Cambridge O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

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

Paper 2 **May/June 2019**

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.

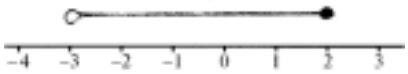
GENERIC MARKING PRINCIPLE 5:

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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Question	Answer	Marks	Partial Marks
1(a)	83[.00]	**1**	
1(b)(i)	15	**2**	**M1** for $\frac{26-22.10}{26}[\times 100]$ oe or $\frac{22.10}{26}\times 100$ oe After 0, **SC1** for answer 85
1(b)(ii)	9.4[0] **or** 9.397 to 9.398	**3**	**M1** for [Total cost =] 22.10 × 2 + 15.50 × 2 oe or [Total reduction =] 2 × (26.00 – 22.10) oe **M1** for $\frac{their83-their75.2}{their83}[\times 100]$ oe or $\frac{their75.2}{their83}\times 100$ oe or for answer 90.6[0…]
1(c)(i)	5 (hours) 35 (minutes) cao	**1**	
1(c)(ii)	140	**2**	**B1** for 4 [shows] soi
2(a)	(16, 23) (18,18) (20, 12) (21, 8) plotted	**2**	**B1** for 2 or 3 correct plots
2(b)	negative	**1**	
2(c)	Ruled line of best fit	**1**	
2(d)	Strict FT *their* ruled line of best fit read at Sydney = 15°C	**1**	
3(a)		**1**	
3(b)	$y \geqslant 0$ $x \leqslant 4$ oe $y \leqslant \frac{1}{2}x$ oe	**3**	**B1** for each inequality After 0, **SC1** for 3 correct equations soi
3(c)	$-1 \leqslant m < 4.5$ final answer	**3**	**B2** for $-1 \leqslant m < 4.5$ seen or final answer $-1 \leqslant m$ or final answer $m < 4.5$ or **M1** for $-\frac{12}{4}$ […] m – 2 […] $\frac{10}{4}$ or –12 + 8 […] $4m$ […] 10 + 8

Question	Answer	Marks	Partial Marks
4(a)(i)	All angles and complete reasons eg $A\hat{E}B = 110$ corresponding angle $A\hat{B}E = 35$ isosceles triangle [x =] 145 [straight] line **OR** $A\hat{E}B = 110$ corresponding angle $A\hat{B}E = 180 - x$ [straight] line 110 + (180–x) + (180–x) = 180 isosceles triangle [x =] 145	**3**	**B1FT** for one angle with its reason stated **B1** for [x =] 145 Alternative example: $D\hat{E}B$ = 70 interior angles (or allied) $A\hat{E}B = 110$ [straight] line $A\hat{B}E = 35$ isosceles triangle [x =] 145 [straight] line
4(a)(ii)	8 cao	**1**	
4(b)	55°	**2**	**B1** for 540 or **M1** for $a + 3a + 130 + 80 + 110 = 180k$ where $k \geqslant 2$ and an integer
4(c)	$\cos\left[P\hat{Q}M\right] = \frac{7}{14}$ **or** $\sin\left[Q\hat{P}M\right] = \frac{7}{14}$	**M1**	
	$\left[P\hat{Q}R =\right] 120$ **or** $P\hat{Q}M = M\hat{Q}R = 60$ **or** $Q\hat{P}M = Q\hat{R}M = 30$	**A2**	**A1** for $P\hat{Q}M = 60$ or $M\hat{Q}R = 60$ or $Q\hat{P}M = 30$ or $Q\hat{R}M = 30$
	6	**A1**	Dep on $P\hat{Q}R$ exactly 120 soi or exterior angle is exactly 60 soi
5(a)(i)	$\frac{7a}{12b}$ final answer	**2**	**M1** for $\frac{9a}{12b} - \frac{2a}{12b}$ or a correct method to a single fraction eg $\frac{18ab - 4ab}{(4b)(6b)}$
5(a)(ii)	$\frac{b+3}{3}$ final answer nfww	**2**	**B1** for $(b - 3)(b + 3)$ seen or final answer $\frac{2(b+3)}{6}$ or $\frac{2b+6}{6}$
5(b)	–2.375 or $-2\frac{3}{8}$ or $-\frac{19}{8}$	**2**	**M1** for $3x = 1 - 5x - 20$ leading to $3x + 5x = 1 - 20$ or $3x + 5x = 1 - 20$ as first line of working

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Question	Answer	Marks	Partial Marks
5(c)	$2y\,(y+3) - y \times y$ [= 55] oe	**M1**	
	$y^2 + 6y - 55[=0]$	**A1**	
	$(y-5)(y+11)$ [=0] **or** $[y=]\dfrac{-6 \pm \sqrt{6^2 - 4\times1\times-55}}{2\times1}$	**M1**	Correct factorisation of *their* three-term quadratic [=0] or correct substitution into quadratic formula
	$y = 5$ [$y = -11$]	**B1**	
	10 by 8	**B1**	**FT** *their* positive y value into $2y$ by $y + 3$
6(a)	80 000	**2**	**B1** for answer figs 8 or 400 000 seen or figs5 : figs4 seen
6(b)	235 to 240	**1**	
6(c)	Correct position of C	**2**	**B1** for bearing of 120° from A or 195° from B
6(d)	2.56 to 2.96	**2**	Dep on 2 marks in (c) **B1FT** for correct measurement of *their AC*
6(e)(i)	38.8 or 38.78 to 38.79	**3**	**M2** for $\sin[...] = \dfrac{4\sin 70}{6}$ or $\sin^{-1}\left(\dfrac{4\sin 70}{6}\right)$ or **M1** for $\dfrac{4}{\sin[...]} = \dfrac{6}{\sin 70}$ oe
6(e)(ii)	29.2 or 29.18 to 29.19	**3**	**M2** for $\dfrac{6}{12\frac{1}{3}} \times 60$ oe or **M1** for $\dfrac{6}{\textit{their}\ \text{time}}$ or $\dfrac{6000}{\textit{their}\ \text{time}}$
7(a)	1.25 oe	**1**	
7(b)	Correct smooth curve	**2**	**B1FT** for at least 6 points correctly plotted
7(c)	$y = -\dfrac{1}{5}x + 2.4$ oe final answer	**3**	**M1** for $\dfrac{d-b}{c-a}$ from correct (a, b) and (c, d) **M1** for correct method to find y intercept

