
oe	or equivalent
SC	Special Case
nfww	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)	28 028	**2**	**B1** for 8372 seen or **M1** for $36400 - \frac{23}{100} \times 36400$ oe
1(b)	2670	**2**	**M1** for $\frac{890}{5}[\times k]$ oe where $k \geq 1$
1(c)(i)	3.5	**2**	**M1** for $\frac{702800 - 678202}{702800}[\times 100]$ oe or $\frac{678202}{702800} \times 100$ oe
1(c)(ii)	627 500	**2**	**M1** for $\frac{(100+12)}{100}x = 702800$ soi
1(d)(i)	1.148×10^6 cao	**1**	
1(d)(ii)	Population densities 1100 or 1101.[…] 2030 or 2026.[…] 1320 or 1315.[…] 510 or 509.6… seen	**M2**	**M1** for one correct population density seen
	Bahrain	**B1**	
2(a)(i)	$x = 2$	**1**	
2(a)(ii)	Correct reflection (5, 2), (5, 4), (6, 4)	**1**	
2(b)	Rotation 90° anticlockwise oe (0, 0) oe	**3**	**B1** for each
3(a)(i)	$\frac{1}{4}$ oe	**1**	
3(a)(ii)	$(0, -\frac{5}{4})$ oe	**1**	

Question	Answer	Marks	Partial Marks
3(b)(i)	6.71 or 6.708…	**2**	**M1** for $(4--2)^2+(5-8)^2$ oe
3(b)(ii)	$[y=]-\frac{1}{2}x+7$ oe final answer	**3**	**M1** for $\frac{8-5}{-2-4}$ oe **M1** for attempt to find *c* by substitution of (4, 5) or (–2, 8) or (1, 6.5) into $y=(their\ m)x+c$ or use of $y-b=(their\ m)(x-a)$
4(a)(i)	40	**1**	
4(a)(ii)	$7n-2$ oe final answer	**2**	**B1** for $7n+j$ oe seen, *j* may be 0
4(a)(iii)	50	**3**	**M1** for correct equation for sum of terms **FT** use of *their* $7n-2$ **M1** for correct rearrangement to $ak = b$, dependent on equation with two terms in *k* and a constant Not $k + k + 1 = 703$ oe
4(b)	58	**5**	**B4** for $a=4$ and $b=-2$ OR **B2** for $1^2 + a + b = 3$ + a + b = 3 or better **and** $3^2 + 3a + b = 19$ + 3a + b = 19 or better or **B1** for one correct **M1** for correct method to eliminate one variable from *their* simultaneous equations **M1** for $6^2 + their\ a \times 6 + their\ b$ <u>Alternative method</u> **B3** for second term = 10 OR **B1** for second difference = 2 **B2** for first pair of differences 7 and 9 or **B1** for sum of first pair of differences = 16 AND **B1** for next first differences 11, 13, 15
5(a)(i)	46	**1**	
5(a)(ii)	[0]8 15	**1**	

Question	Answer	Marks	Partial Marks
5(b)(i)	55 to 57	**1**	
5(b)(ii)	30 nfww	**2**	**B1** for 54 or 24 seen
5(b)(iii)	17.5	**3**	**B1** for 132 or 28 **M1** for $\frac{160-\textit{their } 132}{160}[\times 100]$ or $\frac{\textit{their } 28}{160}[\times 100]$ or $\frac{\textit{their } 132}{160}\times 100$
5(c)	50.3 or 50.34…	**3**	**B1** for 36.5 and 43.5 seen **M1** for $\frac{\textit{their } 36.5}{\textit{their } 43.5}\times 60$ oe
6(a)	$\frac{30}{x}$	**1**	
6(b)	Correct unexpanded expression for shaded area e.g. $[y=]30-(x-2)\left(\frac{30}{x}-2\right)$ or $[y=]2(x-2)+2\times 2+2\left(\frac{30}{x}-2\right)$ or $[y=]2x+2\left(\frac{30}{x}-2\right)$ or $[y=]2(x-2)+2\left(\frac{30}{x}\right)$	**M2**	**B1** for $(x-2)$ or $\left(\textit{their}\frac{30}{x}-2\right)$ seen 
	Correct expansion of brackets and rearrangement to $y=2x+\frac{60}{x}-4$	**A1**	**A0** if any errors or omissions
6(c)	28.3	**1**	
6(d)	Correct smooth curve	**3**	**B2 FT** for 7 or 8 points correctly plotted or **B1 FT** for 5 or 6 points correctly plotted
6(e)	FT reading the two values from *their* graph at $y = 24$	**2**	**B1 FT** for one correct **B1 FT** for second value = 30 ÷ *their* first value or for *their* second value at $y = 24$
7(a)	$5a-3b$ final answer	**2**	**B1** for answer $5a+kb$ or $ka-3b$ $k\neq 0$ or for $5a-3b$ seen
7(b)	$11x+1$ final answer	**2**	**B1** for answer $11x+k$ or $kx+1$ $k\neq 0$ or **M1** for $6x-9+5x+10$ seen

