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MATHEMATICS **0580/41**

Paper 4 (Extended) **May/June 2024**

MARK SCHEME

Maximum Mark: 130

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 descriptions 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.

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Mathematics-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, non-integer 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 or sign 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 A or B 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

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Question	Answer	Marks	Partial Marks
1(a)(i)	4.55 or 4.545…	**1**	
1(a)(ii)	50 : 263 : 400 cao	**2**	**M1**for a correct simplification from 250 000 : 1 315 000 : 2 000 000
1(a)(iii)	83 cao	**3**	**M2** for $\frac{43\frac{1}{3}}{100}\times(100-60-10)$ oe or **M1** for 100 – 60 – 10 seen
1(a)(iv)	10 200 000 cao	**3**	**B2** for 10 185 185 to 10 185 200 or **M1** for 5 500 000 ÷ 27 [× 50]
1(a)(v)	3.19×10^7 or $3.190\ldots \times 10^7$	**3**	**B2** for 31903920 or **M1** for 60.7 × 60 × 24 × 365 If B0 scored **SC1** for correctly converting *their* number seen to standard form to 3sf or better
1(b)	2095 nfww	**3**	**M2** for 6445 – C where $4300 \leqslant C < 4400$ oe or A – 4350 where $6440 < A \leqslant 6450$ oe or **M1** for 6440 +5 or 6440 –5 or 4400 + 50 or 4400 – 50 seen oe
2(a)(i)	Triangle at (2, 1) (1, 3) (5, 3)	**1**	
2(a)(ii)	Triangle at (–4, –5) (–3, –3) (0, –5)	**2**	**B1** for translation by $\begin{pmatrix}-5\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-2\end{pmatrix}$
2(a)(iii)	Triangle at (–2.5, 2) (–4, 3) (–2, 3)	**2**	**B1** for enlargement by sf $-\frac{1}{2}$ with any centre
2(b)	14.4	**3**	**M2** for [10 ×] $3^2 \times \left(\frac{2}{5}\right)^2$ oe or **M1** for 3^2 or $\left(\frac{2}{5}\right)^2$ soi
3(a)(i)	80	**2**	**M1** for $\frac{1}{4}\times 5\times 8^2$
3(a)(ii)	5	**2**	**M1** for $[y^2 =]\frac{15\times 4}{2.4}$ oe

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Question	Answer	Marks	Partial Marks
3(b)	$\frac{5x+23}{(x-1)(2x+5)}$ or $\frac{5x+23}{2x^2+3x-5}$ final answer	**3**	**B1** for $4(2x + 5) -3(x – 1)$ oe isw **B1** for common denominator = $(x – 1)(2x + 5)$ oe isw
3(c)	$2x^3 -13x^2 + 8x + 48$ final answer	**3**	**B2** for correct expansion of 3 brackets but unsimplified or for simplified four-term expression of correct form with 3 terms correct or **B1** for correct expansion of two brackets with at least 3 terms out of 4 correct
3(d)	$\frac{8x^{12}}{y^6}$ or $8x^{12}y^{-6}$ final answer	**3**	**B2** for two elements correct in final answer or for correct answer seen then spoiled or for correct expression where all parts of the power have been dealt with or for $(\,)^{-1}$ or $\left(\frac{2x^4}{y^2}\right)^3$ or **B1** for 8 or y^6 or y^{-6} or x^{12} correct in final answer or for $\left(\frac{16x^{16}}{y^8}\right)^{\frac{3}{4}}$ or $\left(\frac{y^2}{2x^4}\right)^{-3}$
4(a)(i)	9.3	**1**	
4(a)(ii)	3.4	**1**	
4(a)(iii)	63	**5**	**M4** for $\frac{195}{6}\times\frac{3600}{1000}-\frac{195}{13}\times\frac{3600}{1000}$ oe or **M3** for $\frac{195}{6}\times\frac{3600}{1000}$ oe or $\frac{195}{13}\times\frac{3600}{1000}$ oe or for $(\frac{195}{6}-\frac{195}{13})[\times k]$ oe OR **M1** for $\frac{195}{6}$ or $\frac{195}{13}$ or *their* speed $\times\frac{3600}{1000}$ seen **M1** for selecting 6 and 13

