



Cambridge O Level

MATHEMATICS (SYLLABUS D)

4024/22

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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This document consists of **9** printed pages.

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:

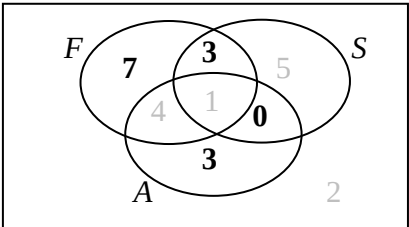
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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

Question	Answer	Marks	Partial Marks
1(a)(i)	13 22, 23 01	2	B1 for each
1(a)(ii)	2 [hours] 41 [minutes]	1	
1(b)	0.87	3	M2 for $\frac{0.75 \times 290}{250}$ oe or M1 for $\frac{290}{250}$ oe seen or $\frac{250}{0.75}$ oe seen or $\frac{0.75}{r} = \frac{250}{290}$ oe seen
1(c)(i)	252	2	M1 for $420 \times 3 \times \frac{20}{100}$ oe or B1 for 84 seen or 252 seen
1(c)(ii)	12.6[0]	3	B2 for answer 100.8[0] or M2 for $\frac{85.68}{8} \times \frac{100}{100-15}$ oe or M1 for $\frac{100-15}{100} \times 85.68 [\div 8]$ soi
2(a)(i)	18.9 or $18\frac{9}{10}$ nfw	2	M1 for $(17 \times 5 + 18 \times 2 + 19 \times 7 + 20 \times 3 + 21 \times 2 + 22 \times 1) \div (5 + 2 + 7 + 3 + 2 + 1)$
2(a)(ii)	5	1	
2(a)(iii)	Type A has more tomatoes per plant oe Number of tomatoes per plant is more consistent for type A oe	2	Strict FT <i>their</i> mean and range B1FT for each
2(b)(i)	Correct cumulative frequency curve	3	B2 for 4 or 5 points plotted correctly or B1 for 4 or 5 correct cumulative frequencies soi
2(b)(ii)	13.3 to 15.8... nfw	3	M1 for correct reading of <i>their</i> increasing curve at $m = 21$ M1 for $\frac{120-y}{120} [\times 100]$

Question	Answer	Marks	Partial Marks
3(a)	$h = \frac{60}{x^2}$ seen $xh = \frac{60}{x}$ seen	M1	
	$[A=]2x^2 + 4x \times \frac{60}{x^2} \rightarrow 2x^2 + \frac{240}{x}$ $[A=]2x^2 + 4 \times \frac{60}{x} \rightarrow 2x^2 + \frac{240}{x}$	A1	A0 if any errors A0 if any errors
3(b)	98 112	2	B1 for each
3(c)	Correct smooth curve	3	B2FT for 7 or 8 points correctly plotted or B1FT for 5 or 6 points correctly plotted
3(d)	90 to 92	1	FT <i>their</i> minimum point provided ≤ 92
3(e)	x, x, h where $2.1 \leq x \leq 2.3$ with corresponding h	3	M1 for a correct reading of <i>their</i> graph at $A = 120$ M1 for $\frac{60}{(\text{their } 2.2)^2}$ or $\frac{120 - 2 \times (\text{their } 2.2)^2}{4 \times \text{their } 2.2}$
4(a)(i)	12, 16, 18, 24, 25, 30, 36	1	
4(a)(ii)	2	1	
4(b)	$(D \cup C) \cap B'$ oe	1	
4(c)(i)	Venn diagram completed correctly 	2	B1 for 2 values correct
4(c)(ii)	$\frac{1}{30}$ oe	2	M1 for $\frac{5}{25} \times \frac{4}{24}$ oe

Question	Answer	Marks	Partial Marks
4(c)(iii)	$\frac{45}{91}$ oe nfw	3	M2 for $\frac{5}{15} \times \frac{10}{14} \times \frac{9}{13} \times k$ where k is 1, 2 or 3 oe or M1 for $\frac{5}{15} \times \frac{10}{14} \times \frac{9}{13}$ seen and spoilt or $\frac{a}{x} \times \frac{b}{x-1} \times \frac{c}{x-2} [\times k]$ where $x = n(\text{their } F)$ and k is 1, 2 or 3 After 0 scored, SC1 for answer $\frac{4}{9}$ oe
5(a)(i)	$x + y = 130$ final answer	1	
5(a)(ii)	$5x + 10y = 815$ oe final answer	1	
5(a)(iii)	Correct method to eliminate one variable	M1	FT <i>their</i> equations provided both equations cannot be written in the form $5x + 10y = k$ or both equations cannot be written in the form $x + y = k$
	[Five-cent coins =] 97 [Ten-cent coins =] 33 nfw	A2	A1 for either $x = 97$ or $y = 33$ nfw After A0 scored, SC1 for final answer two positive integers satisfying either $x + y = 130$ or $5x + 10y = 815$
5(b)	1.56×10^7 cao nfw	3	B2 for 15 600 000 oe or 15 550 000 oe or 15 552 000 oe or answer (cao) 1.56×10^9 or 1.55×10^7 or 3.11×10^8 or 3.11×10^6 or 2.59×10^5 or 5.18×10^4 (nfw) or M1 for $720 \times 24 \times 60 \times 300 \times 0.05$
5(c)	34	3	B1 for 21.25 and 17.85 seen M1 for $[-](\text{their } 21.25 \times 10 - \text{their } 17.85 \times 10)$ oe
6(a)	Correct reflection (5, 2), (5, 5), (4, 2)	2	B1 for reflection in $y = 1$ or reflection in $x = m$ where $-4 \leq m \leq 1.5$

