



Cambridge O Level

MATHEMATICS (SYLLABUS D)

3171/22

Paper 2

May/June 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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This document consists of **10** 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:

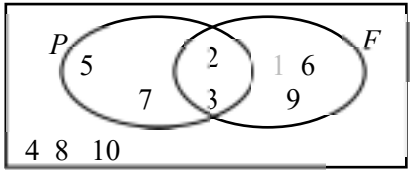
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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
nfw	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)(i)	6 points plotted correctly	2	B1 for 3, 4 or 5 points plotted correctly
1(a)(ii)	Positive	1	
1(a)(iii)	Ruled line of best fit	1	
1(a)(iv)	Reading at $d = 30$	1	FT <i>their</i> ruled straight line of best fit with positive gradient
1(b)(i)	36.7 or 36.66 to 36.67 or $36\frac{2}{3}$	2	M1 for $\frac{36+19}{150}[\times 100]$ oe
1(b)(ii)	22.2[3...] nfw	3	B1 for correct midpoints soi M1 for $(5 \times 25 + 15 \times 28 + 22.5 \times 42 + 27.5 \times 36 + 45 \times 19) \div 150$
2(a)	635.25	3	B1 for 8.25 [hours] oe or 41.25 [hours] oe M1 for <i>their</i> $8.25 \times 15.40 [\times 5]$ oe
2(b)	503.2[0]	3	B2 for 12.58 or 40.8[0] or M2 for $\left(13.6 - \frac{7.5}{100} \times 13.6\right) \times 40$ oe or M1 for $13.6 - \frac{7.5}{100} \times 13.6$ soi or $\frac{7.5}{100} \times 40 \times 13.6$ soi

Question	Answer	Marks	Partial Marks
2(c)	2.02 final answer nfw	5	<p>M2 for $750 + 750 \times \frac{2.1}{100} \times 5$ oe</p> <p>or M1 for $750 \times \frac{2.1}{100} \times 5$ oe</p> <p>M1 for $750 \left(1 + \frac{p}{100}\right)^5 = \text{their } 828.75$ oe</p> <p>M1 for $1 + \frac{p}{100} = \sqrt[5]{\frac{k}{750}}$, k numeric</p> <p>or B1 for $p = 2.016[9]$ to $2.017[1]$</p>
3(a)	5.5 or $5 \frac{1}{2}$	1	
3(b)	Correct smooth curve	3	B2FT for 8 or 9 points correctly plotted or B1FT for 6 or 7 points correctly plotted
3(c)	Tangent drawn at $x = 2$	B1	Dependent on curve drawn between $x = 1.5$ and $x = 3$
	-3.8 to -2.2	B1	Dependent on close attempt at tangent
3(d)	Ruled line $y = x + 2$	M2	M1 for short or unruled line or $x + 2$ seen or either line $y = x + k$ or $y = mx + 2$ drawn, $m \neq 0$
	-2.3 to -2.1 0.4 to 0.7 1.5 to 1.8	A2	B1 for 3 correct values with no/incorrect line drawn or for two FT x values where <i>their</i> ruled straight line, but not $y = 0$ or $y = -1.5x + 1$, crosses <i>their</i> curve
4(a)(i)		2	B1 for Venn diagram with 1 or 2 errors, omissions or repeats or for correct Venn diagram with $(P \cup F)'$ blank
4(a)(ii)	2, 3	1	FT <i>their</i> Venn diagram provided $P \cap F$ contains at least one element
4(a)(iii)	8	1	
4(b)(i)	$\frac{3}{10}$ oe	1	
4(b)(ii)	$\frac{1}{25}$ final answer	2	M1 for $\frac{2}{10} \times \frac{2}{10}$ oe

