Cambridge Assessment International Education

Cambridge O Level

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

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.

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.

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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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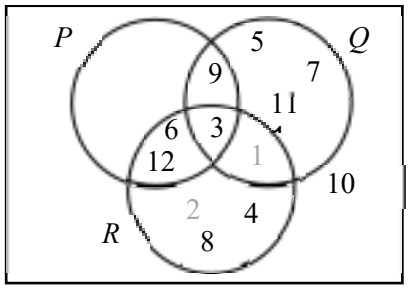
Mathematics Specific Marking Principles	
1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given 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)	$y = x \times (5 - x) \times 15 = 75x^2 - 15x$	**1**	
1(b)	93.75	**1**	
1(c)	Correct smooth curve	**3**	**B2FT** for 6 or 7 points correctly plotted or **B1FT** for 4 or 5 points correctly plotted
1(d)(i)	$y = \frac{1}{3} \times 9 \times 9 \times x = 27x$ or $y = \frac{1}{3} \times 9^2 \times x = 27x$	**1**	
1(d)(ii)	Correct ruled line crossing *their* curve	**B2**	**B1** for short or unruled line or for two correct coordinates soi
	x-coordinate where ruled line $y = 27x$ crosses $y = 75x - 15x^2$	**B1**	**FT** x-coordinate where *their* ruled line and *their* curve cross After 0 scored overall, **SC1** for 3.2
2(a)	[0]1 35pm or 13 35 final answer	**1**	
2(b)(i)	11.6[0]	**1**	
2(b)(ii)	3 hours 36 minutes cao	**2**	**M1** for $4.5 - \frac{20}{100} \times 4.5$ oe or $270 - \frac{20}{100} \times 270$ oe or **B1** for 54 [minutes]
2(c)	4.4	**2**	**M1** for $\frac{33408 - 32000}{32000}[\times 100]$ oe or $\frac{33408}{32000} \times 100$ oe
2(d)	860[.00]	**2**	**M1** for $x + 3 \times \frac{1.2}{100} x = 890.96$ oe
3(a)	$\angle ECQ = 40$ and correct reasons for each step eg $\angle CBE = 70$ sum of angles on a straight line equal 180 $\angle BCE = 70$ base angles in an isosceles triangle are equal $\angle BCQ = 110$ corresponding angles are equal oe	**3**	**B1** for $\angle ECQ = 40$ **B1** for one correct angle with reason

Question	Answer	Marks	Partial Marks
3(b)	$[b =]\ 100 + \frac{a}{2}$ or $[b =]\ \frac{200 + a}{2}$ final answer	**4**	**B2** for $\angle XUO = 45 - \frac{a}{2}$ oe or $\angle UXO = 145 - b$ oe or **M1** for $OXZ = 90$ soi or $\angle XUO = 145 - b$ oe **M1** for $b + 35 + \textit{their}\left(45 - \frac{a}{2}\right) = 180$ oe or $2 \times \textit{their}\ (145 - b) + 90 + a = 180$ oe
4(a)(i)	28 to 30	**1**	Not including 28 or 30
4(a)(ii)	16 to 20	**2**	**B1** for 23 to 24.5 or 41 to 43 seen
4(b)	$\frac{12}{100}$ or $\frac{6}{50}$ or $\frac{3}{25}$	**3**	**B2** for 12 or $\frac{100-88}{100}$ oe or $\frac{88}{100}$ oe fraction or **M1** for $\frac{91}{1.75}$ soi
4(c)	14 8 4 2	**2**	**B1** for 2 or more correct
5(a)(i)		**3**	**B2** for Venn diagram with 1 error, omission or repeat or **B1** for Venn diagram with 2 or 3 errors, omissions or repeats
5(a)(ii)	5	**1**	
5(a)(iii)	1, 3, 9	**1**	**FT** *their* Venn diagram
5(a)(iv)	Multiples of 6 oe	**1**	
5(a)(v)	$\frac{3}{7}$ oe	**2**	**B1FT** for answer $\frac{k}{\textit{their}7}$ or $\frac{\textit{their}3}{k}$
5(b)(i)	$x = 4$ $y = -2$	**2**	**B1** for $x = 4$ or **B1FT** for $y = (\textit{their}\ x) - 6$ *their x* must be a positive integer
5(b)(ii)	20736	**1**	
5(b)(iii)	$2^3 \times 3^4 \times 5$ cao	**1**	
6(a)	$3w - 2u$ final answer	**2**	**B1** for $3w - 2u$ seen or answer $3w + ku$ or $kw - 2u$