Question	Answer	Marks	Partial Marks
4(b)(i)	$420 < d \leqslant 450$	**1**	
4(b)(ii)	411.25	**4**	**M1** for 275, 350, 410, 435, 475 soi **M1** for Σfx **M1 dep** for *their* $\Sigma fx \div 80$
4(b)(iii)	2.6 19 14	**3**	**B1** for each If 0 scored, **SC1** for 3 of 0.14, 0.13, 0.95 or 0.7 oe
4(b)(iv)	$\frac{7}{158}$ oe	**3**	**M2** for $[2\times]\frac{20}{80}\times\frac{7}{79}$ oe or **M1** for $\frac{20}{80}$ or $\frac{7}{79}$ or $\frac{7}{80}$ or $\frac{20}{79}$ oe seen After 0 scored, **SC1** for $\frac{7}{160}$ oe
5(a)(i)	$\begin{pmatrix} 4 \\ -12 \end{pmatrix}$	**2**	**B1** for each
5(a)(ii)	$1^2 + 7^2$	**M1**	
	$5^2 + ([-]5)^2$	**M1**	
	Both $\sqrt{50}$ oe	**A1**	With no errors seen If M0M0A0 scored SC1 for $\sqrt{50}$ oe for each
5(a)(iii)	44.4 or 44.42[8…] to 44.435	**2**	FT *their* **(a)(ii)** correct to 3sf or better **M1** for $2 \times \pi \times$ *their* $\sqrt{50}$ oe
5(a)(iv)	(3, 1)	**2**	**B1** for each

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Question	Answer	Marks	Partial Marks
5(a)(v)	[$y =$] $\frac{1}{3}x$	**4**	**B3** for a correct equation in the wrong form as final answer Or **B2** for 1/3 stated or used as perpendicular gradient OR **M1** for [grad PQ] = $\frac{7--5}{1-5}$ oe **M1** for $\frac{-1}{their\ \text{grad}\ PQ}$ **M1dep** for substituting *their*(a)(iv) or (0,0) into $y = their\ mx + c$ oe dep on the 2nd M1 or B2
5(b)	$\frac{3}{5}$ **a** + $\frac{2}{5}$ **b** final answer	**4**	**B3** for an unsimplified correct answer or **B2** for $AM = \frac{2}{5}(\boldsymbol{b}-\boldsymbol{a})$ soi or $BM = \frac{3}{5}(\boldsymbol{a}-\boldsymbol{b})$ soi or **B1** for AB = **b** – **a** or BA = **a** – **b** or for a correct route for OM or for correct diagram
6(a)	245	**1**	
6(b)(i)	180 – (55 + 25) [=100]	**M1**	
6(b)(ii)	$\frac{32\times\sin 25}{\sin 100}$ oe	**M2**	**M1** for $\frac{\sin 25}{BH} = \frac{\sin 100}{32}$ oe
	13.73…	**A1**	

