



# Ay Cambridge IGCSE™

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**MATHEMATICS (US)**

**0444/43**

Paper 4 (Extended)

**October/November 2022**

MARK SCHEME

Maximum Mark: 130

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**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.

Cambridge International is publishing the mark schemes for the October/November 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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.

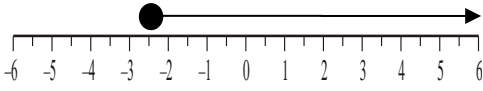
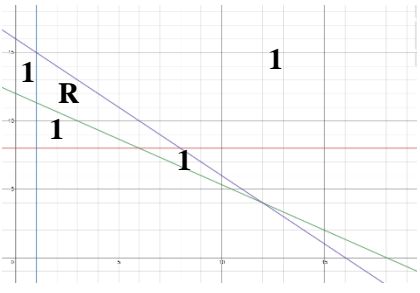
Maths-Specific Marking Principles	
1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given as fractions, 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)	Triangle drawn at (1, - 5), (1, - 7), (5, - 5)	2	<b>B1</b> for reflection in any horizontal line If 0 scored, <b>SC1</b> for reflection in $x = - 2$
1(b)	Triangle drawn at (- 2, 0), (- 2, - 1), (0, - 1)	2	<b>B1</b> for correct size and orientation but wrong position
1(c)	Rotation  90 [anticlockwise] oe  [centre] (- 1, 0)	3	<b>B1</b> for each
2(a)(i)	60.9 or 60.86 to 60.87	1	
2(a)(ii)	375	2	<b>M1</b> for $\frac{250}{12}$ [ $\times 18$ ] oe
2(a)(iii)	30 nfw	3	<b>M1</b> for figs $2200 \div 800$ [ $\times 12$ ] oe <b>M1</b> for $1500 \div 600$ [ $\times 12$ ] oe
2(b)(i)	1.92	2	<b>M1</b> for $k \times \left(1 + \frac{25}{100}\right) = 2.4[0]$ oe or better
2(b)(ii)	43.75 or $43\frac{3}{4}$	3	<b>M2</b> for $\left[\left(1 + \frac{25}{100}\right) \times \left(1 + \frac{15}{100}\right) [-1]\right] [\times 100]$ oe or $\left(1 + \frac{25}{100}\right) \times \left(1 + \frac{15}{100}\right) \times 100 [-100]$ or for $\frac{2.40 \times \left(1 + \frac{15}{100}\right)}{\text{their(b)(i)}} \times 100 [-100]$ oe or <b>M1</b> for $2.40 \times \left(1 + \frac{15}{100}\right)$ or $\left(1 + \frac{25}{100}\right) \times \left(1 + \frac{15}{100}\right)$ oe
2(c)	15	2	<b>M1</b> for $\frac{59}{50} \times 250$ oe (implied by 295)
3(a)(i)	$p^{14}$ final answer	1	
3(a)(ii)	$6m^4$ final answer	2	<b>B1</b> for $6m^k$ or $km^4$ in final answer or correct answer seen and spoilt

Question	Answer	Marks	Partial Marks
3(a)(iii)	$\frac{4}{3x^3y^9}$ or $\frac{4x^{-3}y^{-9}}{3}$ final answer	3	<b>B2</b> for correct answer seen and spoilt or 2 correct elements in final answer or <b>B1</b> for one of $\frac{4}{3}$ or $\frac{3}{4}$ oe or $x^3$ or $y^9$ seen
3(b)	3, 12, 27	2	<b>B1</b> for 12 or 27
3(c)(i)	$3n + 10$ oe final answer	2	<b>B1</b> for $3n + k$ oe or $jn + 10$ oe ( $j \neq 0$ ) or for correct expression shown in working and then spoilt
3(c)(ii)	$2n^3 + 1$ oe final answer	2	<b>B1</b> for 3rd diff = 12 (both needed) or for cubic answer or for correct expression shown in working and then spoilt
3(d)	38	3	<b>M2</b> for $3x = 4 \times 23 + 22$ or <b>M1</b> for $3x - 22 = 4 \times 23$ or for $\frac{3x}{4} = 23 + \frac{22}{4}$ oe
3(e)	$\frac{-8 \pm \sqrt{8^2 - 4(3)(-20)}}{2 \times 3}$ or $\frac{-8}{2 \times 3} \pm \sqrt{\frac{8^2}{4 \times 3^2} - \frac{(-20)}{3}}$ or better	<b>B2</b>	<b>B1</b> for $\sqrt{8^2 - 4(3)(-20)}$ oe or $\frac{-8 + \sqrt{q}}{2 \times 3}$ oe or $\frac{-8 - \sqrt{q}}{2 \times 3}$ oe or both
	- 4.24, 1.57 final answers	<b>B2</b>	<b>B1</b> for each If <b>B0</b> , <b>SC1</b> for answers - 4.2 or -4.23 or -4.240 to - 4.239 <b>and</b> 1.6 or 1.572 to 1.573 or - 4.24 <b>and</b> 1.57 seen in working or for -1.57 and 4.24 as final answer
4(a)	$\left(\frac{(36 + 50) \times 40}{2}\right) \times 120$ oe or $\left(\frac{(0.36 + 0.5) \times 0.4}{2}\right) \times 1.2$ oe	<b>M2</b>	<b>M1</b> for $\frac{(36 + 50) \times 40}{2}$ oe or $\frac{(0.36 + 0.5) \times 0.4}{2}$ oe
	$206400 \div 1000 = 206.4$ or $0.2064 \times 1000 = 206.4$ nfw	<b>A1</b>	Must see an explicit conversion
4(b)	5 [minutes] 44 seconds	3	<b>B2</b> for 344 [seconds] oe 5.73... [mins] or <b>M1</b> for figs $206.4 \div$ figs 6 oe