Question	Answer	Marks	Partial Marks
4(b)(iii)	$\frac{8}{15}$ oe nfw	3	<p>M2 for $1 - \frac{7}{10} \times \frac{6}{9}$ or $\frac{3}{10} \times \frac{2}{9} + \frac{3}{10} \times \frac{7}{9} + \frac{7}{10} \times \frac{3}{9}$ oe</p> <p>or M1 for $\frac{3}{10} \times \frac{2}{9}$ or $\frac{3}{10} \times \frac{7}{9}$ or $\frac{7}{10} \times \frac{3}{9}$ oe</p> <p>After 0 scored, SC1 for answer $\frac{51}{100}$ oe</p>
5(a)	$0.5^2 - 0.15^2$ oe OR $\sin \left[\cos^{-1} \left(\frac{0.15}{0.5} \right) \right] = \frac{d}{0.5}$ oe	M2	<p>M1 for $\frac{1}{2}(0.95 - 0.65)$ soi or $0.5^2 - (\text{their } 0.15)^2$</p> <p>or</p> <p>$\sin \left[\cos^{-1} \left(\frac{\text{their } 0.15}{0.5} \right) \right] = \frac{d}{0.5}$ oe</p>
	0.4769... or 0.4770	A1	
5(b)	3.4[0] or 3.403... nfw	3	<p>M1 for [area of $ABCD =$] $\frac{1}{2} \times (0.65 + 0.95) \times 0.477 [\times k]$, $k = \text{integer}$ oe</p> <p>M1 for [area of rectangular sides =] 0.65×1.60 and $0.50 \times 1.60 [\times 2]$</p>

Question	Answer	Marks	Partial Marks
5(c)(i)	$[x =] \frac{0.15[\times 2] \times 0.3}{0.477} \text{ oe}$ <p>OR</p> $\frac{1}{2} 0.3(w + 0.65) + \frac{1}{2} 0.177(w + 0.95)$ $= \frac{1}{2} 0.477(0.65 + 0.95) \text{ oe}$	M2	M1 for $\frac{0.3}{0.477} = \frac{x}{0.15[\times 2]}$ oe or $\tan\left(\tan^{-1}\left(\frac{0.15[\times 2]}{0.477}\right)\right) = \frac{x}{0.3}$ oe or $\frac{1}{2} 0.3(w + 0.65) + \frac{1}{2} 0.177(w + 0.95) \text{ oe}$
	$[w =] 2 \times 0.09434 + 0.65$ $= 0.838 \text{ to } 0.839$ <p>OR</p> $[w =] \frac{0.3816 - 0.0975 - 0.084075}{0.2385}$ <p style="text-align: right;">oe</p> $= 0.838 \text{ to } 0.839$	A1	
5(c)(ii)	1.34 to 1.344	1	
6(a)	1 [minutes] 28 [seconds] final answer nfw	4	M3 for $60\left(\frac{0.750}{12.2} - \frac{0.425}{11.5}\right) [\times 60] \text{ oe}$ or B2 for 3 min 41[.3...] sec or 2 min 13[.0...] sec or 221[.3...] sec or 133[.0...] sec or M2 for $\frac{0.750}{12.2} - \frac{0.425}{11.5} \text{ oe or } \frac{0.425}{11.5} - \frac{0.750}{12.2}$ oe or $60\left(\frac{\text{figs}75[0]}{\text{figs}122} - \frac{\text{figs}425}{\text{figs}115}\right) [\times 60]$ or M1 for $\frac{\text{figs}75[0]}{\text{figs}122}$ or $\frac{\text{figs}425}{\text{figs}115}$ soi After 0 scored SC1 for answer 1[<i>min</i>] 49[<i>sec</i>]
6(b)(i)	407[.0...]	2	M1 for $\tan 35 = \frac{285}{AD} \text{ oe}$
6(b)(ii)	[0]67.4 to [0]67.5	5	M1 for $BD = \frac{285}{\sin 35} \text{ oe}$ M2 for $\cos[] = \frac{\text{their}BD^2 + 750^2 - 425^2}{2 \times \text{their}BD \times 750} \text{ oe}$ or M1 for $425^2 = \text{their}BD^2 + 750^2 - 2 \times \text{their}BD \times 750 \cos[] \text{ oe}$ M1 for bearing = 35 + <i>their</i> 32.48