Question	Answer	Marks	Partial Marks
7(c)	$\frac{-(-2)\pm\sqrt{(-2)^2-4\times6\times-9}}{2\times6}$ oe or $\frac{-(-2)}{2\times6}\pm\sqrt{\left(\frac{-2}{2\times6}\right)^2-\left(\frac{-9}{6}\right)}$	**B2**	**B1** for $\sqrt{(-2)^2-4\times6\times-9}$ oe or for $\frac{-(-2)\pm\sqrt{their\ \text{discriminant}}}{2\times6}$ or for $\left(x+\frac{-2}{2\times6}\right)^2$
	–1.07 and 1.40	**B1**	
7(d)(i)	$\frac{xy}{8}$ final answer	**1**	
7(d)(ii)	$\frac{38-x}{(2x+1)(x-5)}$ or $\frac{38-x}{2x^2-9x-5}$ final answer	**3**	**B1** for $3(2x+1)-7(x-5)$ oe isw **B1** for denominator $(2x+1)(x-5)$ oe isw
8(a)(i)	1	**1**	
8(a)(ii)	2	**1**	
8(a)(iii)	1.95	**2**	**M1** for $\frac{([0\times7]+1\times11+2\times9+3\times5+4\times6+5\times2)}{40}$ oe
8(a)(iv)	$\frac{1}{5}$ cao	**2**	**M1** for $\frac{6+2}{40}$ oe
8(b)(i)	$\frac{21}{50}$ oe	**2**	**M1** for $\frac{7}{10}\times\frac{3}{10}[\times2]$ oe
8(b)(ii)	$\frac{7}{40}$ oe	**3**	**M2** for $\frac{3}{10}\times\frac{2}{9}\times\frac{7}{8}\times3$ oe or **M1** for $\frac{3}{10}\times\frac{2}{9}\times\frac{7}{8}$ oe If 0 scored, **SC1** for answer $\frac{189}{1000}$ oe
9(a)(i)	688	**B1**	
	cm^3	**B1**	
9(a)(ii)	$\frac{34.4}{\frac{1}{2}\times6\times\sin55}$	**M2**	**M1** for $\frac{1}{2}\times6\times AC\times\sin55=34.4$
	13.998[…] or 14.00	**A1**	

Question	Answer	Marks	Partial Marks
9(a)(iii)	702 or 701.6 to 701.8	**5**	**B2** for $\left[BC^2 =\right] 135.4$ to 135.6… soi or **M2** for $\sqrt{6^2+14^2-2\times6\times14\cos55}$ or **M1** for $6^2+14^2-2\times6\times14\cos55$ AND **M2** for $2\times34.4+6\times20+14\times20+\textit{their}\,BC\times20$ oe or **M1** for sum of areas of 4 faces from the M2 calculation
9(b)	9.41 or 9.407…	**4**	**M1** for area of base $=\frac{98}{8}$ soi **M2** for $\textit{their}\,12.25+\textit{their}\,12.25+8^2$ oe or **M1** for $\textit{their}\,12.25+\textit{their}\,12.25$ oe or $\textit{their}\,12.25+8^2$ oe
10(a)	*AO* = *DO* [equal] radii *BO* = *CO* [equal] radii ∠*AOB* = ∠*DOC* [vertically] opposite [Congruent] SAS	**3**	**B2** for two pairs of equal sides/angles with correct reasons or **B1** for one pair of equal sides/angles with correct reason or for two appropriate pairs with no or incorrect reasons Angles described using convention of 3 letters 

Question	Answer	Marks	Partial Marks
10(b)	4.39 or 4.40 or 4.392 to 4.398	**5**	**M2** for $[AOB =]2\times\sin^{-1}\left(\frac{4.5}{5}\right)$ oe or $\cos[\ ]=\frac{5^2+5^2-9^2}{2\times5\times5}$ oe or **M1** for $\sin[\ ]=\frac{4.5}{5}$ oe or $9^2=5^2+5^2-2\times5\times5\cos[\ ]$ oe AND **M2** for $10\pi-\left(9+9+2\times\frac{\textit{their AOD}}{360}\times10\pi\right)$ oe or **M1** for $[2\times]\frac{\textit{their AOD}}{360}\times10\pi$ oe