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MATHEMATICS

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Paper 4 (Extended)

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MARK SCHEME

Maximum Mark: 130

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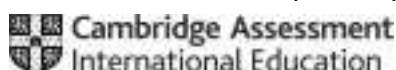
This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, 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 **8** 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
nfw	not from wrong working
soi	seen or implied

Question	Answer	Marks	Partial Marks
1(a)(i)	5 : 6	1	
1(a)(ii)	$2.0736[0] \times 10^5$ final answer	3	B2 for 207360 oe or M1 for $16 \times 18 \times 720$
1(b)(i)	26780	2	M1 for $18540 \div 9$ soi
1(b)(ii)	1.36	2	M1 for 0.85×1.6 oe or B1 for 0.51 or 51
1(c)	66.7 or 66.66 to 66.67	5	M4 for $\frac{(2.3 - 1.5 \times 0.92)}{1.5 \times 0.92} [\times 100]$ oe or $\frac{2.3 \times 100}{1.5 \times 0.92}$ oe OR Working in euros B2 for [€]1.38 or M1 for $1.5[0] \times 0.92$ M2dep on B2 or M1 for $\frac{2.3 - \text{their } 1.38}{\text{their } 1.38} [\times 100]$ oe or $\frac{2.3 - \text{their } 1.38}{\text{their } 1.38} \times 100$ oe or M1 for $2.3 - \text{their } 1.38$ or $\frac{2.3}{\text{their } 1.38}$ OR Working in dollars B2 for [\$]2.50 or M1 for or $2.3[0] \div 0.92$ M2dep on B2 or M1 for $\frac{\text{their } 2.5 - 1.5}{1.5} [\times 100]$ oe or $\frac{\text{their } 2.5}{1.5} \times 100$ or M1 for $\text{their } 2.5 - 1.5$ or $\frac{\text{their } 2.5}{1.5}$

Question	Answer	Marks	Partial Marks
1(d)	219 000 or 218814[.3....] rounded to 4 sf or more	3	B2 for 414000 or 414414[.3....] rounded to 4 sf or more or M2 for $195600 \times \left(1 + \frac{8.7}{100}\right)^9$ [– 195600] or M1 for $195600 \times \left(1 + \frac{8.7}{100}\right)^k$ or better ($k > 1$ and an integer)
2(a)(i)	54	1	
2(a)(ii)	29	2	M1 for [UQ =] 65 or [LQ =] 36
2(a)(iii)	32	1	
2(a)(iv)	17, 18 or 19	2	M1 for 61 to 63 written or for decimal answer in range 17 to 19
2(b)(i)	18, 26, 26	2	B1 for 1 or 2 correct
2(b)(ii)	51 nfw	4	M1 for 10 , 30 , 50 , 70 , 90 soi M1 for Σfx M1 dep for <i>their</i> $\Sigma fx \div \Sigma f$
2(c)(i)	75	1	
2(c)(ii)	IQR is bigger for the girls with [boys =] 20 seen oe	2	FT <i>their</i> IQR from (a)(ii) M1 for IQR for boys = 20 isw or for girls IQR is bigger than boys IQR oe isw FT <i>their</i> IQR from (a)(iii)
3(a)(i)	(3, 5.5)	2	B1 for either value correct
3(a)(ii)	$\frac{5}{4}x + \frac{7}{4}$ final answer	3	B2 for answer $\frac{5}{4}x + c$ oe or for correct equation in different form or M1 for $\frac{8-3}{5-1}$ oe and M1 for correct substitution shown of (1, 3) or (5, 8) or <i>their</i> (a)(i) into $y = (\text{their } m)x + c$ oe
3(b)(i)	(6, 1) (10, 6)	2	B1 for 2 or 3 values correct
3(b)(ii)	(–3, 1) (–8, 5)	2	B1 for 2 or 3 values correct If 0 scored, SC1 for (3, –1) and (8, –5)
3(b)(iii)	(3, 3) (–1, 8)	2	B1 for 2 or 3 values correct but not for (1, 3) and (5, 8)

