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International Education

Cambridge O Level

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

Paper 2 **May/June 2024**

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 descriptions 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, non-integer 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 or sign 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 A or B 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)	8.26 cao	**1**	
1(b)(i)	328 to 332	**1**	
1(b)(ii)	388 to 402	**2**	**B1** for 208 to 212 seen or 180 to 190 seen
1(b)(iii)	Ruled line from (0, 90) to (500, 390)	**2**	**B1** for short or unruled or dashed correct line or for two correct coordinates soi or for a ruled line with a positive gradient passing through (0, 90) and (500, *k*) or (*h*, 400)
1(c)	8 : 3 : 12 cao	**2**	**B1** for 1600 : 600 : 2400 oe
2(a)(i)	$\frac{1}{5}$ oe	**1**	
2(a)(ii)	$\frac{2}{5}$ oe	**1**	
2(b)(i)	…….. 7 8 5 6 7 8 9 6 7 8 9 10	**2**	**B1** for at least 7 values correct
2(b)(ii)	$\frac{3}{25}$ oe	**1**	
2(b)(iii)	$\frac{10}{25}$ oe	**2**	**FT** *their* complete possibility diagram $\frac{their10}{25}$ **B1FT** for answer $\frac{their10}{k}$ where *k* is 35 or 36
3(a)	42.75	**2**	**M1** for $\frac{179.12}{4.19}$

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Question	Answer	Marks	Partial Marks
3(b)	4.08	**4**	**M3** for $\dfrac{1500\times\left(1+\dfrac{4}{100}\right)^2-1500}{1500\times 2}$ [×100] oe OR **B2** for 1622.4[0] or 122.4[0] or **M1** for $1500\left(1+\dfrac{4}{100}\right)^2$ oe **M1** for *their* 1622.40 = 1500 + $\dfrac{1500\times 2\times x}{100}$ oe After 0 scored, **SC1** for answer 3.92[3…]
4(a)(i)		**1**	
4(a)(ii)	25 36 6 10 15 10 15 21	**2**	**B1** for one row correct or column 5 correct or column 6 correct
4(a)(iii)	n^2 oe final answer	**1**	
4(a)(iv)	$\frac{1}{2}n^2+\frac{1}{2}n$ oe final answer	**2**	**B1** for $\frac{1}{2}n^2+\frac{1}{2}n$ oe seen or answer kn^2 [+ ….] oe or second difference = 1
4(b)(i)	42	**2**	**M1** for $\dfrac{34-14}{8-3}$ oe or $\dfrac{34-14}{3-8}$ oe or $a + 2d = 34$ <u>and</u> $a + 7d = 14$ oe or **B1** for <u>difference</u> = 4 or <u>difference</u> = –4
4(b)(ii)	–2	**1**	

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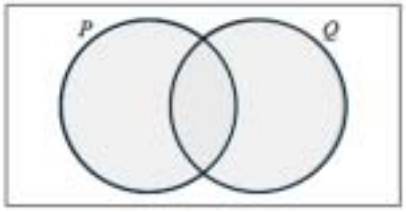
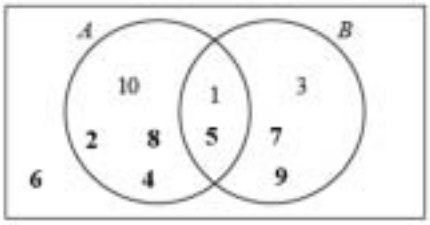
Question	Answer	Marks	Partial Marks
5(a)	Reflection $y = -x$ oe	2	**B1** for Reflection **B1** for $y = -x$ oe
5(b)(i)	(–4, 5)	2	**B1** for (– 4, k) or (h, 5) with $h < -2$
5(b)(ii)	13.5 or $13\frac{1}{2}$	2	**B1** for area $A = 1.5$ seen or for Answer $3^2 \times k$ where $k > 0$ and $k \neq 1$ or **M1** for $\frac{1}{2}(3+6)\times 3$ oe
5(c)(i)	Shape D at (–6, –1) (–4, –1) (–5, –2) (–6, –2)	2	**B1** for three vertices correct or three correct pairs of coordinates soi
5(c)(ii)	Rotation 90° anticlockwise oe (0, 0) oe	3	**B1** for Rotation **B1** for 90° anticlockwise oe **B1** for (0, 0) oe
6(a)		1	
6(b)	$(X \cap Y)'$ oe	1	
6(c)(i)		2	**B1** for Venn diagram with 1 or 2 errors, omissions, or repeats
6(c)(ii)	3 7 9	1	**FT** *their* Venn diagram
6(c)(iii)	$\frac{2}{10}$ oe	1	
7(a)	21	1	
7(b)	$2\frac{3}{4}$ oe	2	**M1** for $6x - 2x = 5 + 6$ oe