Question	Answer	Marks	Partial Marks
6(b)	$40m + 12 \times 85 = 2000 - 220$ or $40m = 2000 - 220 - 12 \times 85$ or $0.4m + 12 \times 0.85 = 20 - 2.20$ or $0.4m = 20 - 2.20 - 12 \times 0.85$	**B2**	**B1** for $40m + 12 \times 85$ oe or $0.4m + 12 \times 0.85$ oe or 1780 or 17.8[0] seen
	19	**B2**	**M1** for correctly rearranging *their* linear equation to $m = \ldots$
6(c)	$\frac{81}{2}$ or $40\frac{1}{2}$ or 40.5	**2**	**B1** for $k = \frac{3}{2}$ oe or **M1** for $\frac{y}{(5-2)^3} = \frac{12}{(4-2)^3}$ oe or **M1** for $y =$ *their* $k \times (5-2)^3$
6(d)	$\frac{2x+7}{(x-1)(2x+1)}$ or $\frac{2x+7}{2x^2-x-1}$ final answer	**3**	**B1** for $3(2x+1) - 4(x-1)$ oe isw **B1** for denominator $(x-1)(2x+1)$ oe isw
7(a)(i)	Correct triangle	**2**	**B1** for either $AC = 8.3$ or $\angle BAC = 105^o$
7(a)(ii)	30.8 to 31.2	**2**	**FT** (17.1 to 17.5) + *their BC* **B1FT** for *their BC* measured
7(b)(i)	15.7 or 15.66…	**3**	**M2** for $[PS =]\frac{15\sin 74}{\sin 67}$ or **M1** for $\frac{\sin 74}{PS} = \frac{\sin 67}{15}$ oe
7(b)(ii) (a)	$\angle QSR = 57$	**B1**	
	$\frac{1}{2} \times 15 \times SR \times \sin(\textit{their } 57) = 63$ oe	**M1**	
	10.01 to 10.02	**A1**	
7(b)(ii) (b)	12.7 or 12.71 to 12.72…	**3**	**M2** for $\sqrt{15^2 + 10^2 - 2 \times 15 \times 10\cos(\textit{their} 57)}$ oe OR **M1** for $15^2 + 10^2 - 2 \times 15 \times 10\cos(\textit{their } 57)$ **A1** for 162 or 161.6 to 161.7
8(a)(i)	Line from (1100, 42) to (1230, 42) Line from (1230, 42) to (1342, 0)	**2**	**B1** for line from (1100, 42) to (1230, 42) or **B1** for line with gradient –35 km/h
8(a)(ii)	13 42 or [0]1 42 pm	**1**	**FT** *their* graph

Question	Answer	Marks	Partial Marks
8(b)	20 000	**3**	**M2** for $\frac{d-7200}{36}=\frac{4}{5}\times\frac{d}{45}$ oe or **M1** for use of $\frac{\text{distance}}{\text{time}}$ for first or third part of journey
9(a)	$\begin{pmatrix}2 & 3\\4 & 1\end{pmatrix}$	**1**	
9(b)(i)	$2x + 3y = 525$ $4x + y = 575$	**B2**	**FT** *their* **(a)** **B1FT** for either
	Correct method to eliminate one variable	**M1**	
	$x = 120$ $y = 95$	**A2**	**A1** for either $x = 120$ or $y = 95$ nfww After 0 scored **SC1** for $x = 120$ and $y = 95$
9(b)(ii)	Cost of flights for Bukhari family and cost of flights for Garcia family oe	**1**	
10(a)(i)	p cannot be negative oe	**1**	
10(a)(ii)	17	**3**	**M2** for $14p + 1106 = 1126.4 + 12.8p$ oe or **M1** for $\frac{11\times15+12\times26+13\times38+14p+15\times9}{15+26+38+p+9}$ oe
10(b)(i)	$\frac{9}{88+r}\times\frac{8}{87+r}\left[=\frac{4}{539}\right]$ oe	**M1**	
	$72 \times 539 = 4(88 + r)(87 + r)$ oe	**M1**	Correct removal of fractions with algebraic denominators of the form $k \pm r$
	Correct expansion of brackets leading to $r^2 + 175r - 2046 = 0$	**A1**	With no errors or omissions including = 0
10(b)(ii)	$(r - 11)(r + 186)$ or $\frac{-175\pm\sqrt{175^2-4\times1\times-2046}}{2\times1}$ oe or $\frac{-175}{2\times1}\pm\sqrt{\left(\frac{175}{2\times1}\right)^2-\left(\frac{-2046}{2\times1}\right)}$ oe	**B2**	**M1** for brackets giving two out of three terms correct or **B1** for $\sqrt{175^2-4\times1\times-2046}$ oe or $\frac{-175\pm\sqrt{k}}{2\times1}$ oe or $\left(r+\left(\frac{175}{2\times1}\right)\right)^2$ oe
	11 cao	**B1**	

Question	Answer	Marks	Partial Marks
11(a)	104[.0…]	**3**	**M2** for $90 + \tan^{-1}\left(\frac{28-24}{16}\right)$ oe or $180 - \tan^{-1}\left(\frac{16}{28-24}\right)$ oe or **M1** for $\tan[\ldots] = \frac{28-24}{16}$ oe or $\tan[\ldots] = \frac{16}{28-24}$ oe
11(b)	$\frac{1}{2}\times 16\times(24+28)\times h = 4000\times 2$ or $\frac{1}{2}\times 16\times(24+28)\times\left(\frac{2}{3}\times 29\right)$	**M2**	**M1** for $\frac{1}{2}\times 16\times(24+28)\times h$
	No and 19.2[3…] and 19.3[3…] OR No and $\frac{19.23}{29}$ or $\frac{8000}{12064} = 0.663...$ and 0.666 to 0.667 OR No and 8040 or 8042 to 8043 and 8000	**A1**	
11(c)	42[.0] or 41.96…	**3**	**M2** for $\tan[\ldots] = \frac{29}{\sqrt{28^2+16^2}}$ oe or **M1** for 28^2+16^2 oe or $\tan[\ldots] = \frac{29}{theirHF}$