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MATHEMATICS **0580/43**

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)	3050	**2**	**M1** for 50 × 40 + 70 × 15 or better
1(a)(ii)	91.1 or 91.14 to 91.15	**1**	**FT** $\frac{2780}{their\,3050}\times 100$
1(a)(iii)	125 nfww	**2**	**M1** for [...] × $\frac{100-4}{100}$=120 oe
1(a)(iv)(a)	132	**2**	**B1** for increase of 6 in adult or junior or **M1** for 56 : 76 or for multiples of 33 seen 33, 66, 99, 132, … or 50 + x : 70 + x = 14 : 19 oe or (70 – 50) × $\frac{19+14}{19-14}$ oe or 50 + x = (120 + 2x) × $\frac{14}{19+14}$ oe
1(a)(iv)(b)	10	**2**	**FT** $\frac{their\textbf{(a)}-120}{120}\times 100$ dep on *their* **(a)** > 120 **M1** for $\frac{their\textbf{(a)}-120}{120}[\times 100]$ or $\frac{their\textbf{(a)}}{120}\times 100\,[-100]$
1(b)(i)	2280 or 2281 to 2282 nfww	**2**	**M1** for $2500\times\left(1-\frac{3}{100}\right)^3$ oe
1(b)(ii)	8	**2**	**M1** for $2500\times\left(1-\frac{3}{100}\right)^n$ or 0.97^n evaluated with n > 3
2(a)(i)	56	**1**	
2(a)(ii)	11	**2**	**M1** for 120 – n^3 = – 1211 or 120 – 11^3 = – 1211
2(b)	0.0048 or $\frac{3}{625}$ oe	**1**	

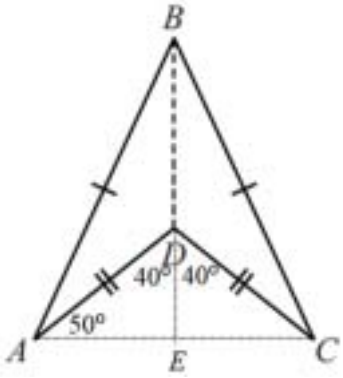
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Question	Answer	Marks	Partial Marks
2(c)	A: –5: $10 - 3n$ B: $\frac{5}{8}$: $\frac{n}{n+3}$ C: 20: $n^2 - n$	**8**	**B1** for –5 **B2** for $10 - 3n$ oe or **B1** for $k - 3n$ or for $10 - kn$ **B1** for $\frac{5}{8}$ **B1** for $\frac{n}{n+3}$ oe **B1** for 20 **B2** for $n^2 - n$ oe or **B1** for any quadratic or for at least two second differences of 2
3(a)	5	**B1**	
	4	**B1**	
	3.55	**3**	**M2** for $(10 \times 1 + 6 \times 2 + 11 \times 3 + 13 \times 4 + 14 \times 5 + 6 \times 6) \div 60$ oe or **M1** for $10 \times 1 + 6 \times 2 + 11 \times 3 + 13 \times 4 + 14 \times 5 + 6 \times 6$ oe
3(b)(i)	42.55 or 42.6	**4**	**M1** for 25, 40, 62.5 soi **M1** for Σfx with x values in correct intervals, including boundaries **M1 dep** on second M1 for $\frac{\Sigma fx}{100}$
3(b)(ii)	10.8 2.16	**2**	**B1** for each or for frequency densities 3.6 and 0.72 seen
4(a)	$\frac{1}{2}(r+5)(r+2)\sin 30 = (r+1)^2$	**M2**	**M1** for $\frac{1}{2}(r+5)(r+2)\sin 30$ oe
	$r^2 + 5r + 2r + 10$ or $r^2 + r + r + 1$ soi	**B1**	
	Leading to $3r^2 + r - 6 = 0$ with no errors or omissions	**A1**	Dependent on both expansions seen

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Question	Answer	Marks	Partial Marks
4(b)	$\frac{-1\pm\sqrt{1^2-4(3)(-6)}}{2(3)}$ Or $-\frac{1}{6}\pm\sqrt{2+\left(\frac{1}{6}\right)^2}$ oe or $\frac{1}{3}\left(-\frac{1}{2}\pm\sqrt{18+\left(\frac{1}{2}\right)^2}\right)$ oe	**B2**	**B1** for $\sqrt{1^2-4(3)(-6)}$ or for $\frac{-1+\sqrt{p}}{2(3)}$ or $\frac{-1-\sqrt{p}}{2(3)}$ or $\left(r+\frac{1}{6}\right)^2$ or $\left(3r+\frac{1}{2}\right)^2$
	–1.59 and 1.26	**B1**	
4(c)	9.028 to 9.040	**2**	**M1** for (*their* root (greater than –1) + 1) × 4
5(a)(i)	3 cao	**1**	
5(a)(ii)	–2, –0.45 to –0.4, 2.40 to 2.45	**3**	**B1** each
5(a)(iii)	3 cao	**1**	
5(a)(iv)	Asymptote	**1**	
5(b)(i)	Correct ruled line	**2**	**B1** for ruled line through (0, –2) but not $y = -2$ or for ruled line with gradient 1
5(b)(ii)	1 cao	**1**	
5(c)	Substituting values of x and y into $y = x^2 - \frac{c}{x}$ for an exact point on graph of $y = f(x)$ or substituting *their* value of x from 5b(ii) into $x^2 - \frac{c}{x} = x - 2$	**M1**	
	leading to $c = 2$ with no errors	**A1**	
5(d)	[p =] –1 and [q =] 2 nfww	**2**	**M1** for $x^3 - x^2 + 2x = 2$ seen or **B1** for each nfww
6(a)	4.27 or 4.272...	**2**	**M1** for $4^2 + 1.5^2$ oe

