Cambridge IGCSE™

MATHEMATICS (US)	**0444/41**
Paper 4 (Extended)	**May/June 2022**
MARK SCHEME	
Maximum Mark: 130	

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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.

	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)	6	3	**B2** for $4x + 6 = 30$ or better or **M1** for $x + x + 7 + 2x - 1\ [= 30]$
1(a)(ii)	21	3	**M2** for $(555 - \textit{their } x \times 15 - \textit{their } (x + 7) \times 18)$ $\div \textit{their } (2x - 1)$ or **M1** for *their* $x \times 15$ or *their* $(x + 7) \times 18$
1(b)(i)	8	2	**M1** for isolating the term in w or correctly removing all fractions eg $\dfrac{3w}{16} = 1 + \dfrac{1}{2}$ or better or $3w - 16 = 8$
1(b)(ii)	−3	2	**M1** for $2^{-y} = 8$ or $2^{y} = \dfrac{1}{8}$ or $2^{-y} = \textit{their } w$ or better
2(a)	e.g. of continuous data	1	
2(b)(i)(a)	4	1	
2(b)(i)(b)	10	1	
2(b)(i)(c)	8.5	1	
2(b)(ii)	135	2	**M1** for $\dfrac{9}{24}[\times 360]$ or $\dfrac{360}{24}[\times 9]$
2(c)(i)	120	1	
2(c)(ii)	130	1	
2(c)(iii)	60	1	
2(d)(i)	93.4	4	**M1** for mid-values soi **M1** for Σfx **M1 dep on second M** for $\Sigma fx \div 200$
2(d)(ii)	19	2	**M1** for $\dfrac{86}{50}$ or $\dfrac{114}{60}$
3(a)	42	2	**M1** for $12 \div 2$ or better
3(b)(i)	5.72	2	**M1** for $\dfrac{100 - 12}{100} \times 6.50$ oe or **B1** for 0.88 oe
3(b)(ii)	12.5[0]	2	**M1** for $\dfrac{100 - 12}{100} \times x = 11$ or better oe

Question	Answer	Marks	Partial Marks
3(c)	4	**2**	**M1** for $\dfrac{100+2.5}{100}\times[...]=\dfrac{100+6.6}{100}$ oe
3(d)(i)	72.3 or 72.31...	**2**	**M1** for $80\times\left(\dfrac{100-2}{100}\right)^5$ oe
3(d)(ii)	4 nfww	**3**	**B2** for answer 9 nfww or **M2** for correct trials with values giving either side of 67 or **M1** for $80\times\left(\dfrac{100-2}{100}\right)^n=67$ or $their\,(i)\times\left(\dfrac{100-2}{100}\right)^k=67$ or an evaluated trial with $n\geq 6$ or $k\geq 1$
4(a)(i)	3	**1**	
4(a)(ii)	7	**1**	**FT** *their* (i) $3\times their\,(i)-2$
4(b)	$\dfrac{x+2}{3}$ oe final answer	**2**	**M1** for $y+2=3x$ or $\dfrac{y}{3}=x-\dfrac{2}{3}$ or $x=3y-2$
4(c)	25	**2**	**M1** for $\dfrac{1}{x}=5^{-2}$ oe
4(d)	$\dfrac{2x^2-x-1}{x}$ final answer	**2**	**M1** for $2x-1-\dfrac{1}{x}$
4(e)	2.98×10^{17} or $2.980...\times 10^{17}$	**1**	
4(f)	625	**2**	**M1** for $x=\text{j}(4)$
5(a)(i)(a)	$\dfrac{(8-2)\times 180}{8\times 2}$ oe	**M2**	**M1** for $\dfrac{(8-2)\times 180}{8}$ or $\dfrac{360}{8}$ or $\dfrac{(2\times 8-4)\times 90}{8}$

