CAMBRIDGE
International Education

Cambridge O Level

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

Paper 2 **May/June 2024**

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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **9** printed pages.

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 descriptions 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.

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).

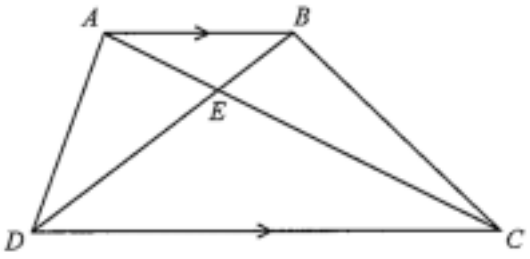
5 Where a candidate has misread a number or sign in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 A or B mark for the misread.

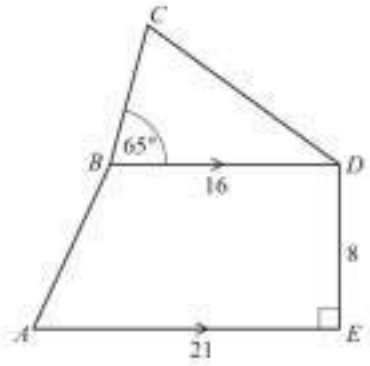
6 Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

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)	17 500	**1**	
1(a)(ii)	65[.00] nfww	**2**	**M1** for $\left(\frac{100+4}{100}\right)x = 67.60$ soi
1(b)	94.1 or 94.13…	**1**	
1(c)	17 252	**3**	**M1** for 16440×41 oe **M1** for $\frac{\textit{their}\,674040 - 329000}{20}$ oe
1(d)(i)	28 130 000 or 2.813×10^7 oe	**1**	ISW attempts to convert to or from standard form
1(d)(ii)	107 250 or 1.0725×10^5 oe	**2**	ISW attempts to convert to or from standard form **M1** for $\frac{102.5}{100} \times 4.29 \times 10^6 - 4.29 \times 10^6$ oe or $\frac{4.29\times10^6 + x}{4.29\times10^6}\times100 = 102.5$ oe
2(a)(i)	Complete scatter diagram	**2**	**B1** for 3 or 4 correct plots
2(a)(ii)	Negative	**1**	
2(a)(iii)	Ruled line of best fit	**1**	
2(a)(iv)	Reading *their* ruled line of best fit at 1000 m	**1**	**FT** from a ruled line with a negative gradient
2(b)(i)	7.88 or 7.884…	**3**	**B1** for correct midpoints soi **M1** for $\frac{6\times8 + 7\times15 + 7.75\times20 + 8.25\times23 + 9.5\times14}{80}$
2(b)(ii)	46	**1**	
3(a)	104	**2**	**B1** for angle *QRP* = 38 or angle *QPR* = 38 or **M1** for $180 - 2\times\textit{their}\,38$

Question	Answer	Marks	Partial Marks
3(b)	angle *AEB* = angle *CED* [vertically] opposite angles angle *EAB* = angle *ECD* alternate angles angle *EBA* = angle *EDC* alternate angles or angles in a triangle add to 180 as reason for the third pair Hence similar	**3**	**B2** for two correct pairs of angles with correct reasons or **B1** for one correct pair of angles with correct reason or two correct pairs of angles with no/incorrect reasons 
4(a)	25	**1**	
4(b)(i)	$2^{x-1} \times 3^{y}$ oe final answer	**2**	**B1** for correct answer seen and spoilt or answer $2^{x-1} \times k$ oe or $m \times 3^{y}$
4(b)(ii)	$2^{x+3} \times 3^{2y} \times 5 \times 7$ oe final answer	**2**	**B1** for correct answer seen and spoilt or answer $2^{x+3} \times 3^{a} \times 5 \times 7$ oe or $2^{b} \times 3^{2y} \times 5 \times 7$ oe or $2^{x+3} \times 3^{2y} \times 5$ oe or $2^{x+3} \times 3^{2y} \times 7$ oe
5(a)	450	**2**	**M1** for $0.5x + 125 = 350$ or better
5(b)	220 nfww	**2**	**B1** for 3.5 used
5(c)	477	**3**	**B1** for $10k : 35k : 8k$ or $[S =] 90$ **M1** for $[M =] \frac{their\,90}{2} \times 7$ oe or $\frac{72}{their\,8k}(their\,10k + their\,35k + their\,8k)$ oe
6(a)	Triangle with vertices (5, –2) (7, –2) and (5, –6)	**2**	**B1** for translation of $\begin{pmatrix}1\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-3\end{pmatrix}$
6(b)	Enlargement [Scale factor] $-\frac{1}{2}$ oe [Centre] (0, 1)	**3**	**B1** for each