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Question	Answer	Marks	Partial Marks
7(c)	$(3x + 4)(x – 2)$ oe factorised final answer	**2**	**M1** for $(3x + 4)(x – 2)$ seen and spoilt or answer $(3x + a)(x + b)$ with $ab = –8$ or answer $(3x + a)(x + b)$ with $3b + a = –2$ or $3x(x – 2) + 4(x – 2)$ or $x(3x + 4) – 2(3x + 4)$
7(d)	$a = 2$ $b = –3$ $c = 9$	**3**	**B1** for $a = 2$ **B1FT** for $b = \dfrac{-12}{2 \times their\ a}$, *their* $a \neq 0$ **B1FT** for $c = (their\ b)^2$, *their* $b \neq 0$ After 0 scored, **SC1** for $(2x – 3)^2 = 4x^2 – 12x + 9$ seen
8(a)(i)	$2 \times \pi \times r^2 = 145$ or $4 \times \pi \times r^2 = 290$	**M1**	
	$r^2 = \dfrac{145}{2\pi}$ or 23.1 or 23.06 to 23.09 or $r = \sqrt{\dfrac{145}{2\pi}}$	**M1**	**FT** from (*their* 2) $\times \pi \times r^2 = 145$ for r^2 or r
	$r = 4.803$ to 4.804	**B1**	
8(a)(ii)	357 to 358	**4**	**B1** for height of cone = 10 – 4.8 soi **M1** for $\dfrac{1}{3} \times \pi \times 4.80^2 \times their\ 5.2$ oe **M1** for $\dfrac{2}{3} \times \pi \times 4.80^3$ oe
8(a)(iii)	107 or 106.7 to 106.8…	**4**	**M2** for $\sqrt{4.80^2 + (their\ 5.2)^2}$ soi or **M1** for $4.80^2 + (their\ 5.2)^2$ soi **M1** for $\pi \times 4.80 \times their\ 7.077$

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Question	Answer	Marks	Partial Marks
8(b)	115.2	**4**	**M3** for $0.8 \times (1.2)^2$ [× 100] oe OR **B1** for $0.8x$ oe or $1.2y$ oe **M2** for $\dfrac{\frac{their\,0.8x}{360} \times \pi \times (their\,1.2y)^2}{\frac{x}{360} \times \pi \times y^2}$ [×100] oe or **M1** for $\dfrac{their\,0.8x}{360} \times \pi \times (their\,1.2y)^2$ After 0 scored, **SC1** for $\dfrac{x-0.2}{360} \times \pi \times (y+0.2)^2$ oe
9(a)(i)(a)	1.33 to 1.335	**1**	
9(a)(i)(b)	1.28 to 1.285	**2**	**M1** for $\dfrac{30}{100} \times 80$ oe
9(a)(ii)	1.355 to 1.36	**2**	**B1** for 48 soi
9(a)(iii)	28 18 4	**2**	**B1** for one correct

