Cambridge Assessment International Education

Cambridge O Level

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

Paper 2 **May/June 2021**

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 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **8** 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 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:

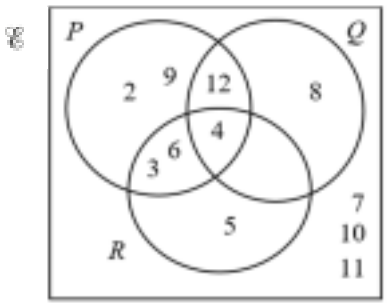
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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

Question	Answer	Marks	Partial Marks
1(a)	66.3[0]	**2**	**M1** for $78-\frac{15}{100}\times 78$ oe or **B1** for 11.7[0]
1(b)	30.6[0]	**2**	**M1** for $100 \times 0.85 - 58.99$ or $\frac{58.99}{0.85}$
1(c)	Pietro and 5.48 or 5.49	**4**	**M1** for $3500+\frac{3500\times 2.1\times 4}{100}$ oe AND **M2** for $3500\left(1+\frac{2}{100}\right)^4$ oe or **M1** for $3500\left(1+\frac{2}{100}\right)^k$ oe where $k>1$ or after M0, **SC1** for $3500\left(1+\frac{2}{100}\right)^4+3500$
2(a)	Complete scatter diagram	**2**	**B1** for 3 or 4 correct plots
2(b)	Temperature increases cups of hot chocolate sold decreases oe	**1**	
2(c)	Ruled line of best fit	**B1**	
	Reading their ruled line of best fit at 17 °C	**B1**	**Strict FT** – must be an integer from a line with a negative gradient
3(a)	$5b - 3a$ final answer	**2**	**B1** for $5b - 3a$ seen or answer $-3a + kb$ or $ka + 5b$
3(b)	18	**2**	**M1** for $\frac{m}{2}=5+4$ or $m-4\times 2=5\times 2$ or better
3(c)	$3u - 4$ or $3\left(u-\frac{4}{3}\right)$ final answer nfww	**2**	**M1** for $3u = t + 4$ or $u-\frac{4}{3}=\frac{t}{3}$
3(d)	$6y^3 + 15y$ final answer	**2**	**B1** for $6y^3 + 15y$ seen or answer $6y^3 + \ldots$ or $\ldots + 15y$
4(a)	4	**1**	

Question	Answer	Marks	Partial Marks
4(b)	3.94 or $3\frac{94}{100}$ or $3\frac{47}{50}$	**2**	**M1** for $\frac{1\times8+2\times10+3\times22+4\times28+5\times15+6\times9+7\times5+8\times3}{100}$
4(c)	$\frac{2}{5}$ cao	**2**	**B1** for $\frac{8+10+22}{100}$ oe After 0 scored, **SC1** for answer $\frac{17}{25}$
4(d)	2700	**2**	**M1** for $\frac{15}{100}$ [× 18 000] oe
5(a)	$(A\cup B)'$ oe	**1**	
5(b)(i)		**3**	**B2** for Venn diagram with 1 or 2 errors, omissions or repeats or for correct Venn diagram with $(P\cup Q\cup R)'$ blank or **B1** for Venn diagram with 3 or 4 errors, omissions or repeats or for correct Venn diagram with $(P\cup Q\cup R)'$ blank and one further error
5(b)(ii)	2, 9	**1**	FT *their* diagram
5(b)(iii)	7	**1**	
5(b)(iv)	$P'\cap Q\cap R$ oe	**1**	
6(a)	(a, a) with $a \neq 1$, 3 or 5	**2**	**SC1** for answer (1, 1) or (5, 5)
6(b)	$[y =] x^2 - 3x$ $[y =] 2 - x^2$ $[y =] x^3 - 2$ cao	**3**	**B1** for each
6(c)	$y = -\frac{1}{2}x - \frac{1}{2}$ oe nfww	**5**	**M1** for [gradient AB =] $\frac{3-(-5)}{3-(-1)}$ oe **M1** for [gradient M =] $-\frac{1}{\textit{their}\text{gradient}AB}$ **B1** for (1, –1) **M1** for *their* (1, –1) substituted into $y = \textit{their}\left(-\frac{1}{2}\right)x + c$ oe
7(a)(i)	150	**1**	
7(a)(ii)	54.1 or 54.08…	**2**	**M1** for $30^2 + 45^2$