Question	Answer	Marks	Partial Marks
4(c)(i)	28[.0] or 27.96 to 27.97	3	<b>M2</b> for $[r^2=] \frac{\text{figs } 2064}{(\text{figs } 84)\pi}$ or <b>M1</b> for $\pi r^2 \times \text{figs } 84 = \text{figs } 2064$
4(c)(ii)	140 cao	2	<b>M1</b> for $0.6h = 84$ oe ALT method <b>M1</b> for $\pi \times (\text{their } (c)(i))^2 \times h = \text{figs } 206400 \div 0.6$ oe
4(d)	38.6 or 38.58...	4	<b>B3</b> for 14.1 or 14.08... or <b>M2</b> for $11.1^2 + 9.5^2 - 3.9^2$ oe or <b>M1</b> for $11.1^2 + 9.5^2$ or $(\text{their } AC)^2 - 3.9^2$
5(a)(i)	38	2	<b>M1</b> for $5 \times 3^2 - 7$ oe
5(a)(ii)	$[\pm] \sqrt{\frac{P+7}{5}}$ oe final answer	3	<b>M1</b> for $P + 7 = 5k^2$ or $\frac{P}{5} = k^2 - \frac{7}{5}$ <b>M1</b> for $k^2 = \dots$ FT <i>their</i> first step <b>M1</b> for square root to final answer Max <b>M2</b> for incorrect answer
5(b)(i)	$x \geq -2.5$ final answer	2	<b>M1</b> for $-4x \leq 7 + 3$ or better
5(b)(ii)		1	<b>FT</b> <i>their</i> inequality in (b)(i)
5(c)(i)	$x = 2$ broken line	<b>B1</b>	
	$y = 32 - x$ solid line	<b>B1</b>	
	$2x + 3y = 72$ solid line	<b>B2</b>	<b>B1</b> for line passing through (0, 24) or (36, 0)
	Correct region indicated cao 	<b>B2</b>	<b>B1</b> for region satisfying 3 of the inequalities
5(c)(ii)	(16, 16)	2	<b>M1</b> for substitution into $2x + y$ for any integer point in <i>their</i> region

Question	Answer	Marks	Partial Marks
6(a)(i)	$\frac{1}{15}$ oe	3	<p><b>M2</b> for <math>2 \times \frac{1}{6} \times \frac{1}{5}</math> oe</p> <p>or <b>M1</b> for <math>\frac{1}{6} \times \frac{1}{5}</math> oe</p> <p>or list or indication of 2 correct pairs</p> <p>If 0 scored, <b>SC1</b> for answer <math>\frac{1}{18}</math> oe</p>
6(a)(ii)	$\frac{7}{15}$ oe	3	<p><b>M2</b> for <math>\left(\frac{4}{6} \times \frac{3}{5}\right) + 2\left(\frac{1}{6} \times \frac{1}{5}\right)</math> oe or 14</p> <p><math>\left(\frac{1}{6} \times \frac{1}{5}\right)</math> oe</p> <p>or <math>1 - 2\left(\frac{2}{6} \times \frac{4}{5}\right)</math></p> <p>or <b>M1</b> for <math>\left(\frac{4}{6} \times \frac{3}{5}\right)</math> or <math>2\left(\frac{1}{6} \times \frac{1}{5}\right)</math> oe or</p> <p><math>2\left(\frac{2}{6} \times \frac{4}{5}\right)</math></p> <p>or correct identification of 14 pairs</p> <p>If 0 scored, <b>SC1</b> for answer <math>\frac{5}{9}</math></p>
6(b)	$\frac{1}{10}$ oe nfw	4	<p><b>M3</b> for <math>6\left(\frac{1}{6} \times \frac{1}{5} \times \frac{1}{4}\right) + 6\left(\frac{1}{6} \times \frac{1}{5} \times \frac{1}{4}\right)</math></p> <p>oe</p> <p>or <b>M2</b> for <math>6\left(\frac{1}{6} \times \frac{1}{5} \times \frac{1}{4}\right)</math> oe or</p> <p><math>2\left(\frac{1}{6} \times \frac{1}{5} \times \frac{1}{4}\right)</math> oe</p> <p>or <b>M1</b> for <math>k\left(\frac{1}{6} \times \frac{1}{5} \times \frac{1}{4}\right)</math> where <math>k</math> is an integer and <math>1 \leq k \leq 12</math> but not <math>k = 2</math> or <math>k = 6</math></p> <p>or identifies <math>-2, 2</math> and <math>5</math> or <math>-3, 3</math> and <math>5</math> as the 3 cards needed</p> <p>If 0 scored, <b>SC1</b> for answer <math>\frac{1}{18}</math></p>
7(a)	Correct histogram	3	<p><b>B1</b> for each correct block</p> <p>If 0 scored, <b>SC1</b> for two of <math>\frac{28}{15}, \frac{33}{20},</math></p> <p><math>\frac{13}{10}</math> or 1.87 or 1.866 to 1.867, 1.65, 1.3</p>