Question	Answer	Marks	Partial Marks
7(d)	line drawn through (1, 3) with negative gradient, crossing the curve twice	**B1**	
	5.8 to 6.2	**B1**	
8(a)	$\frac{23}{75}$ oe	**1**	
8(b)	192 or 192.4 to 192.5 nfww	**3**	**M1** for 4×165, 10×175, 15×185, 23×195, 18×205 and 5×215 **M1** for (4×165 + 10×175 + 15×185 + 23×195 + 18×205 + 5×215) ÷ 75 oe After 0 scored, **SC1** for $\sum fx \div 75$
8(c)	Correct cumulative frequency curve	**3**	**B2** for at least 5 points plotted correctly or **B1** for 4, 14, 29, 52, 70, 75 soi
8(d)	193 to 195	**1**	Dep on no clear indication of incorrect CF
8(e)	202 to 205	**2**	**FT** *their* increasing curve **B1** for 60 nfww
8(f)	11 or 12 cao	**1**	
9(a)	6.84 or 6.839 to 6.84[0]	**3**	**B2** for 46.7 to 46.8 or **M1** for $15^2 + 14^2 - 2 \times 14 \times 15 \times \cos 27$
9(b)	21[.0] or 20.97 to 20.98	**3**	**M2** for $\frac{1000}{\frac{1}{2} \times 14 \times 15 \times \sin 27}$ oe or **M1** for $\frac{1}{2} \times 14 \times 15 \times \sin 27$ oe isw
9(c)	6.36 or 6.355 to 6.356	**2**	**M1** for $\sin 27 = \frac{h}{14}$ oe
10(a)(i)	$\begin{pmatrix} -7 \\ 1 \end{pmatrix}$ final answer	**1**	

Question	Answer	Marks	Partial Marks
10(a)(ii)	$4^2 + (\pm 3)^2$	**M1**	
	$1^2 + (\pm 5)^2$	**M1**	
	Correct concluding statement eg $\sqrt{25} < \sqrt{26}$ or 5 > 5.1[0] wrong or $\lvert f \rvert = 5$ $\lvert g \rvert = 5.099$ so $\lvert f \rvert$ is not greater than $\lvert g \rvert$	**A1**	
10(b)(i)	$-\frac{1}{3}\mathbf{a} + \mathbf{b}$ or $\frac{1}{3}(-\mathbf{a} + 3\mathbf{b})$	**1**	
10(b)(ii)	$\frac{1}{6}\mathbf{a} + \frac{1}{2}\mathbf{b}$ or $\frac{1}{6}(\mathbf{a} + 3\mathbf{b})$	**2**	**M1FT** for a correct vector route for $\overrightarrow{OQ}$
10(b)(iii)	$\left[\overrightarrow{AR} =\right] -\frac{1}{2}\mathbf{a} + \frac{3}{2}\mathbf{b}$ or $\frac{1}{2}(-\mathbf{a} + 3\mathbf{b})$ or $-\frac{1}{2}(\mathbf{a} - 3\mathbf{b})$	**B2**	**M1** for $-\mathbf{a} + 3 \times$ *their* **(b)(ii)** or $-\frac{2}{3}\mathbf{a} + \frac{1}{2}$ *their*(b)(i)$+2\times$*their* **(b)(ii)**
	$OQ = \frac{1}{3}OR$, $OP = \frac{1}{3}OA$ and $P\hat{O}R = A\hat{O}R$		**M1** for <u>two</u> of $OQ = \frac{1}{3}OR$, $OP = \frac{1}{3}OA$ or $P\hat{O}R = A\hat{O}R$
	$\overrightarrow{AR} = \frac{3}{2}\overrightarrow{PB}$ oe	**B1**	Dep on B2
	Similar triangles $O\hat{P}Q = O\hat{A}R$ or Similar triangles $O\hat{Q}P = O\hat{R}A$		Dep on B2
11(a)	2.5 oe	**1**	
11(b)	$\frac{4x+4}{7}$ oe	**2**	**B1** for $\frac{7x}{4} = y + 1$ or $7x - 4 = 4y$ or $\frac{x}{4} - \frac{1}{7} = \frac{y}{7}$ or $x = \frac{7y}{4} - 1$ or better
11(c)	4	**2**	**B1** for $3(t - 2) = 6$ oe
11(d)	$p = \frac{21}{4}$ oe $q = -9$	**3**	**B2** for $p = \frac{21}{4}$ oe or $q = -9$ or **B1** for $3\left(\frac{7x}{4} - 1 - 2\right)$ oe