Question	Answer	Marks	Partial Marks
7(b)	$5\frac{10}{19}$ or 5.53 or 5.526… nfww	**4**	**M1** for $(a+4)^2 = a^2 + 11^2 - 2\times a\times 11\cos 60$ oe **B1** for $a^2 + 4a + 4a + 16$ oe **M1** for correct isolation of *their* terms in a to form a linear equation with use of $\cos 60 = 0.5$ After 0 scored, **SC1** for $a + 4 = a^2 + 121 - 11a$ oe
7(c)	107.8 or 107.78 to 107.79…	**6**	**M2** for $\tan^{-1}\left(\frac{10}{8}\right)$ oe or **M1** for $\tan \ldots = \frac{10}{8}$ oe **B1** for $\frac{1}{2}\times 10\times 8$ soi **M2** for $\frac{1}{2}\times 8\times 9\sin x = 70 - \textit{their}40$ oe or **M1** for $\frac{1}{2}\times 8\times 9\sin x$
8(a)	–11	**1**	
8(b)	–10 nfww	**3**	**B2** for $x < -9$ or **B1** for $3x - 5 > 3\times\frac{4x+4}{3}$ oe or x […] –9
8(c)	$\frac{1}{3}$ oe or 0.333[3…]	**3**	**B2** for $9x - 15 = 12x - 20 + 4$ or better or $3x - 5 = 4x - \frac{20}{3} + \frac{4}{3}$ or better or **B1** for $3x - 5 = \frac{4(3x-5)+4}{3}$
8(d)	8	**1**	
9(a)	$6\pi l + \pi\times 6^2$ OR $84\pi - \pi\times 6^2$	**M1**	
	$6\pi l + \pi\times 6^2 = 84\pi$ leading to $l = 8$ OR $6\pi l = 84\pi - \pi\times 6^2$ leading to $l = 8$	**A1**	**A0** if any errors or omissions
9(b)	199 or 200 or 199.4 to 199.5…	**3**	**M2** for $\frac{1}{3}\pi\times 6^2\times\sqrt{8^2 - 6^2}$ or **M1** for $8^2 - 6^2$ or $\frac{1}{3}\pi\times 6^2\times \textit{their}\ h$
9(c)	4.5 nfww	**2**	**B1** for $\sqrt{\frac{47.25\pi}{84\pi}}$ soi or $\sqrt{\frac{84\pi}{47.25\pi}}$ soi or **M1** for a correct equation in r

Question	Answer	Marks	Partial Marks
10(a)	$A\hat{B}O = 50°$ angles on straight line $A\hat{O}B = 80°$ angles in isosceles triangle $A\hat{C}B = 40°$ angles at centre twice angle at circumference	**3**	**B1FT** for one correct angle with reason **B1** for $A\hat{C}B = 40°$ nfww
10(b)(i)	17.2 or 17.15 to 17.16	**2**	**M1** for $\tan\left(\frac{130}{2}\right) = \frac{PR}{8}$ oe
10(b)(ii)	47 to 47.4	**4**	**M1** for $[2\times]\frac{1}{2}\times \textit{their}17.2\times 8$ or $[2\times]\frac{1}{2}\times 8\times\frac{8}{\cos 65}\times\sin 65$ or $\frac{1}{2}\times 8^2\sin 130+\frac{1}{2}\textit{their}17.2^2\sin 50$ oe AND **M2** for $\frac{\textit{their}137-\frac{130}{360}\times\pi\times 8^2}{\textit{their}137}$ [$\times$ 100] oe or $\frac{\frac{130}{360}\times\pi\times 8^2}{\textit{their}137}\times 100$ oe or **M1** for $\frac{130}{360}\times\pi\times 8^2$ oe
11(a)	$\frac{12-x}{11}, \frac{x}{11}, \frac{11-x}{11}$ oe correctly placed	**2**	**B1** for one correct
11(b)	$\frac{x(12-x)}{66}$ oe simplified single fraction final answer	**3**	**M2** for $\frac{x}{12}\times\textit{their}\frac{12-x}{11}+\frac{12-x}{12}\times\textit{their}\frac{x}{11}$ or **M1** for $\frac{x}{12}\times\textit{their}\frac{12-x}{11}$ or $\frac{12-x}{12}\times\textit{their}\frac{x}{11}$
11c	$\frac{x}{12}\times\frac{x-1}{11}=\frac{14}{33}$	**M1**	
	$x^2 - x - 56 = 0$ oe Alternative: $x(x-1) = 56$ cao	**A1**	
	$(x-8)(x+7)$ [$= 0$] or [$x =$] $\frac{-(-1)\pm\sqrt{(-1)^2-4\times 1\times -56}}{2\times 1}$ Alternative: $8(8-1) = 56$ soi	**M1**	Dep on M1 **FT** factorisation/use of formula for *their* 3-term quadratic

Question	Answer	Marks	Partial Marks
	8 cao	**A1**	After maximum 2 marks scored, **B1** for $\frac{8}{12}\times\frac{8-1}{11}=\frac{14}{33}$ oe seen and answer 8
12(a)(i)	$\begin{pmatrix}1\\-8\end{pmatrix}$	**2**	**B1** for answer $\begin{pmatrix}1\\p\end{pmatrix}$ or $\begin{pmatrix}p\\-8\end{pmatrix}$ After 0 scored, **SC1** for answer $\begin{pmatrix}-1\\8\end{pmatrix}$
12(a)(ii)	(–1, –2)	**1**	
12(a)(iii)	10 and –4	**3**	**B2** for answer 10 or –4 nfww or $n-3=\pm7$ oe or $n^2-6n-40$ [=0] or **M1** for $\sqrt{74}=\sqrt{(-3-2)^2+(n-3)^2}$ oe
12(b)	2 : 3 nfww	**3**	**B2** for $\overrightarrow{PL}=\frac{2}{5}\mathbf{q}$ oe or $\overrightarrow{RL}=-\frac{3}{5}\mathrm{q}$ oe or **M1** for correct vector route for $\overrightarrow{KL}$ along the lines of the diagram or $\overrightarrow{PL}=\frac{1}{2}\mathrm{q}-\frac{1}{10}\mathrm{q}$ oe or $\overrightarrow{RL}=-\frac{1}{2}\mathrm{q}-\frac{1}{10}\mathrm{q}$ oe