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Question	Answer	Marks	Partial Marks
6(c)	258 or 257.9 to 258.0…	**5**	**B4** for 67.9 to 68.0… OR **M2** for [cos =] $\left(\frac{11^2+13.7^2-14^2}{2\times13.7\times11}\right)$ **A1** for 0.3738 to 0.376 or **M1** for $14^2 = 11^2 + 13.7^2 - 2\times 11 \times 13.7 \times \cos B$ **M1dep** on at least M1 for 190 + *their* angle *B*
6(d)(i)	2 44 pm or 14 44 cao	**4**	**B3** for 1 hour 44 or 1 hour 43.6 to 1 hour 43.8 or 104 or 103.6 to 103.8 or **B2** for 1.727 to 1.73 or **M2** for $\frac{32}{10\times1.852}\times60$ or **M1** for 32 ÷ (10 × 1.852)
6(d)(ii)	7.857 to 7.88	**3**	**M2** for $\frac{x}{13.7} = \cos 55$ oe or **M1** for dist to *H* occurs when perpendicular from *B* meets *CH* soi
7(a)(i)	10 100	**3**	**M2** for $30\times70+2\times30\times40+2\times40\times70$ or **M1** for 30 × 40 or 30 × 70 or 40 × 70
7(a)(ii)	16	**3**	**M2** for 2 fit width, 2 fit height and 4 fit length soi or **M1** for 70, 30 or 40 ÷ 15 or 20
7(b)(i)	$\frac{1}{3}\pi r^2 \times 3r =$ *their* (750 ÷ 8.9) oe	**M2**	**M1** for using 750 and 8.9 correctly in $v = m / d$ oe or 750 ÷ 8.9
	$r^3 = \frac{\textit{their}(750\div 8.9)}{\pi}$ oe	**M1dep**	
	$r = 2.993\ldots$	**A1**	

Question	Answer	Marks	Partial Marks
7(b)(ii)	117 or 116.9 to 117.2	**5**	**M4** for $\pi \times 2.99^2 + \pi \times 2.99 \times \sqrt{2.99^2 + (3 \times 2.99)^2}$ oe or **M3** for $\pi \times 2.99 \times \sqrt{2.99^2 + (3 \times 2.99)^2}$ or **M2** for $\sqrt{2.99^2 + (3 \times 2.99)^2}$ or **M1** for $2.99^2 + (3 \times 2.99)^2$ or for $\pi \times 2.99^2$
8(a)	Correct sketch with roots indicated at $x = –9$ and $x = 2$ and y intercept = –18 Minimum should be in 3rd quadrant	**4**	**B1** for U shaped parabola **B2** for roots at –9 and 2 on diagram or **M1** for $(x + 9)(x – 2)$ [= 0] **B1** for y – intercept at –18 on diagram Maximum 3 marks if sketch not fully correct
8(b)(i)	$2x – 3$	**2**	**B1** for $2x + k$ or $kx^{[p]} – 3$
8(b)(ii)	(1.5, –30.25) oe	**3**	**B2** for $x = 1.5$ or **M1** for *their* **(b)(i)** = 0 or for $(x – 1.5)^2$
8(c)	$x^2 – x – 33$ [= 0] seen	**B1**	
	$\frac{[--]1 \pm \sqrt{([-]1)^2 - 4(1)(-33)}}{2 \times 1}$ oe	**B2FT**	**FT** *their* quadratic dep on no factors **B1** for $\sqrt{([-]1)^2 - 4(1)(-33)}$ or better or **B1** for $\frac{[--]1 + \sqrt{q}}{2(1)}$ oe or $\frac{[--]1 - \sqrt{q}}{2(1)}$ oe
	–5.27 or –5.267 to –5.266 **and** 6.27 or 6.266 to 6.267	**B2**	**B1** for each If 0 scored, **SC1** for –6.27 and 5.27
	(–5.27, 15.53 or 15.54) **and** (6.27, –7.53 or – 7.54)	**B1**	
9(a)(i)	13	**1**	
9(a)(ii)	–20	**1**	**FT** 6 – 2(*their* **(a)(i)**)

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Question	Answer	Marks	Partial Marks
9(b)	$\frac{6-x}{2}$ oe final answer	**2**	**M1** for correct first step $x = 6 - 2y$, $y - 6 = -2x$, $\frac{y}{2} = 3 - x$
9(c)	2.375 oe	**4**	**B1** for $6 - 2(2x - 7)$ oe **B1** for $4x + 1 = 6 - 4x + 14$ **M1** for $8x = 19$ FT *their* linear equation rearranged correctly from $ax + b = cx + d$ to form $ex = f$
9(d)	$\frac{1}{3}$ or 0.333…	**2**	**M1** for h(1) or 3^($3^{x-2} - 2$) or 3^($3^{2-2} - 2$) or better
9(e)	6561	**2**	**M1** for 3^{10-2} or x = h(10)

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