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Question	Answer	Marks	Partial Marks
9(b)	$p = 10$ $q = 8$	**6**	**B5** for $1.6p + 2.1q = 32.8$ oe soi <u>and</u> $p + q + 15 + 17 = 50$ oe or $0.21p – 0.29q = –0.22$ oe soi <u>and</u> $p + q + 15 + 17 = 50$ oe OR **B4** for $1.6p + 2.1q = 32.8$ oe soi or $0.21p – 0.29q = –0.22$ oe soi OR **B1** for $p + q + 15 + 17 = 50$ oe **B1** for correct midpoints soi **M2** for $\frac{1.6\times p+1.75\times 15+1.85\times 17+2.1\times q}{50}$ =1.81 oe soi $\frac{1.6\times p+1.75\times 15+1.85\times 17+2.1\times q}{p+q+15+17}$ =1.81 oe soi or **M1** for $\frac{1.6\times p+1.75\times 15+1.85\times 17+2.1\times q}{50}$ soi or $\frac{1.6\times p+1.75\times 15+1.85\times 17+2.1\times q}{p+q+15+17}$ soi
10(a)	87	**2**	**M1** for $B+106+120+79+148 = 3 \times 180$ oe soi or $74+60+101+32+180–B = 360$ oe soi

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Question	Answer	Marks	Partial Marks
10(b)	$x^2 + 8x - 161$ [= 0]	**M2**	**M1** for $15^2 = 8^2 + x^2 - 2 \times 8 \times x \times \cos 120$ oe
	$\sin ADE = \frac{8\sin 120}{15}$ oe		**M1** for $\frac{15}{\sin 120} = \frac{8}{\sin ADE}$ oe
	$\frac{-8 \pm \sqrt{8^2 - 4\times1\times-161}}{2\times1}$ oe or $\frac{-8}{2\times1} \pm \sqrt{\left(\frac{8}{2\times1}\right)^2 - \frac{-161}{1}}$ oe	**M2**	**M1** $\sqrt{8^2 - 4\times1\times-161}$ oe or $\frac{-8+\sqrt{p}}{2\times1}$ oe or $\left(x + \frac{8}{2\times1}\right)^2$
	$\frac{15\sin(60 - their\,27.5)}{\sin 120}$ oe or $\frac{8\sin(60 - their\,27.5)}{\sin their\,27.5}$ oe or $\sqrt{8^2 + 15^2 - 2\times8\times15\cos(\theta)}$ where $\theta = 60 - their\,27.5$		**M1** for $\frac{\sin 120}{15} = \frac{\sin(60 - their\,27.5)}{ED}$ oe or $\frac{\sin their\,27.5}{8} = \frac{\sin(60 - their\,27.5)}{ED}$ oe or $8^2 + 15^2 - 2\times8\times15\cos(\theta)$ oe where $\theta = 60 - their\,27.5$
	9.3 nfww	**B1**	
11(a)	4, –6 nfww	**3**	**M2** for $(n+1)^2 = 25$ or $(-n-1)^2 = 25$ or $n^2 + 2n - 24$ [=0] or $-n^2 - 2n + 24$ [=0] or **M1** for $\sqrt{(n - -1)^2 + (-4-8)^2} = 13$ oe After 0 scored, **SC1** for one correct nfww
11(b)	(9, –7)	**2**	**B1** for $\left[\overrightarrow{RT} =\right]\begin{pmatrix}10\\-15\end{pmatrix}$ soi or $\left[\overrightarrow{ST} =\right]\begin{pmatrix}6\\-9\end{pmatrix}$ soi or **M1** for $x = \frac{5(3+1)}{2} - 1$ oe or $\frac{3(3+1)}{2} + 3$ oe or $y = \frac{5(2-8)}{2} + 8$ oe or $\frac{3(2-8)}{2} + 2$ oe

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Question	Answer	Marks	Partial Marks
11(c)	$y = \frac{2}{3}x + 4\frac{1}{3}$ oe simplified equation	**5**	**B1** for midpoint (1, 5) soi **M1** for $\frac{8-2}{-1-3}$ oe **M1** for grad perpendicular = $-\frac{1}{their\left(-\frac{3}{2}\right)}$ **M1** for substitution of *their* (1, 5) into $y = (their\,\frac{2}{3})x + c$ oe