Cambridge Assessment International Education

Cambridge O Level

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

Paper 2 **October/November 2022**

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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Maths-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)	39 [hours] 35 [minutes]	**2**	B1 for 2375 [min] or 35 [h] 275 [m] or 7 [h] 55 [m] or 475 [min] or 22 [h] 5 [m] or 17 [h] 30 [m] After 0 scored, SC1 for answer 39 [h] 35 [m] to 39 [h] 36 [m]
1(b)	14.91 final answer	**2**	M1 for $14.20+\frac{5}{100}\times 14.20$ oe or B1 for 0.71 seen
1(c)	8 : 15 : 17 final answer	**3**	**M2** for $\frac{1}{5}k:\frac{3}{8}k:\frac{17}{40}k$ soi or 20 : 37.5 : 42.5 oe or for final answer ratio with 8, 15 and 17 in wrong order or **M1** for $\frac{1}{5}k+\frac{3}{8}k$ or 20[%] + 37.5[%] soi
1(d)	1.6	**2**	**M1** for $\frac{2400\times r\times 4}{100}=153.60$ oe
1(e)	1700[.00…]	**3**	**M2** for $\frac{1822.38}{1.014^5}$ oe or **M1** for $x\times\left(1+\frac{1.4}{100}\right)^5=1822.38$ oe
2(a)(i)	Four points plotted correctly	**2**	**B1** for 2 or 3 correct plots
2(a)(ii)	Ruled line of best fit	**1**	
2(a)(iii)	Reading at age 14	**1**	FT their ruled straight line of best fit with positive gradient
2(a)(iv)	Age outside range of given data oe	**1**	Do not allow contradictory statements
2(b)(i)	47.8 or 47.77 to 47.78	**2**	**M1** for $\frac{62+24}{180}[\times 100]$ oe
2(b)(ii)	144 or 144.4 to 144.5 nfww	**3**	**B1** for correct midpoints soi **M1** for $\frac{130\times 8+137.5\times 31+142.5\times 55+147.5\times 62+155\times 24}{180}$
3(a)	6.5 oe	**1**	
3(b)	Correct smooth curve	**3**	**B2FT** for 6 or 7 points correctly plotted or **B1FT** for 4 or 5 points correctly plotted

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Question	Answer	Marks	Partial Marks
3(c)	Coordinates of minimum of *their* curve	**2**	Dependent on a single local minimum below the *x*-axis **B1** for one correct After 0 scored, SC1 for (3, *their* negative $y < -0.5$)
3(d)	Reading at $y = 0$	**2**	**B1** for two correct values
4(a)	57 cao	**1**	
4(b)	5 cao	**1**	
4(c)	$\frac{4-2x}{3}$ oe final answer	**3**	**B2** for $3y = 4 - 2x$ or $x = \frac{4-2y}{3}$ oe or **B1** for $x = \frac{4-3y}{2}$ or $2y = 4 - 3x$ or $y - 2 = -\frac{3x}{2}$ oe
4(d)	$-\frac{1}{2}$ oe and $\frac{3}{2}$ oe	**4**	**B1** for $(2x-1)^2 - 7 + 3[=0]$ AND **M2** for $2x = 1 \pm \sqrt{4}$ or **M1** for $2x - 1 = [\pm]\sqrt{4}$ OR **M1** for expansion of bracket and simplification to 3-term quadratic $4x^2 - 4x - 3[=0]$ **M1** for correct factorisation/use of formula for *their* 3-term quadratic $(2x+1)(2x-3)[=0]$
5(a)(i)	Correct justification with probabilities 0.44… and 0.45… seen	**2**	**B1** for $\frac{4}{9}$ oe or $\frac{5}{11}$ oe seen
5(a)(ii)	120	**2**	**M1** for $\frac{6}{11} \times 220$
5(b)(i)	Correct tree diagram $\frac{6}{15}, \frac{3}{15}, \frac{5}{15}, \frac{3}{15}, \frac{6}{15}, \frac{2}{15}$ oe	**2**	**M1** for 4 or more probabilities completed correctly

Question	Answer	Marks	Partial Marks
5(b)(ii)	$\frac{5}{8}$ oe nfww	**3**	**M2FT** for $1-\frac{10}{16}\times\frac{9}{15}$ oe or $1-\frac{7}{16}\times\frac{9}{15}-\frac{3}{16}\times\frac{9}{15}$ oe or $\frac{7}{16}\times\frac{6}{15}+\frac{3}{16}\times\frac{6}{15}+\frac{6}{16}$ oe or **M1FT** for $\frac{7}{16}\times\frac{6}{15}$ or $\frac{3}{16}\times\frac{6}{15}$ or $\frac{6}{16}\times\frac{7}{15}+\frac{6}{16}\times\frac{5}{15}+\frac{6}{16}\times\frac{3}{15}$ oe
6(a)(i)	$\begin{pmatrix}5\\-5\end{pmatrix}$	**1**	
6(a)(ii)	$(\textit{their}\,5)^2+(\textit{their}-5)^2$ oe or $(9-4)^2+(2-7)^2$ oe	**M1**	Correct use of Pythagoras using *their* $\overrightarrow{AB}$ or $\overrightarrow{OB}-\overrightarrow{OA}$
	7.07[1…]	**A1**	
6(a)(iii)	[C =] (5, 3) [D =] (0, 8)	**2**	**B1** for each
6(b)	[r =] –3 [t =] 5 [u =] 2	**4**	**B1** for $u=2$ **M2** for two correct equations involving r and/or t or **M1** for one correct equation involving r and/or t OR **B1** for $r=-3$ **M2** for two correct equations involving u and/or t or **M1** for one correct equation involving u and/or t After 0 scored, **SC1** for $\frac{u-4}{t-r}=-\frac{1}{4}$
7(a)	Translation $\begin{pmatrix}2\\-5\end{pmatrix}$ oe	**2**	**B1** for each
7(b)	Correct reflection (3, –3), (3, –4), (2, –4), (1, –3)	**1**	