Question	Answer	Marks	Partial Marks
5(a)(i)(b)	174 or 173.8....	4	**M3** for $\frac{1}{2} \times 6 \times OM$ oe or $\frac{1}{2} \times (OA)^2 \times \sin45$ oe or $\frac{1}{2} \times 6 \times OA \times sin67.5$ oe where OA and OM are as in the **M2** or **M2** for $OM = 3 \times \tan 67.5$ oe or for $OA = \left(\dfrac{3}{cos67.5} \right)$ or $\dfrac{6 \times sin67.5}{sin45}$ oe or **M1** for $\dfrac{OM}{3} = \tan 67.5$ oe or for $\dfrac{3}{OA} = cos67.5$ oe or for $\dfrac{sin45}{6} = \dfrac{sin67.5}{OA}$ oe
5(a)(ii)	193 or 193.0 to 193.1	3	**M2** for $\pi \times \left(\dfrac{3}{\cos 67.5} \right)^2$ oe or **M1** for $\dfrac{3}{r} = \cos 67.5$ or $\dfrac{\sin 45}{6} = \dfrac{\sin 67.5}{r}$
5(b)(i)	1.27 or 1.272 to 1.273	2	**M1** for $\left[\dfrac{1}{2} \times \right] \pi \times 0.45^2 \times 4$ or $\dfrac{1}{2} \times \pi \times 0.45^2 [\times 4]$

Question	Answer	Marks	Partial Marks
5(b)(ii)	742 or 743	6	**M5** for a method leading to the volume of water e.g. $4 \times \{2 \times \dfrac{inv\cos\left(\dfrac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2$ $-\dfrac{1}{2} \times 0.45^2 \times \sin\left(2\,inv\cos\left(\dfrac{0.15}{0.45}\right)\right)\}$ oe **OR** **M2** $[2\times]\dfrac{inv\cos\left(\dfrac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2$ oe or $[2\times]\dfrac{90 - inv\cos\left(\dfrac{0.15}{0.45}\right)}{360} \times \pi \times 0.45^2$ oe or **M1** for use of $\dfrac{\theta}{360} \times \pi \times 0.45^2$ oe **M2** for $\dfrac{1}{2} \times 0.45^2 \times \sin\left(2\,inv\cos\left(\dfrac{0.15}{0.45}\right)\right)$ oe or $\dfrac{1}{2} \times 0.15 \times 0.45 \times \sin\left(inv\cos\left(\dfrac{0.15}{0.45}\right)\right)[\times 2]$ oe or **M1** for use of $\dfrac{1}{2} \times 0.45^2 \times \sin\theta$ oe or $[2\times]\dfrac{1}{2} \times 0.15 \times 0.45 \times \sin\beta$ oe If 0 scored, **SC**1 for $inv\cos\left(\dfrac{0.15}{0.45}\right)$ or $inv\sin\left(\dfrac{0.15}{0.45}\right)$ or $\sqrt{0.45^2 - 0.15^2}$ soi
6(a)(i)	−3	1	
6(a)(ii)	−1 1.55 to 1.6 4.4 to 4.45	3	**B1** for each
6(a)(iii)	−8	1	

Question	Answer	Marks	Partial Marks
6(a)(iv)	Correct ruled line	**B2**	At least through (4, 2) and (5, 0) **B1** for ruled line with gradient – 2 or through (0, 10)
	4.45 to 4.55	**B1**	
6(a)(v)	Ruled line through origin intersecting curve once	**2**	**B1** for ruled line through origin
6(b)	$y = -\dfrac{1}{2}x + 1$ final answer	**4**	**M1** for grad = 2 **M1** for grad of perpendicular = $-\dfrac{1}{their\ 2}$ **M1** for $-1 = (their\ m) \times 4 + b$ oe
7(a)	39.6 or 39.57....	**4**	**M2** for $[\cos =] \dfrac{14^2 + 12^2 - 9^2}{2 \times 14 \times 12}$ or **M1** for $9^2 = 14^2 + 12^2 - 2 \times 14 \times 12 \times \cos ACD$ **A1** for 0.7708... or 0.771 or $\dfrac{37}{48}$ oe
7(b)	$\dfrac{14 \sin 25}{\sin 123}$	**M2**	**M1** for $\dfrac{\sin 123}{14} = \dfrac{\sin 25}{BC}$ oe
	7.054…	**A1**	
7(c)	3.74 or 3.735 to 3.739	**3**	**M2** for $7.05 \times \sin 32$ or **M1** for recognition that the line from B is perpendicular to AC
7(d)	11.8 or 11.83 to 11.85	**4**	**M1** for $32 + their$(a) soi **M2** for $12^2 + 7.05^2 - 2 \times 12 \times 7.05 \times \cos(their\,(a) + 32)$ or **M1** for $\cos(their\,(a) + 32) = \dfrac{12^2 + 7.05^2 - BD^2}{2 \times 12 \times 7.05}$
7(e)	309.6 or 309.57...	**2**	**FT** 270 + *their(a)* **M1** for 270 + *their(a)* oe
8(a)(i)	Correct possibility diagram showing all twenty totals	**2**	**B1** for 20 correct totals or 20 correct combinations or possibility diagram with no more than two errors
8(a)(ii)(a)	$\dfrac{3}{20}$ oe	**1**	

