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MATHEMATICS

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MARK SCHEME

Maximum Mark: 130

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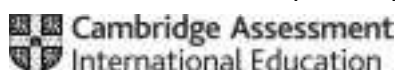
This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, 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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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.

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)	16.5 or 16.49...	3	M2 for $\frac{1.13 - 0.97}{0.97} [\times 100]$ oe or $\frac{1.13}{0.97} \times 100$ oe or M1 for $\frac{1.13}{0.97}$ oe
1(b)(i)	35	2	M1 for $60 \div (5 + 7)$
1(b)(ii)	140	1	
1(c)	\$1.26 final answer	3	B2 for 1.259... or 1.26 but not as final answer or M1 for $2.25 \div 0.9416$ If 0 scored, SC1 for 1.13×0.9416
1(d)	15[.0...]	3	M2 for $\sqrt[21]{\frac{58000}{1763000}}$ oe or M1 for $58000 = 1763000 (k)^{21}$
1(e)	1239.75	2	B1 for $43 + 0.5$ or $28 + 0.5$ oe seen
2(a)	103	3	M1 for angle ABC or angle $ACB = \frac{1}{2}(180 - 26)$ oe M1 for angle $ABF = 26$ or angle CBD or angle $FBE = 77$ or exterior angle $ACB = 103$ correctly identified or in correct position

Question	Answer	Marks	Partial Marks
2(b)	75	5	B4 for 105 at a or b or 73 at c and 32 at d or B3 for 58 at m or 58 at e and 17 at k or B2 for 32 at d and 90 soi at $(c+k)$ or 32 at d and 17 at k or 73 at c or B1 for 90 soi at $(c + k)$ or between tangent and radius or 32 at d or 17 at k
3(a)	$1 - r$	1	
3(b)(i)	$(1 - r) (1.3 - r) [= 0.4]$	1	FT their(a) dep on (a) being an expression in r
3(b)(ii)	$1.3 - 1.3r - r + r^2$ or better nfw	M1	FT their (b)(i)
	$0.9 - 2.3r + r^2 [= 0]$ OR $13 - 13r - 10r + 10r^2 = 4$ oe	M1	Strict FT their expansion to a quadratic then equating to 0.4 and then collecting to 3 terms on ‘one side’ OR Strict FT their expansion to a quadratic = 0.4 all multiplied by 10
	$10r^2 - 23r + 9 = 0$	A1	no errors or omissions seen

Question	Answer	Marks	Partial Marks
3(b)(iii)	$(5r - 9)(2r - 1) [= 0]$	B2	or B2 for e.g. $5r(2r - 1) - 9(2r - 1)$ and then $5r - 9 = 0$ and $2r - 1 = 0$ or B1 for $5r(2r - 1) - 9(2r - 1) [= 0]$ or $2r(5r - 9) - 1(5r - 9) [= 0]$ or $(5r + a)(2r + b) [= 0]$ where a, b are integers and $ab = +9$ or $2a + 5b = -23$ If 0 scored, SC1 for $5r - 9$ and $2r - 1$ seen but not in factorised form
	$[r =] \frac{9}{5}$ oe $[r =] \frac{1}{2}$ oe	B1	
3(b)(iv)	0.8 or $\frac{4}{5}$ oe	1	
4(a)(i)	1.5 oe	1	
4(a)(ii)	(0, 2)	1	
4(b)(i)	$y = -2x + 6$ oe final answer	3	B2 for $y = -2x + c$ oe or $y = mx + 6$ oe $m \neq 0$ or for answer $-2x + 6$ or B1 for [gradient =] $-\frac{6}{3}$ oe or $c = +6$ soi
4(b)(ii)	$y = 0.5x - 1.5$ oe final answer	3	B1 for [gradient =] -1 divided by <i>their</i> gradient from (b)(i) evaluated soi M1 for substitution of (9, 3) into $y = (\text{their } m)x + c$ seen in working
4(c)(i)	12.6 or 12.64 to 12.65	3	M2 for $\sqrt{(8 - -4)^2 + (5 - 1)^2}$ oe or M1 for $(8 - -4)^2 + (5 - 1)^2$ oe
4(c)(ii)	(2, 3)	2	B1 for each
5(a)	2.45, 0.25, -0.25	3	B1 for each
5(b)	Fully correct smooth curve	4	B3FT for 6 or 7 points or B2 FT for 4 or 5 points or B1 FT for 2 or 3 points
5(c)	0.7 to 0.8	1	FT <i>their</i> curve
5(d)(i)	Correct ruled line	2	M1 for good freehand, or ruled line with gradient -1.05 to -0.95 or ruled line through (0, 2) but not line $y = 2$

