



MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2018

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.

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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.

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)	17.6[0]	2	B1 for 7 (hours) 45 (minutes) or 7.75 (hours) or M1 for $682 \div (5 \times \textit{their } 7.75)$ oe
1(b)	275	2	M1 for $\frac{(100-16)}{100}x = 231$ oe or SC1 for answer 44
1(c)	259[.00] cao	3	M2 for $\frac{850 \times 0.44 - 260}{0.44}$ oe or M1 for 850×0.44 or $260 \div 0.44$ or $(\textit{their } 374 - 260) \div 0.44$
1(d)	Account B, \$3118.53 and 3112.37 or 1.037[...] seen	4	M1 for $[3000 \times] 1.011 \times 1.012 \times 1.014$ oe M1 for $[3000 \times] 1.013^3$ oe A1 for 3112.37_or 3118.53 or 1.037[...] or 1.0395[...]
2(a)	Correct frequency polygon (ruled lines)	2	B1 for 4 or 5 heights correct soi
2(b)	$q = 9$	B2	M1 for $[0 \times p] + 1 \times 14 + 2 \times 15 + 3 \times 7 + 4 \times q + 5 \times 5 + 6 \times 2$ oe
	$p = 17 - \textit{their } q$	B1	Strict FT provided q integer with $0 \leq q \leq 17$
2(c)(i)	Correct labelled pie chart: C[omedy], D[rama], H[orror]	3	B2 for correct sectors without labels or incorrect labels or B1 for one correct sector or 90, 54 and 72 seen
2(c)(ii)	$\frac{21}{60}, \frac{7}{20}, \frac{126}{360}, 0.35$ or 35%	1	
2(c)(iii)	$\frac{210}{3540}$ oe	2	M1 for $\frac{15}{60} \times \frac{14}{59}$ [$\times 2$] or SC1 for $\left(\frac{15}{60}\right)^2$ or answer $\frac{1}{16}$ oe
3(a)	$x = -1.8$ oe	2	M1 for $3x + 7x = 12 - 30$ or $-7x - 3x = 30 - 12$ or better

Question	Answer	Marks	Partial Marks
3(b)	Correct method to eliminate one variable	M1	
	$x = 2.5$ oe $y = -6$	A2	A1 for either $x = 2.5$ or $y = -6$ After A0 , SC1 for a pair of values that satisfy either equation or for correct answers with no working
3(c)	$\frac{v}{2v+3}$ final answer nfw	3	B1 for $v(v-8)$ seen B1 for $(2v+3)(v-8)$ seen
4(a)(i)	Correctly completed Venn diagram	1	
4(a)(ii)	36	1	
4(a)(iii)	13	1	FT $n(A \cup B)$ from <i>their</i> Venn diagram provided no repeated elements in sets A and B
4(a)(iv)	1, 4, 6, 9, 12, 18	1	FT provided no repeated elements in sets A and B
4(b)	1540	2	B1 for answer $1540k$, where k is an integer or for $2 \times 2 \times 5 \times 7$ and $2 \times 5 \times 7 \times 11$ seen or 2, 2, 5, 7, 11
4(c)	18	2	B1 for answer 2, 3, 6 or 9 or for $2 \times 3 \times 3 \times 5 \times 5$ and $2 \times 3 \times 3 \times 17$ seen or 2, 3, 3 with 25 and 17
5(a)(i)	25.7 or 25.72 to 25.73	2	M1 for $\frac{134}{360} \times 2 \times \pi \times 11$ oe
5(a)(ii)	4.3[0] or 4.298...	2	M1 for $\cos\left(\frac{134}{2}\right) = \frac{d}{11}$ or $\sin\left(\frac{180-134}{2}\right) = \frac{d}{11}$ oe
5(b)(i)	$\frac{1}{3}\pi r^2 \times 9.5 = 115$ or $r^2 = \frac{3V}{\pi h}$ or better	M1	Correct substitution into volume equation or correct rearrangement
	$r = 3.39[9\dots]$ or $3.40[00]$	A1	
5(b)(ii)	108 or 107.7 to 107.8	3	M2 for $\pi \times 3.4 \times \sqrt{9.5^2 + 3.4^2}$ or M1 for $l^2 = 9.5^2 + 3.4^2$ soi

Question	Answer	Marks	Partial Marks
6(a)	5.5, 5.5 oe	1	Both correct
6(b)	Correct smooth curve	3	B2FT for 8 or 9 points correctly plotted or B1FT for 6 or 7 points correctly plotted
6(c)	tangent drawn at $x = 1.5$	B1	Dependent on a curve drawn between $x = 1$ and $x = 2$
	-1.7 to -1.3	B1	
6(d)	$x \leq 0.6$ to 0.9 $x \geq 5.1$ to 5.4	2	B1 for one correct or SC1 for answers reversed
6(e)(i)	Ruled line passing through (0, 3) and (4, 0) crossing curve twice	2	B1 for short or unruled line or for two correct points plotted
6(e)(ii)	$A = -9, B = -4$	2	B1 for either correct or $2x^2 - 9x - 4 [=0]$ or M1 for $\left(\frac{x^2}{2} - 3x + 2\right) = \frac{12 - 3x}{4}$ oe After 0, SC1 for $A = -9.2$ to -8.8 <u>and</u> $B = -4.2$ to -3.8
7(a)	$\sin CAB = \frac{3.7 \sin 42}{2.8}$ OR $C\hat{A}B = \sin^{-1}\left(\frac{3.7 \sin 42}{2.8}\right)$ OR $\frac{\sin CAB}{3.7} = \frac{\sin 42}{2.8}$ and $\sin = 0.88[42\dots]$	M2	M1 for $\frac{3.7}{\sin CAB} = \frac{2.8}{\sin 42}$ oe
	$C\hat{A}B = 62.15[4\dots]$	A1	
7(b)	[0]17.2°	2	M1 for $135 + 62.2 - 180$ oe