Question	Answer	Marks	Partial Marks
8(a)(ii)(b)	$\dfrac{1}{5}$ oe	1	
8(a)(ii)(c)	1	1	
8(a)(iii)	9	1	**FT** *their* $\dfrac{3}{20} \times 60$
8(b)(i)	$\dfrac{1}{6}$ oe	1	
8(b)(ii)(a)	$\dfrac{1}{12}$ oe	2	**M1** for $\dfrac{1}{2} \times \dfrac{1}{6}$
8(b)(ii)(b)	$\dfrac{7}{12}$ oe	2	**M1** for $\dfrac{1}{2} \times \dfrac{1}{6} - \dfrac{1}{2} \times \dfrac{1}{6}$ If 0 scored **SC1** for final answer $\dfrac{6}{12}$ oe
8(c)	$\dfrac{17}{30}$	3	**M2** for $\dfrac{2}{3} \times \dfrac{4}{5} + \dfrac{1}{3} \times \dfrac{1}{10}$ or **M1** for one of these products
9(a)	$x^2 - x - 30[= 0]$	B3	**M1** for $(2x+1)(x-1) - x^2 = 29$ oe **B1** for $(2x+1)(x-1) = 2x^2 - 2x + x - 1$ oe soi
	$(x-6)(x+5)$ oe	M1	or correct factors for *their* 3 term quadratic equation or for correct substitution into quadratic formula or correctly completing the square for *their* 3 term quadratic equation
	$x = 6$ cao	B1	
	12 or 2 × *their x* evaluated or $k = 2x$ stated	B1 FT	
9(b)(i)	$\dfrac{1}{2}(2y+3)2y - \dfrac{1}{2}(y+3)y = 2$ oe	M2	**M1** for $\dfrac{1}{2}(2y+3)2y$ or $\dfrac{1}{2}(y+3)y$
	$\dfrac{1}{2}(4y^2+6y) - \dfrac{1}{2}(y^2+3y) = 2$ oe or $2y(2y+3) - y(y+3) = 4$ oe	M1	i.e. correct expansions or correct removal of fractions which may be seen together
	Completion to $3y^2 + 3y - 4 = 0$	A1	With no errors or omissions
9(b)(ii)	$\dfrac{-3 \pm \sqrt{3^2 - 4(3)(-4)}}{2 \times 3}$	B2	or **B1** for $\sqrt{3^2 - 4(3)(-4)}$ or for $\dfrac{-3 + \sqrt{\ldots}}{2 \times 3}$ or $\dfrac{-3 - \sqrt{\ldots}}{2 \times 3}$

Question	Answer	Marks	Partial Marks
	1.42 or 1.424 to 1.425	**B2**	**B1** for 0.758 or 0.7583...
10(a)	$[p =] \dfrac{1}{2}$ oe $[q =] 1$	**2**	**B1** for each If zero scored, **SC1** for 2 values satisfying one of the original equations
10(b)	$[u =]$ 30 and 150 $[v =]$ 0 and 360	**4**	**B1** for each OR **SC1** for sin u = *their p* and cos v = *their q* **SC1** if their two different angles for u sum to 180 or if their different two angles for v sum to 360