Question	Answer	Marks	Partial Marks
5(d)(ii)	Both intersections of <i>their</i> (b) and <i>their</i> (d)(i)	2	Strict FT intersection of <i>their</i> (b) and <i>their</i> (d)(i) B1FT for one correct OR B2 for 0.27 to 0.28 and 2.38 to 2.39
5(e)	Substitutes $x = \sqrt{2}$ into $\frac{1}{2x} - \frac{x}{4}$ OR Identifies $y = 0$ oe OR Correctly manipulates to a single fraction e.g. $\frac{2-x^2}{4x}$ oe seen	M1	
	Concludes ‘read the graph at $y = 0$ ’ oe OR Manipulates $0 = \frac{1}{2x} - \frac{x}{4}$ oe leading to $x^2 = 2$ OR States $\frac{2-x^2}{4x}$ oe = 0 leading to $x^2 = 2$	A1	
6(a)	$x^2 + 4x - 21$ final answer	2	B1 for three of x^2 , $+7x$, $-3x$, -21
6(b)(i)	$5q^2(3p^2 - 5q)$ final answer	2	B1 for $5(3p^2q^2 - 5q^3)$ or $q^2(15p^2 - 25q)$ or $q(15p^2q - 25q^2)$ or $5q(3p^2q - 5q^2)$ or for correct answer seen
6(b)(ii)	$(2g + 5k)(2f + 3h)$ final answer	2	B1 for $2g(2f + 3h) + 5k(2f + 3h)$ or $2f(2g + 5k) + 3h(2g + 5k)$ or for correct answer seen
6(b)(iii)	$(9k + m)(9k - m)$ final answer	2	M1 for $(9 + m)(9 - m)$ or for correct answer seen

Question	Answer	Marks	Partial Marks
6(c)	5.5	4	M1 for $5 \times 3(x-4) + x + 2 = 5 \times 6$ M1 for $15x - 60 + x + 2 = 30$ FT <i>their</i> first step or $3x - 12 + \frac{x+2}{5} = 6$ If M0M0, SC1 for $3x - 12 + x + 2 = 30$ oe M1dep for $16x = 88$ FT <i>their</i> previous steps
7(a)	$180 - \frac{360}{5}$ or $\frac{(5-2) \times 180}{5}$ or $\frac{(2 \times 5 - 4) \times 90}{5}$ or $\frac{5 \times 180 - 360}{5}$	M2	or M1 for $\frac{360}{5}$ or $(5-2) \times 180$ or $90(2 \times 5 - 4)$ or $3 \times 180 \div 5$ or $6 \times 90 \div 5$ or $5 \times 180 - 360$ If 0 scored, SC1 for $\frac{5-2 \times 180}{5}$
7(b)(i)	7.05 or 7.053...	3	M2 for $12 \times \cos 54$ oe or M1 for implicit form or B1 for length of edge of pentagon = 14.1 to 14.11 If 0 scored, SC1 for right angle at <i>M</i>
7(b)(ii)(a)	22.8 or 22.81 to 22.83... nfw	3	M2 for $\frac{\text{their (b)(i)}}{\cos 72}$ oe or M1 for implicit form oe or B1 for $AX = 36.9$ or 36.93 to 36.94
7(b)(ii)(b)	179 or 179.1 to 179.3...	3	M2 for $\frac{1}{2} \times 12 \times \text{their } AX \times \sin 54$ oe or $\frac{1}{2} \times 12 \times \text{their } OX \times \sin 108$ oe or $\frac{1}{2} \times \text{their } AX \times \text{their } OX \times \sin 18$ or $\frac{1}{2} \times 12^2 \times \sin 72 + \text{area } OBX$ oe or $\frac{1}{2} \times 12^2 \times \sin 72 + \text{area } OMB + \text{area } MBX$ oe or M1 for a correct method to find area of one relevant triangle <i>AOB</i> , <i>OMB</i> , <i>MBX</i> , <i>OBX</i> or <i>ONX</i> seen
8(a)(i)	15.7 or 15.70...	4	M2 for $16.5^2 + 12.4^2 - 2 \times 16.5 \times 12.4 \times \cos 64$ or M1 for implicit form A1 for 246 to 247

