Cambridge Assessment International Education

Cambridge O Level

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

Paper 2 **October/November 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.

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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)(i)	1980	**2**	**M1** for $2250-\frac{12}{100}\times 2250$ oe or **B1** for 270 After 0 scored, **SC1** for answer 3960
1(a)(ii)	14 : 31 final answer	**2**	**M1** for 700 : 1550 oe After 0 scored, **SC1** for answer 31 : 14
1(b)	77.65 cao	**3**	**M2** for $350-\frac{19500}{71.6}$ oe OR **M1** for 350 × 71.6 soi **M1** for $\frac{\textit{their}\,25060-19500}{71.6}$ oe
1(c)(i)	1.333×10^7 final answer	**1**	
1(c)(ii)	749 or 7.49×10^2 cao	**2**	**M1** for $\frac{4.44\times 10^{10}}{5.93\times 10^7}$ oe
1(c)(iii)	739 000 or 7.39×10^5	**2**	**M1** for $\frac{(100+23.5)}{100}x=9.13\times 10^5$ soi
2(a)(i)	16 to 20	**1**	
2(a)(ii)	240	**2**	**M1** for $\frac{90}{54}$ [×144] or $\frac{144}{54}$ [×90] or $54x = 90\times 144$
2(b)(i)	Correct histogram	**3**	**B1** for 3 or more rectangles on correct bases **B1** for 3 or more correct frequency densities soi
2(b)(ii)	28.8	**2**	**M1** for $\frac{30+42}{250}[\times 100]$ oe or for $\frac{k}{250}\times 100$, where $42 < k < 102$ but $k \neq 75$
3(a)	-5.5 or $-5\frac{1}{2}$ or $-\frac{11}{2}$	**1**	
3(b)	Correct smooth curve	**3**	**B2FT** for 6 or 7 points correctly plotted or **B1FT** for 4 or 5 points correctly plotted
3(c)	Line $y = 3$ only intersects the graph once oe	**2**	**M1** for $\frac{x^3}{2}-3x-1=3$ soi or $y = 3$ soi

Question	Answer	Marks	Partial Marks
3(d)(i)	Ruled line through (1, 1) and (–2, –1)	**1**	
3(d)(ii)	$\frac{2}{3}$ nfww	**2**	**M1** for gradient = $\frac{1+1}{1+2}$ oe
3(d)(iii)	FT reading three x-values where *their L* intersects *their* curve	**2**	**B1FT** for two correct
4(a)(i)	20 24	**1**	Both correct
4(a)(ii)	$4n + 4$ oe final answer	**2**	**B1** for $4n + k$ oe seen
4(a)(iii)	36	**2**	**M1** for *their* $(4p + 4) = 150$ soi
4(b)(i)	44	**2**	**M1** for $\frac{26-2}{4}$ or difference = [–]6
4(b)(ii)	$50 – 6n$ oe final answer	**2**	**B1** for $–6n + k$ oe seen
5(a)	$4c + 3e = 85$ oe $2c + 5e = 67$ oe	**B1**	
	Correct method to eliminate one variable	**M1**	**FT** *their* equations
	[Card =] 16 [Envelope =] 7 final answer	**A2**	**A1** for either $c = 16$ or $e = 7$ If A0 scored, **SC1FT** for a pair of positive values that satisfy either equation or for correct answers with no working
5(b)	$(x+5)(x-5)$ nfww final answer	**1**	
5(c)	$\frac{5r}{r-2}$ or $\frac{-5r}{2-r}$ final answer	**3**	**B1** for $rt – 5r = 2t$ or $\frac{rt-5r}{2} = t$ **M1** for isolation of terms in t **M1** for factorising and completing to $t =$ Maximum 2 marks if final answer not correct
5(d)	$\frac{5x+19}{(x-5)(2x+1)}$ or $\frac{5x+19}{2x^2-9x-5}$ final answer	**3**	**B1** for $4(2x+1)-3(x-5)$ oe isw **B1** for denominator $(x-5)(2x+1)$ oe isw