Question	Answer	Marks	Partial Marks
7(b)	38.65	4	<b>M1</b> for 12.5, 20, 32.5, 50, 65 soi <b>M1</b> for $\sum fx$ where $x$ is in the correct interval including boundaries <b>M1dep</b> for $\sum fx \div 100$
8(a)	$[\cos B = ] \frac{9.5^2 + 7.7^2 - 10^2}{2 \times 9.5 \times 7.7}$ oe	<b>M2</b>	<b>M1</b> for $10^2 = 9.5^2 + 7.7^2 - 2 \times 9.5 \times 7.7 \cos B$ oe or better
	70.206 to 70.207 or 70.21 to 70.22	<b>A2</b>	<b>A1</b> for $\frac{2477}{7315}$ oe or 0.339 or 0.3386....
8(b)(i)	140.4	1	
8(b)(ii)	19.8	1	<b>FT</b> $(180 - \text{their (b)(i)}) \div 2$
8(b)(iii)	70.2	1	<b>FT</b> $90 - \text{their (b)(ii)}$
8(c)	5.31 or 5.314 to 5.315	3	<b>M2</b> for $\frac{5}{\cos \text{their (b)(ii)}}$ oe or <b>M1</b> for $\frac{5}{r} = \cos(\text{their (b)(ii)})$ oe
8(d)	38.8 or 38.78 to 38.85	4	<b>M3</b> for $\frac{0.5 \times 9.5 \times 7.7 \times \sin 70.2}{\pi \times (\text{their (c)})^2} [\times 100]$ OR <b>M1</b> for $0.5 \times 9.5 \times 7.7 \times \sin 70.2$ <b>M1</b> for $\pi \times (\text{their (c)})^2$
9(a)(i)	2a drawn correctly with direction arrow	1	
9(a)(ii)	a – b drawn correctly with direction arrow	2	<b>B1</b> for $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ seen or implied or <b>M1</b> for correctly drawing <i>their a – b</i> with an arrow
9(b)(i)(a)	$\mathbf{q} + \frac{3}{4} \mathbf{p}$ final answer	1	
9(b)(i)(b)	$\mathbf{q} - \frac{1}{4} \mathbf{p}$ final answer	2	<b>M1</b> for a correct route



Question	Answer	Marks	Partial Marks
9(b)(i)(c)	$\frac{13}{24}p - \frac{2}{3}q$ final answer	3	<p><b>M2</b> for <math>\frac{3}{8}p - \frac{2}{3}</math> (their (b)(i)(b)) oe  or for <math>-\frac{3}{8}p - q + p + \frac{1}{3}</math> (their (b)(i)(b)) oe  or <b>M1</b> for a correct route or for  [ <math>\overline{BN} =</math> ] <math>-\frac{2}{3}</math> (their (b)(i)(b))  or [ <math>\overline{AN} =</math> ] <math>\frac{1}{3}</math> (their (b)(i)(b))  or final answer <math>kp - \frac{2}{3}q</math> oe or <math>\frac{13}{24}p - kq</math> oe</p>
9(b)(ii)	$\frac{19}{16}p$ oe final answer	2	<p><b>M1</b> for <math>\overline{AG} = \frac{3}{8}p \div 2</math> soi  or for answer <math>kp</math> oe</p>
10(a)	17 1.4 oe 0.4 oe	3	<b>B1</b> for each
10(b)(i)	170	1	
10(b)(ii)	8.5	2	<b>M1</b> for $50 + 30x = 305$ or better
10(b)(iii)	1.5	2	<b>M1</b> for $50 + 30x = 20 + 50x$ or better
10(c)	[ $a =$ ] 5 [ $b =$ ] 6	2	<b>B1</b> for each
10(d)(i)	11.5 or 11.53 to 11.54 168.5 or 168.46...	2	<b>B1</b> for each If 0 scored, <b>SC1</b> for two angles that add to give 180.0
10(d)(ii)	$90 - x$ oe	1	
10(e)	119	2	<b>M1</b> for $x = g(3)$ or better
10(f)	Stretch [factor =] 3 $x$ -axis oe invariant	3	<b>B1</b> <b>B1</b> <b>B1</b>