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Question	Answer	Marks	Partial Marks
7(c)	Correct enlargement (1, 2), (1, 4), (–1, 4), (–3, 2)	**2**	**B1** for correct size and orientation, wrong centre
7(d)(i)	Correct transformation (–3, 3), (–3, 1), (–4, 2), (–4, 3)	**2**	**B1** for three vertices correct or three correct pairs of coordinates soi
7(d)(ii)	Rotation 90 anticlockwise oe (0, 0) oe	**3**	**B1** for each
7(d)(iii)	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	**1**	
8(a)	$\frac{50}{x}$ or $50x^{-1}$ final answer	**1**	
8(b)	$\frac{50}{x-3}-\frac{50}{x}=\frac{15}{60}$ oe	**M2**	**B1** for $\frac{50}{x-3}$ soi
	$60\times50x-60\times50(x-3)=15x(x+3)$ oe or $\frac{60\times50x-60\times50(x-3)}{60x(x-3)}=\frac{15x(x+3)}{60x(x-3)}$ oe	**M1**	**DEP** on previous **M2** **FT** elimination of fractions or use of common denominator
	Correct expansion of brackets and rearrangement to $x^2-3x-600=0$	**A1**	**A0** if any errors or omissions
8(c)	$\frac{-(-3)\pm\sqrt{(-3)^2-4\times1\times-600}}{2\times1}$ oe or $\frac{-(-3)}{2}\pm\sqrt{\left(\frac{(-3)}{2}\right)^2-(-600)}$ oe	**B2**	**B1** for $\sqrt{(-3)^2-4\times1\times-600}$ oe or for $\frac{-(-3)\pm\sqrt{their\,2409}}{2\times1}$ oe or for $\left(x+\frac{-3}{2}\right)^2$
	26.04 and –23.04	**B1**	
8(d)	2 [hours] 10 [minutes] cao	**2**	**M1** for substitution of *their* positive root into $\frac{50}{x-3}$ or $\frac{50}{x}+0.25$ oe or **B1** for final answer 1 [hour] 55 [minutes]

Question	Answer	Marks	Partial Marks
9(a)	$3(n-8)=n-11$ oe	**B2**	**B1** for $3(n-8)$ oe or $n-11$ soi
	[n =] 6.5 oe nfww	**B2**	**M1** for correct rearrangement of *their* four-term equation to isolate n $3n-n=-11+24$ **SC1** for answer $11\frac{2}{3}$ or $\frac{35}{3}$ or 11.66 to 11.7
9(b)	$\frac{2(x-2)}{x}$ or $\frac{2x-4}{x}$ or $2-\frac{4}{x}$ final answer	**3**	**B1** for $(x+2)(x-2)$ seen **B1** for $x(x+2)$ seen
10(a)	150.5 or 150.48 to 150.49	**4**	**B3** for [$\angle PQR$ =] 81.5[1…] OR **M2** for $\frac{11.5^2+14.6^2-17.2^2}{2\times11.5\times14.6}$ oe or **M1** for $17.2^2=11.5^2+14.6^2-2\times11.5\times14.6\cos[\ ]$ oe **M1** for 180 + 52 – *their PQR* oe
10(b)	107.4…	**3**	**B1** for 67.5 and 44.5 seen **M1** for tan (*their* 67.5) = $\frac{h}{\textit{their}\ 44.5}$ oe
11(a)	Angle at centre = 72° or interior angle = 108°	**B1**	
	$\sin\left(\frac{\textit{their}\ 72}{2}\right)=\frac{3}{d}$ oe or $\cos\left(\frac{\textit{their}\ 108}{2}\right)=\frac{3}{d}$ oe	**M1**	*their* 72 angle at centre *their* 108 interior angle
	5.103 to 5.104	**A1**	

Question	Answer	Marks	Partial Marks
11(b)	269 or 268.5 to 269.2	**5**	**M2** for $\sqrt{14^2 - 5.10^2}$ oe or **M1** for $14^2 = h^2 + 5.10^2$ oe **M2** for $\frac{1}{3}(5 \times \frac{1}{2} \times 5.10^2 \times \sin(their\ 72)) \times their\ 13.04$ oe or **M1** for $\frac{1}{2} \times 5.10^2 \times \sin(their\ 72)$ oe or $\frac{1}{2} \times 3 \times \sqrt{5.10^2 - 3^2}$