Question	Answer	Marks	Partial Marks
7(a)(i)	$6n - 5$ oe final answer	2	B1 for $6n + k$ oe as final answer
7(a)(ii)	$6n$ is always even, 5 is odd, even – odd = odd oe	1	Dep on correct expression in(a)(i) and FT an equivalent explanation
7(b)	$\frac{2^n}{(n+2)^2}$ oe final answer	3	B1 for [numerator sequence =] 2^n oe B2 for [denominator =] $(n+2)^2$ oe or B1 for quadratic expression for denominator sequence Maximum 2 marks if answer incorrect
7(c)	27 nfwf final answer	4	B3 for $[k =] 26.8[0] \text{ to } 26.81$ nfwf OR B1 for $3k^2 - 6k - 1995[=0]$ oe 3-term expression $[=0]$ M2 for correct substitution into quadratic formula $\frac{-(-6) \pm \sqrt{(-6)^2 - 4 \times 3 \times -1995}}{2 \times 3}$ oe or M1 for $\sqrt{(-6)^2 - 4 \times 3 \times -1995}$ or $\frac{-(-6) \pm \sqrt{p}}{2 \times 3}$ or $3(k-1)^2 = 1995 + 3$ oe After 0 scored, SC2 for $u_{26} = 1877$ <u>and</u> $u_{27} = 2030$ or $3(27)^2 - 6(27) + 5$ <u>and</u> final answer 2030
8(a)(i)	5.39 or 5.385 to 5.386	2	M1 for $(3 - -2)^2 + (3 - 1)^2$ oe
8(a)(ii)	(5, -2) nfwf	2	B1 for $[\overline{BC} =] \begin{pmatrix} 2 \\ -5 \end{pmatrix}$ soi After 0 scored, SC1 for answer (1, 8) or (0, -4)
8(b)(i)	(1, 6)	1	
8(b)(ii)	$y = 4x + 2$ nfwf final answer	4	M1 for [gradient $PQ =] \frac{8-4}{-7-9}$ oe M1 for [gradient perpendicular =] $\frac{1}{\text{their}(-0.25)}$ M1 for substituting <i>their</i> (1, 6) in $y = (\text{their}4)x + c$ oe

Question	Answer	Marks	Partial Marks
9(a)	Statements, reasons and conclusion Usually, three of these with the appropriate conclusion 1 $AX = BY$ <u>midpoints</u> , $AB = BC$ 2 $AO = BO$ <u>equal radii</u> 3 $OX = OY$ <u>equal chords</u> are <u>equidistant from the centre</u> 4 $\angle AXO = \angle BYO$, <u>perpendicular bisector</u> of chord	3	B2 for two pairs of equal sides/angles with correct reasons or B1 for one pair of equal sides/angles with correct reason or for two pairs of equal sides with no or incorrect reasons or for one pair of equal sides <u>and</u> one pair of equal angles with no or incorrect reasons
9(b)(i)	122[.0] to 122.1 nfw	3	M2 for $2 \times \sin^{-1}\left(\frac{3.5}{4}\right)$ soi or for $\cos[\] = \frac{4^2 + 4^2 - 7^2}{2 \times 4 \times 4}$ or M1 for $\sin[\] = \frac{3.5}{4}$ oe or for $7^2 = 4^2 + 4^2 - 2 \times 4 \times 4 \times \cos[\]$
9(b)(ii)	20.49 to 20.55	4	M3 for $\left(\frac{\text{their122}}{360} \times \pi \times 4^2 - \frac{1}{2} \times 4^2 \times \sin(\text{their122})\right) [\times 2]$ oe OR M1 for $\frac{\text{their122}}{360} \times \pi \times 4^2$ soi or $\frac{\text{their116}}{360} \times \pi \times 4^2$ soi M1 for $\frac{1}{2} \times 4^2 \times \sin(\text{their122})$ soi

Question	Answer	Marks	Partial Marks
10(a)	$11(x - 4) = 5x + 1$ soi or $11x - 44 = 5x + 1$ soi	B1	
	7.5 or $7\frac{1}{2}$ or $\frac{15}{2}$ final answer	B2	B1 for $x = 7.5$ seen or M1FT for $11x - 5x = 1 + 44$ or better
10(b)	$\frac{4b - a}{a + b}$ oe final answer nfw	3	B1 for $ac + a = 4b - bc$ or better M1FT for isolation of terms in c M1FT for factorising and completing to $c =$ Maximum 2 marks if final answer not correct
10(c)	$\frac{13 - 17x}{(1 - x)(3x - 2)}$ or $\frac{13 - 17x}{-3x^2 + 5x - 2}$ final answer	3	B1 for $5(1 - x) - 4(3x - 2)$ oe isw B1 for denominator $(1 - x)(3x - 2)$ oe isw