Question	Answer	Marks	Partial Marks
6(c)	Triangle with vertices (–5, 4) (–3, 4) and (–3, 5)	**3**	**B2** for triangle with vertices (–2, –5) (–2, –3) and (–3, –3) seen or **B1** for triangle Q correct size and orientation but wrong position After 0 scored, **SC2** for triangle Q at (3, –6) (1, –6) and (1, –7) or **SC1** for triangle Q at (3, 2) (1, 2) and (1, 1) or triangle Q at (7, –2) (5, –2) and (5, –3)
7(a)	8	**2**	**M1** for $5 \times 12 \times h = 480$ oe
7(b)(i)	58[.0] or 57.99… nfww	**3**	**M2** for $\tan[\ ] = \frac{8}{21-16}$ oe or **B1** for horizontal distance 21 – 16 soi
7(b)(ii)	7.17 or 7.171 to 7.172  	**5**	**M2** for $200 - \frac{1}{2}(16+21)\times 8$ oe or **M1** for $\frac{1}{2}(16+21)\times 8$ oe **M2** for $\frac{2\times their\,52}{16\times \sin 65}$ oe or **M1** for $\frac{1}{2}\times BC\times 16\times \sin 65$ oe or for [height =] $\frac{2\times their\,52}{16}$
8(a)(i)	6.4 oe cao	**1**	
8(a)(ii)	Correct smooth curve	**3**	**B2FT** for 5 or 6 points correctly plotted or **B1FT** for 3 or 4 points correctly plotted
8(a)(iii)(a)	$2^{x+3} = 2^x \times 2^3$ soi	**M1**	May be done in stages by division by 2 three times
	$\frac{2^x}{5} = \frac{100}{8\times 5}$ leading to $\frac{2^x}{5} = \frac{5}{2}$	**A1**	$\frac{2^x}{5} = \frac{12.5}{5} = \frac{5}{2}$
8(a)(iii)(b)	$y = 2.5$ drawn	**M1**	
	3.5 to 3.8	**A1**	

Question	Answer	Marks	Partial Marks
8(b)	$a = 7$ $b = 6$	**3**	**B1** for $a = 7$ **B1** for (–1, 0) and (7, 0) soi or (–7, 0) and (1, 0) soi or (c, 0) and (d, 0) where $cd = -$ *their* a soi where c and d are integer values
9(a)	287	**1**	
9(b)	211 or 210.5 to 210.6	**4**	**B1** for angle $CAB = 85$ soi **B2** for 44350.[…] or **M2** for $\sqrt{176^2 + 132^2 - 2\times176\times132\cos(\textit{their}85)}$ oe or **M1** for $176^2 + 132^2 - 2\times176\times132\cos(\textit{their}85)$ oe
9(c)	40	**5**	If hours and minutes used, apply first scheme **M2** for $\frac{176}{48}\times60$ oe soi or **M1** for $\frac{176}{48}$ oe OR **M2** for $\frac{176}{48}$ and $\frac{7}{60}$ or and $\frac{15}{60}$ oe soi or **M1** for $\frac{176}{48}$ oe AND **M2** for $\frac{132}{(\textit{their}\,220)-15-7}[\times60]$ oe or **M1** for 1.33pm oe or (*their* 220) – 15 –7 oe or $\frac{132}{\textit{their}\,220+k}\times60$ oe OR **M2** for $\frac{132}{\left(\textit{their}\frac{176}{48}\right)-\frac{15}{60}-\frac{7}{60}}$ oe or **M1** for $\left(\textit{their}\frac{176}{48}\right)-\frac{15}{60}-\frac{7}{60}$ oe or $\frac{132}{\left(\textit{their}\frac{176}{48}\right)+k}$ oe

Question	Answer	Marks	Partial Marks
10(a)	6.5 oe	**3**	**M2** for $10\times2-3\times-2=4p$ oe or $p=\frac{2r-3t}{4}$ oe or **M1** for $10=\frac{4p+3\times-2}{2}$ oe or $2r=4p+3t$ or $r-\frac{3t}{2}=\frac{4p}{2}$ or better
10(b)	$w + 2w + w + 10 + w – 15 = 360$ oe	**M1**	e.g. $5w – 5 = 360$
	146	**B3**	**B2** for [w =] 73 OR **M1** for correctly rearranging *their* initial equation to $kw = c$ **M1** for largest angle = 2 × *their* 73
10(c)	$\frac{2k+1}{k+3}$ final answer	**3**	**B1** for $(2k + 1)(k – 3)$ seen **B1** for $(k + 3)(k – 3)$ seen
10(d)	$x^2 – 6x – 17$ [= 0] or equivalent 3-term quadratic all terms on one side	**B4**	**M2** for $2(x-2)+5(x+3)=(x+3)(x-2)$ or $\frac{2(x-2)}{(x+3)(x-2)}+\frac{5(x+3)}{(x+3)(x-2)}$ or **M1** for $2(x-2)+5(x+3)$ seen **M1** for $x^2 + 3x – 2x – 6$ soi
	$\frac{--6\pm\sqrt{(-6)^2-4\times1\times-17}}{2\times1}$ oe	**B1**	**FT** *their* quadratic oe e.g. $\frac{6}{2}\pm\sqrt{\left(\frac{6}{2}\right)^2+17}$
	8.10, –2.10	**B1**	
11(a)(i)	10 or 11	**1**	
11(a)(ii)(a)	Correct tree diagram 0.65, 0.65, 0.35, 0.65 oe	**2**	**M1** for 2 or 3 probabilities completed correctly
11(a)(ii)(b)	0.1225 oe e.g. $\frac{49}{400}$	**1**	
11(a)(ii)(c)	0.455 oe e.g. $\frac{91}{200}$	**2**	**M1** for $[2\times]0.35\times0.65$

Question	Answer	Marks	Partial Marks
11(b)	$\frac{106}{182}$ oe e.g. $\frac{53}{91}$	**3**	**M2** for $1 - \left(\frac{8}{14}\times\frac{7}{13}+\left[\frac{1}{14}\times\frac{0}{13}\right]+\frac{5}{14}\times\frac{4}{13}\right)$ oe or $\frac{8}{14}\times\frac{6}{13}+\frac{1}{14}\times\frac{13}{13}+\frac{5}{14}\times\frac{9}{13}$ oe or **M1** for $\left(\frac{8}{14}\times\frac{7}{13}+\left[\frac{1}{14}\times\frac{0}{13}\right]+\frac{5}{14}\times\frac{4}{13}\right)$oe or 3 correct products After 0 scored, **SC1** for $\frac{106}{196}$ e.g. $\frac{53}{98}$