Question	Answer	Marks	Partial Marks
3(b)(iv)	(5, -3) (11, -8)	2	B1 for either or M1 for $\begin{pmatrix} -1 & 2 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ or $\begin{pmatrix} -1 & 2 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 5 \\ 8 \end{pmatrix}$
3(c)	Enlargement -2 Origin oe	3	B1 for each
4(a)	452 or 452.2 to 452.4...	2	M1 for $\left[\frac{1}{2} \times \right] \frac{4}{3} \times \pi \times 6^3$
	cm ³	1	
4(b)(i)(a)	400 or 399.6 to 399.9	6	B3 for $[CD =] \sqrt{72.96}$ or $[\text{angle } CBD =] 58.7$ or 58.66 to 58.67 or M2 for $\sqrt{10^2 - 5.2^2}$ oe or $[CBD =] \cos^{-1} \left(\frac{5.2}{10} \right)$ oe or M1 for $(CD)^2 + 5.2^2 = 10^2$ oe or $\cos [CBD] = \frac{5.2}{10}$ oe or $\sin [CDB] = \frac{5.2}{10}$ oe M1dep for $\frac{5.2 \times \text{their } CD}{2}$ oe or $\frac{1}{2} \times 5.2 \times 10 \times \sin(\text{their } CBD)$ oe M1 for $\text{their area} \times 18$ oe
4(b)(i)(b)	14.6 or 14.62 to 14.63...	4	M3 for $\sin BEC = \frac{5.2}{\sqrt{10^2 + 18^2}}$ oe or M2 for $[BE =] \sqrt{10^2 + 18^2}$ oe seen or $[EC =] \sqrt{18^2 + 10^2 - 5.2^2}$ oe seen or M1 for $[BE^2 =] 10^2 + 18^2$ oe seen or $[EC^2 =] 18^2 + 10^2 - 5.2^2$ seen
4(b)(ii)	125 or 124.9 to 125.0...	3	B2 for $55[.0\dots]$ seen or M2 for $180 - \tan^{-1} \left(\frac{10}{7} \right)$ oe or $\cos EGB = \frac{11^2 + (10^2 + 7^2) - (10^2 + 18^2)}{2 \times 11 \times \sqrt{10^2 + 7^2}}$ oe or M1 for $\tan[] = \left(\frac{10}{7} \right)$ oe or for $(10^2 + 18^2) = 11^2 + (10^2 + 7^2) - 2 \times 11 \times \sqrt{10^2 + 7^2} \cos EGB$ oe

Question	Answer	Marks	Partial Marks
5(a)	3.5, 15, 3.9	3	B1 for each
5(b)	Correct graph	5	B4 for correct curves but branches joined or touching y -axis or B3FT 10 or 11 points or B2FT for 8 or 9 points or B1FT for 6 or 7 points B1indep two separate branches not touching or crossing y -axis
5(c)	0.5 to 0.6 and 1.3 to 1.6	2	B1 for each or both correct but in reverse order
5(d)	1	1	
5(e)(i)	$y = 3x + 1$ ruled and 0.3 to 0.49	3	B2 for correct ruled line that crosses <i>their</i> curve or B1 for $y = 3x + 1$ soi or freehand line or ruled line with gradient 3 or with y – intercept at 1 (but not $y = 1$)
5(e)(ii)	$[a =] -6$ $[b =] -2$ $[c =] -4$	3	M2 for $x^4 + 2 - 4x = 6x^3 + 2x^2$ or better seen or B1 for each correct value to a maximum of 2 marks If 0 scored, SC1 for answer $[a =] 6, [b =] 2$ and $[c =] 4$ or for $x^5 + 2x - 4x^2 = 6x^4 + 2x^3$ or better
6(a)(i)	13.9[0...] from cosine rule	4	M2 for $8^2 + 13^2 - 2 \times 8 \times 13 \cos 79$ or M1 for $\cos 79 = \frac{13^2 + 8^2 - BC^2}{2 \times 8 \times 13}$ A1 for 193
6(a)(ii)	66.6 or 66.60... to 66.65 from sine rule	3	M2 for $[\sin ACB =] \frac{13 \times \sin 79}{\text{their}(a)(i)}$ or M1 for $\frac{\sin ACB}{13} = \frac{\sin 79}{\text{their}(a)(i)}$ oe
6(b)(i)	$\frac{1}{2}(x+4)(4x-5)\sin 30 = 70$	M1	
	$4x^2 + 16x - 5x - 20 = 280$	M2	Dep on M1 B1 for $4x^2 + 16x - 5x - 20$ or better
	Leading to $4x^2 + 11x - 300 = 0$	A1	with no errors or omissions seen