Question	Answer	Marks	Partial Marks
7(c)	10.5 to 10.6	4	<p>B3 for 4.05 to 4.06</p> <p>OR</p> <p>M2 for $\sqrt{2.8^2 + 3.7^2 - 2 \times 2.8 \times 3.7 \times \cos(180 - 42 - 62.2)}$ oe</p> <p>or M1 for $2.8^2 + 3.7^2 - 2 \times 2.8 \times 3.7 \times \cos(180 - 42 - 62.2)$ oe</p> <p>OR</p> <p>M2 for $\frac{2.8 \sin(180 - 42 - 62.2)}{\sin 42}$ oe</p> <p>or M1 for $\frac{\sin(180 - 42 - 62.2)}{AB} = \frac{\sin 42}{2.8}$ oe</p> <p>OR</p> <p>M2 for $\frac{3.7 \sin(180 - 42 - 62.2)}{\sin 62.2}$ oe</p> <p>or M1 for $\frac{\sin(180 - 42 - 62.2)}{AB} = \frac{\sin 62.2}{3.7}$ oe</p> <p>OR</p> <p>B1 for $\hat{ACB} = 75.8$</p>
8(a)	$\angle BAX = \angle OCX$, alternate [angles] $\angle ABX = \angle COX$, alternate [angles] $\angle AXB = \angle CXO$, [vertically] opposite	3	<p>B1 for two correct pairs of angles</p> <p>B1 for correct reason for one pair of angles</p>
8(b)(i)	4c	1	
8(b)(ii)	9a – 6c or 3(3a – 2c)	2	B1 for answer 9a + kc or ka – 6c (k ≠ 0)
8(c)(i)	3 : 2	2	B1 for 3k : 2k, where k is an integer
8(c)(ii)	9 : 4	1	FT their 3 ² : their 2 ²
8(c)(iii)	4 : 5	1	
9(a)(i)	$\frac{12 \times 60}{x}$ oe	1	
9(a)(ii)	$\frac{8 \times 60}{x - 1.5}$ oe	1	<p>After 0 in (i) and (ii), SC1 for $\frac{8}{x - 1.5}$ and (a)(i)</p> <p>$\frac{12}{x}$</p>

Question	Answer	Marks	Partial Marks
9(a)(iii)	$\frac{720}{x} + \frac{480}{x-1.5} = 110$ oe	M1	FT <i>their</i> (a)(i) and (a)(ii) if functions of x
	$\frac{720(x-1.5) + 480x}{x(x-1.5)} = 110$ or $720(x-1.5) + 480x = 110x(x-1.5)$	M1	Dep on equation of form $\frac{c}{px} + \frac{d}{qx+r} = e$ where p, q, r, c, d and e are numeric and non zero, AND either correctly uses a common denominator for <i>their</i> fractions or correctly removes <i>their</i> fractions
	$720x - 1080 + 480x = 110x^2 - 165x$	A1	Correct elimination of correct brackets
	With a minimum of one intermediate step establishes $22x^2 - 273x + 216 = 0$	A1	
9(a)(iv)	$\frac{-(-273) \pm \sqrt{(-273)^2 - 4 \times 22 \times 216}}{2 \times 22}$ or $\frac{273}{44} \pm \sqrt{\left(\frac{273}{44}\right)^2 - \left(\frac{216}{22}\right)}$	B2	B1 for $\sqrt{(-273)^2 - 4 \times 22 \times 216}$ or for $\frac{-(-273) \pm \sqrt{\text{their}55521}}{2 \times 22}$ or for $\left(x - \frac{273}{44}\right)^2$
	11.56 and 0.85 cao	B1	
9(b)	1 hour 59 minutes cao	3	M2 for $\frac{20}{\text{their}11.56 - 1.5} [\times 60]$ oe or M1 for <i>their</i> $11.56 - 1.5$ or for $\frac{20}{\text{their } x}$
10(a)	$\left(-1, \frac{1}{2}\right)$ or $(-1, 0.5)$ cao	1	
10(b)	$\frac{1}{2}$ oe	1	

Question	Answer	Marks	Partial Marks
10(c)	[Gradient of $BC =] \frac{-8}{4}$	M1	<u>Alternative 1:</u> M1 for $\frac{1}{2} \times m_{BC} = -1$ or $m_{BC} = -\frac{1}{0.5}$ oe leading to $m_{BC} = -2$
	$\frac{1}{2} \times \frac{-8}{4} = -1$ hence perpendicular	A1	A1 for gradient of $BC = \frac{-8}{4} = -2$ hence perpendicular <u>Alternative 2:</u> M1 for $\overline{AB} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}$ oe and $\overline{AC} = \begin{pmatrix} 10 \\ -5 \end{pmatrix}$ oe A1 for $(4^2+8^2) + (6^2+3^2) = (10^2+5^2)$ hence perpendicular
10(d)	(0, -9)	2	B1 for one value correct or M1 for $\begin{pmatrix} -4 \\ -1 \end{pmatrix} + \begin{pmatrix} 4 \\ -8 \end{pmatrix}$ oe or $\begin{pmatrix} 6 \\ -6 \end{pmatrix} + \begin{pmatrix} -6 \\ -3 \end{pmatrix}$ oe
10(e)	31.3 or 31.30...	4	M3 for $[2 \times] (\sqrt{3^2 + 6^2} + \sqrt{4^2 + (-8)^2})$ oe or M2 for $\sqrt{4^2 + (-8)^2}$ oe or $\sqrt{3^2 + 6^2}$ oe or M1 for $4^2 + (-8)^2$ oe or $3^2 + 6^2$ oe