Question	Answer	Marks	Partial Marks
8(a)(ii)	18.7 or 18.68 to 18.69	4	B1 for 32 or angle $DBM = 37$ or angle $CBM = 58$ M2 for $\frac{12.4 \times \sin 53}{\sin 32}$ oe or M1 for implicit form oe
8(b)(i)	116.1 or 116.08 to 116.09...	2	M1 for $\frac{y}{360} \times 2 \times \pi \times 3.8 = 7.7$ oe
8(b)(ii)	14.6 or 14.61 to 14.63...	2	M1 for $\frac{\text{their(b)(i)}}{360} \times \pi \times 3.8^2$ oe
9(a)	12.8[0]	4	M1 for midpoints soi M1 for use of $\sum fm$ with m in correct interval including both boundaries M1 (dep on 2nd M1) for $\sum fm \div 100$
9(b)	54 84 93	2	B1 for 2 correct or 1 error and 2 correct or FT
9(c)	correct diagram with all points correctly plotted	3	B1FT their (b) for plots at 5 correct heights B1 for 5 points at upper ends of intervals on correct vertical line B1FT (dep on at least B1) for increasing curve or polygon through 5 points After 0 scored, SC1FT for 4 correct points plotted
9(d)(i)	9 to 9.8 final answer	1	
9(d)(ii)	8.5 to 11.5	2	B1 for [UQ =] 15.5 to 17.5 or [LQ =] 6 to 7 seen
9(d)(iii)	10, 11 or 12	2	B1 for 88 to 90 seen or for answer between 10 and 12
10(a)(i)	18[.0] or 17.99 to 18.00...	3	M2 for $\sqrt[3]{\frac{24430 \times 3}{4\pi}}$ oe or M1 for $\frac{4}{3}\pi r^3 = 24430$
10(a)(ii)	447 or 446.8 to 446.9...	3	M2 for $\pi \times 50^2 \times 60 - 24430$ oe or M1 for $\pi \times 50^2 \times 60$ oe

Question	Answer	Marks	Partial Marks
10(b)	4 [hours] 30 [mins] nfw	4	B3 for 16200 or 4.5 or 270 or M2 for $\frac{\text{figs } 18 \times \text{figs } 15 \times \text{figs } 12}{\text{figs } 2}$ oe or M1 for $\text{figs } 18 \times \text{figs } 15 \times \text{figs } 12$ oe
10(c)	12.5 or 12.50...	3	M2 for $17 \times \sqrt{\frac{159.5}{295}}$ oe or M1 for $\sqrt{\frac{159.5}{295}}$ or $\sqrt{\frac{295}{159.5}}$ seen or for $\frac{159.5}{295} = \frac{x^2}{17^2}$ oe
11(a)	40 54 26 34	4	B1 for each
11(b)	$n^2 + 3n$ or $n(n+3)$ oe	2	B1 for a quadratic expression or for 2nd common difference 2 (at least 2 shown) or for 2 correct equations seen or for subtracting n^2
11(c)	100	2	M1 for <i>their</i> (b) = 10300 seen
11(d)	$[a =] \frac{1}{2}$ oe and $[b =] \frac{5}{2}$ oe	2	B1 for each or M1 for one correct equation or for 2nd difference = 1 soi (at least 2 shown)