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Question	Answer	Marks	Partial Marks
6(a)(i)a	$\frac{1}{8}$ oe	**1**	
6(a)(i)b	$\frac{5}{8}$ oe	**1**	
6(a)(ii)	$\frac{9}{64}$ oe	**2**	**M1** for $\frac{3}{8}\times\frac{3}{8}$
6(b)	$\frac{13}{40}$ oe	**3**	**M2** for $\frac{7}{16}\times\frac{6}{15}+\frac{6}{16}\times\frac{5}{15}+\frac{3}{16}\times\frac{2}{15}$ oe or **M1** for $\frac{7}{16}\times\frac{6}{15}$ or $\frac{6}{16}\times\frac{5}{15}$ or $\frac{3}{16}\times\frac{2}{15}$ After 0 scored, **SC1** for answer $\frac{47}{128}$
7(a)(i)	(–1, 4.5)	**1**	
7(a)(ii)	(–1, 13)	**1**	
7(a)(iii)	7.21[1...]	**2**	**M1** for $(-4)^2 + 6^2$ oe
7(b)(i)	$\mathbf{b} - \mathbf{a}$	**1**	
7(b)(ii)	$\frac{1}{4}\mathbf{a}+\frac{1}{4}\mathbf{b}$ or $\frac{1}{4}(\mathbf{a}+\mathbf{b})$	**3**	**M1** for correct vector route along the lines of the diagram **B1** for $\overrightarrow{BC}=\frac{\mathbf{a}}{2}$ soi or for $\overrightarrow{NB}=\frac{1}{4}their(\mathbf{b}-\mathbf{a})$ soi or $\overrightarrow{NA}=\frac{3}{4}their(\mathbf{a}-\mathbf{b})$ soi
8(a)	$\frac{3\times110}{\pi\times3.5^2}$ oe	**M2**	**M1** for $\frac{1}{3}\times\pi\times3.5^2\times h=110$ oe
	= 8.573 to 8.574...	**A1**	
8(b)	9.26 or 9.256 to 9.262	**2**	**M1** for $3.5^2 + 8.57^2$

Question	Answer	Marks	Partial Marks
8(c)	135.7 to 136.1… nfww	**4**	**M3** for $\frac{360\times\pi\times7}{2\times\pi\times \textit{their}\,9.26}$ oe or **M2** for $\frac{x}{360}\times2\times\pi\times \textit{their}\,9.26=\pi\times7$ oe or **M1** for $\frac{x}{360}\times2\times\pi\times \textit{their}\,9.26$ seen or $\pi\times7$ oe seen Alternative method: **M3** for $\frac{360\times\pi\times3.5\times \textit{their}\,9.26}{\pi\times(\textit{their}\,9.26)^2}$ oe or **M2** for $\frac{x}{360}\times\pi\times(\textit{their}\,9.26)^2=\pi\times3.5\times \textit{their}\,9.26$ oe or **M1** for $\frac{x}{360}\times\pi\times(\textit{their}\,9.26)^2$ seen or $\pi\times3.5\times \textit{their}\,9.26$ seen
8(d)	8.01...	**2**	**M1** for $\sqrt[3]{\frac{165}{110}}$ oe or $\sqrt[3]{\frac{110}{165}}$ oe or $\left(\frac{7}{x}\right)^3=\frac{110}{165}$ oe
9(a)	[W =] $x + 5$ [L =] $2(x + 5)$ oe final answers	**2**	**B1** for [W =] $x + 5$ or **B1FT** for [L =] $2\times$*their* algebraicW
9(b)	$(x+5)\times2(x+5)\ +\ 2(x\times(x+5))$ $+2(x\times2(x+5))$ oe	**M2**	**FT** *their* algebraic expressions in x for length and width **B1FT** for two different areas seen e.g. two of $(x + 5)\times2(x +5)$, $x(x + 5)$, $x \times 2(x + 5)$ or $2((x + 5)\times2(x +5) + x(x + 5) + x \times 2(x + 5))$
	$2x^2 + 20x + 50 + 2x^2 + 10x + 4x^2 + 20x = 210$	**M1**	Set equal to 210 and expansion of brackets. Must have three different areas from width and length of form $ax + b$, a and $b \neq 0$
	Correct simplification to $4x^2+25x-80=0$	**A1**	
9(c)	$\frac{-25\pm\sqrt{25^2-4\times4\times-80}}{2\times4}$ oe or $\frac{-25}{8}\pm\sqrt{\left(\frac{25}{8}\right)^2-\frac{-80}{4}}$	**B2**	**B1** for $\sqrt{25^2-4\times4\times-80}$ oe or $\frac{-25\pm[...]}{2\times4}$ oe or $\left(x+\frac{25}{8}\right)^2$
	2.33 and –8.58	**B1**	

Question	Answer	Marks	Partial Marks
9(d)	250 or 251 or 250.3 to 250.5…	**2**	**M1** for *their* 2.33 × (*their* 2.33 + 5) × 2(*their* 2.33 + 5)
9(e)	6.5 nfww	**3**	**B1** for 255 and 261.5 seen **M1** for *their* 261.5 – *their* 255
10(a)	207.2 to 207.3 nfww	**4**	**B1** for $\angle BAD = 55$ soi nfww **M2** for $\sin[\ ] = \frac{290\sin(\textit{their}55)}{350}$ or **M1** for $\frac{350}{\sin(\textit{their}55)} = \frac{290}{\sin[\ ]}$ oe
10(b)	17.6 to 17.8… nfww	**5**	**M1** for *CD* = 350 sin (70 – *their* 42.7) oe or 350 sin (*their* (a) – 180) oe AND **M3** for $\tan = \frac{290\tan 10}{\textit{their}\,CD}$ or **M2** for [height of mast =] 290 tan 10 or **M1** for $\tan 10 = \frac{[...]}{290}$