Question	Answer	Marks	Partial Marks
6(b)	Rotation 90 anticlockwise oe (0, 0) oe	5	M2 for triangle <i>C</i> at $(-2, -2), (-2, -3), (-5, -3)$ or M1 for triangle <i>D</i> translated by $\begin{pmatrix} -6 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -1 \end{pmatrix}$ or for $\begin{pmatrix} -6 \\ -1 \end{pmatrix}$ soi B2dep for two of: rotation 90 anticlockwise oe (0, 0) oe or B1dep for rotation or 90 anticlockwise oe or (0, 0) oe After 0 scored, SC2 for answer $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$
7(a)	83.4 or 83.36 to 83.43	4	M1 for $160^2 + 95^2$ oe M2 for $[\cos =] \frac{107^2 + 165^2 - \text{their}34625}{2 \times 107 \times 165}$ oe or M1 for $(\text{their}34625) =$ $107^2 + 165^2 - 2 \times 107 \times 165 \times \cos[\]$ oe
7(b)	9.2[2] or 9.218 to 9.219... nfw	4	M2 for $107 \tan 8.2$ or $\frac{107}{\tan 81.8}$ or $\frac{107 \sin 8.2}{\sin 81.8}$ oe or M1 for $\tan 8.2 = \frac{\text{height}}{107}$ or $\tan 81.8 = \frac{107}{\text{height}}$ or $\frac{\sin 8.2}{\text{height}} = \frac{\sin 81.8}{107}$ oe M1 for $\tan [\] = \frac{\text{their height}}{95}$ oe

Question	Answer	Marks	Partial Marks
8(a)	$5v - 2w$ final answer	2	B1 for correct answer seen and spoilt or answer $5v + kw$ or $kv - 2w$ with $k \neq 0$
8(b)	3.4 or $3\frac{2}{5}$ or $\frac{17}{5}$ final answer	2	M1 for $5x = 10 + 7$ or better
8(c)(i)	a^4 final answer	1	
8(c)(ii)	b^{-2} or $\frac{1}{b^2}$ final answer	1	
8(d)(i)	43	1	
8(d)(ii)	$\frac{r+3t}{4}$ oe final answer	2	M1 for $r + 3t = 4p$ or $-r - 3t = -4p$ or $\frac{r}{4} = p - \frac{3t}{4}$ or better
8(e)	$\frac{-3 \pm \sqrt{3^2 - 4 \times 5 \times -6}}{2 \times 5}$ oe or $\frac{-3}{2 \times 5} \pm \sqrt{\left(\frac{3}{2 \times 5}\right)^2 - \frac{-6}{5}}$	B2	B1 for $\sqrt{3^2 - 4 \times 5 \times -6}$ oe or for $\frac{-3 \pm \sqrt{\text{theirdiscriminant}}}{2 \times 5}$ or for $\left(x + \frac{3}{2 \times 5}\right)^2$
	0.836 and -1.44	B1	
9(a)	$2\pi \times 10^2 + 2\pi \times 8^2 + \pi \times 10^2 - \pi \times 8^2$	M2	M1 for $2\pi \times 10^2$ seen or $2\pi \times 8^2$ seen or $\pi \times 10^2 - \pi \times 8^2$ seen
	Completion to 364π with at least one intermediate step isw AG	A1	A0 if any errors or if π evaluated as 3.14[2...] or $\frac{22}{7}$ before getting to 364π
9(b)	756 or 756.2 to 756.4...	3	M2 for $\left(\frac{2}{3}\pi \times 10^3 - \frac{2}{3}\pi \times 8^3\right) \times 0.74$ oe or M1 for $\frac{2}{3}\pi \times 10^3 - \frac{2}{3}\pi \times 8^3$ oe or $\left(\frac{2}{3}\pi \times k^3 [+...] \right) \times 0.74$ oe with $k > 0$

Question	Answer	Marks	Partial Marks
9(c)	1390 or 1388 to 1390	3	M2 for $\left(\sqrt{\frac{546}{364}}\right)^3$ oe soi or $\left(\sqrt{\frac{364}{546}}\right)^3$ oe soi or M1 for $\sqrt{\frac{546}{364}}$ oe soi or $\sqrt{\frac{364}{546}}$ oe soi or $\frac{364^3}{546^3} = \frac{(theirb)^2}{V^2}$ oe
10(a)(i)	AC is common $\angle ACD = \angle CAB$ [given] $\angle ABC = \angle CDA [= 90^\circ]$ angle in semicircle [Congruent] AAS	3	B2 for two pairs of equal sides/angles with correct reasons or B1 for $\angle ABC = \angle CDA$ angle in semicircle or AC is common or for two appropriate pairs with no/incorrect reasons
10(a)(ii)	Option 1: $\angle ACB = \angle CAD = 50^\circ$ since $\angle ABC = \angle CDA = 90^\circ$ angle in semicircle Option 2: AB parallel to DC since $\angle ACD$ and $\angle CAB$ are alternate angles	M1	
	Option 1: Rectangle because $\angle DAB = \angle BCD = \angle ABC = \angle CDA = 90^\circ$ Option 2: $\angle ABC = \angle ADC = 90^\circ$ angle in semicircle Rectangle because perpendicular parallel sides	A1	
10(b)	18.5 or 18.49 to 18.50...	5	B2 for $\angle HOG = 112^\circ$ soi or B1FT for $\angle OHG = 34^\circ$ soi or $\angle HOG = 180 - 2 \times their \angle OHG$ M1 for $\frac{their112}{360} \times \pi \times 6^2$ oe M1 for $\frac{1}{2} \times 6^2 \times \sin(their112)$ oe