Question	Answer	Marks	Partial Marks
6(b)(ii)	$\frac{-11 \pm \sqrt{11^2 - 4 \times 4 \times -300}}{2 \times 4}$	B2	B1 for $\sqrt{11^2 - 4(4)(-300)}$ or better or for $\frac{-11 + \sqrt{q}}{2 \times 4}$ or $\frac{-11 - \sqrt{q}}{2 \times 4}$
	-10.14 and 7.39	B2	B1 for each or SC1 for final answers -10.1 or -10.144 to -10.143 and 7.4 or 7.393 to 7.394 or -10.14 and 7.39 seen in working or for -7.39 and 10.14 as final answer
6(b)(iii)	11.4 or 11.39...	1	FT <i>their</i> positive root + 4
7(a)(i)	13	1	
7(a)(ii)	3	2	M1 for $h\left(\frac{10}{30}\right)$ oe soi or $27^{\frac{10}{x}}$
7(a)(iii)	$\frac{7-x}{2}$ oe final answer	2	M1 for $x = 7 - 2y$ or $y - 7 = -2x$ or $7 - y = 2x$ or $-\frac{y}{2} = -\frac{7}{2} + x$ oe
7(b)	0.75 oe final answer	3	M1 for $\frac{10}{2x+1} = 4$ M1 for $10 = 8x + 4$ or better
7(c)	$\frac{70-19x}{x(7-2x)}$ or $\frac{70-19x}{7x-2x^2}$ final answer	3	M1 for $x + 10(7-2x)$ or better isw B1 for common denominator $x(7-2x)$ oe isw
7(d)	3 final answer	1	
8(a)(i)	$\frac{m-7}{5}$ oe final answer	2	M1 for $5p = m - 7$ or $p + \frac{7}{5} = \frac{m}{5}$
8(a)(ii)	$[\pm]\sqrt{\frac{y^2-h}{2}}$ or $[\pm]\sqrt{\frac{h-y^2}{-2}}$ oe final answer	3	M1 for first correct step isolate term in p or divide by ± 2 M1 for second correct step FT <i>their</i> first step
8(b)(i)	$\begin{pmatrix} 0 \\ 5 \end{pmatrix}$	1	
8(b)(ii)	$\begin{pmatrix} -3 \\ -1 \end{pmatrix}$	1	

Question	Answer	Marks	Partial Marks
8(b)(iii)	3.22 or 3.216... to 3.220...	6	B3 for [angle AOB =] 36.8 or 36.9 or 36.84 to 36.87 or M2 for $\tan[AOB] = \frac{3}{4}$ oe or for $[AOB =]2 \times \sin^{-1}$ $\left(\frac{\sqrt{(5-4)^2 + (0-3)^2}}{10} \right)$ oe or for $\cos [AOB =]$ $\frac{5^2 + 5^2 - \left(\sqrt{(5-4)^2 + (0-3)^2} \right)^2}{2 \times 5 \times 5}$ oe or M1 for recognition of right-angle with perpendicular from B to OA or x-axis or for $[AB^2 =](5-4)^2 + (0-3)^2$ or better oe or $(their\ AB)^2 = 5^2 + 5^2 - 2 \times 5 \times 5 \times \cos OAB$ oe M2 for $\frac{their\ angle\ AOB}{360} \times 2 \times \pi \times 5$ oe or M1 for radius = 5 soi
9(a)	171 or 171.0...	3	M2 for $\frac{7.6}{160} \times 60 \times 60$ oe or M1 for $\frac{7.6}{160}$ or $\frac{7.6}{2\frac{2}{3}}$ or $\frac{7.6}{2\text{ min } 40\text{ sec}}$ If 0 scored, SC1 for answer 189 or 188.6 to 188.7
9(b)(i)	77 [min] 20 [s]	4	M3 for $\frac{32}{12} \times 29$ oe or B2 for 4640 or 1.29 or 1.288 to 1.289, $\frac{58}{45}$ oe or 32 laps or 29 laps or M2 for $2^5 \times 5 \times 29$ oe or M1 for 2 m 40 sec $\div$ (2 m 40 sec – 2 m 25 sec) soi for 2 m 25 sec $\div$ (2 m 40 sec – 2 m 25 sec) soi or for an attempt to find LCM or 23 200 seen or correctly find prime factors of 145 or 160 or for $\frac{7.6}{145}$ or $\frac{7.6}{2\frac{5}{12}}$ or $\frac{7.6}{2\text{ min } 25\text{ sec}}$ oe, provided SC1 not earned in part (a)
9(b)(ii)	220.4	2	M1 for $their\ (b)(i) \div 2\text{ min } 40\text{ sec} [\times 7.6]$ oe or $their\ (a) \times their\ (b)(i) \div 60$ oe