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Question	Answer	Marks	Partial Marks
6(b)	203 or 202.6…	**3**	**B2** for [angle at W =] 22.6... or for [angle at V =] 67.4 or 67.38… or **M1** for tan = $\frac{5}{12}$ or $\frac{12}{5}$ oe
6(c)	25.2 or 25.20 to 25.21[0]  	**5**	**B4** for [BC or AB =] 7.6[0] or 7.604 to 7.605 OR **M3** for a complete explicit method leading to AB or BC, e.g. $\frac{5\sin 140}{\sin 25}$ OR **M2** for a complete implicit method leading to AB or BC, e.g. $\frac{\sin 25}{5} = \frac{\sin 140}{BC \text{ or } AB}$ oe and **M1** (dep on AB from trig) for 2 × *their* AB + 10 OR **B1** for any relevant angle E.g. $\angle BDA$ or $\angle BDC$ = 140, $\angle DAE$ or $\angle DCE$ = 50 or $\angle ADE$ or $\angle CDE$ = 40 or $\angle ADC$ = 80
6(d)	79.5 or 79.6 or 79.54 to 79.55...	**5**	**B2** for [PR^2 =] 245 or 245.1 to 245.2 or [PR =] 15.65 to 15.66 or 15.7 or **M1** for [PR^2 =] $11^2 + 8^2 - 2 \times 11 \times 8 \times \cos 110$ **M2** for [cosPQR =] $\frac{10^2 + 14^2 - (\textit{their } PR)^2}{2 \times 10 \times 14}$ oe or **M1** for (*their* PR)^2 = $10^2 + 14^2 - 2 \times 10 \times 14\cos PQR$ oe
7(a)(i)	40	**2**	**M1** for $\frac{50}{75}$ [× 60] oe
7(a)(ii)	36 nfww	**3**	**M2** for $\frac{47 - 0.5}{75 \text{ to } 80}$ [× 60] or $\frac{46 \text{ to } 47}{75 + 2.5}$ [× 60] or **M1** for 47+0.5 or 47 – 0.5 or 75 + 2.5 or 75– 2.5

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Question	Answer	Marks	Partial Marks
7(b)	107 or 107.2...	**6**	**M5** for [speed =] $\frac{240}{\left(2\times\frac{260}{7}+60\right)}\times 60$ oe OR **B5** for [total time =] 134 or 134.2 to 134.3 or 2.24 or 2.238... or **B4** for (t =) 37.1 or 37.14... OR **M2** for $\frac{t}{60}\times 100+\frac{t+60}{60}\times 110=240$ oe or **M1** for $\frac{t}{60}\times 100$ or $\frac{t+60}{60}\times 110$ oe **M1** for correct equation of form $at = b$ from *their* equation containing two terms in t and involving the speeds. **M1** for $\frac{240}{2\times \textit{their}\, t+60}$ [× 60]
8(a)(i)	37.3 or 37.26 to 37.27	**5**	**M2** for $\pi\times 0.35\times\sqrt{0.35^2+1.5^2}$ oe or **M1** for $0.35^2+1.5^2$ or better **M1** for $\pi\times 0.35^2$ **M1** for $2\times\pi\times 0.35\times 16$
8(a)(ii)	6.35 or 6.349 to 6.351	**3**	**M1** for $\pi\times 0.35^2\times 16$ **M1** for $\frac{1}{3}\times\pi\times 0.35^2\times 1.5$
8(a)(iii)	22.2 or 22.3 or 22.24 to 22.26	**3**	**M2** for $17.5\times 3.5\times 1.4 - 10\times$ *their*(**a)(ii)** or **M1** for $17.5\times 3.5\times 1.4$

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Question	Answer	Marks	Partial Marks
8(b)	154 or 154.3 to 154.4	**3**	**M2** for $450 \times \left(\sqrt{\frac{98}{200}}\right)^3$ oe or **M1** for $\left(\sqrt{\frac{98}{200}}\right)^3$ or $\left(\sqrt{\frac{200}{98}}\right)^3$ oe or for $\left(\frac{450}{V}\right)^2 = \left(\frac{200}{98}\right)^3$ oe
9(a)(i)	0	**1**	
9(a)(ii)	$\frac{1}{7}$ oe	**1**	
9(b)	$\frac{4}{49}$ oe	**2**	**M1** for $\frac{2}{7} \times \frac{2}{7}$
9(c)(i)	$\frac{2}{21}$ oe	**3**	**M2** for $\frac{2}{7} \times \frac{1}{6} + \frac{1}{7} \times \frac{2}{6}$ oe or **M1** for $\frac{2}{7} \times \frac{1}{6}$ or $\frac{1}{7} \times \frac{2}{6}$ oe seen If 0 scored SC1 for $\frac{4}{49}$
9(c)(ii)	$\frac{19}{21}$ oe	**3**	**M2** for $1 - \left(\frac{2}{7} \times \frac{1}{6}\right) - \left(\frac{2}{7} \times \frac{1}{6}\right)$ oe or **M1** for $\left(\frac{2}{7} \times \frac{1}{6}\right) + \left(\frac{2}{7} \times \frac{1}{6}\right)$ oe ALTERNATIVE **M2** for $\frac{1}{7}$ [× 1] × 3 + $\frac{2}{7} \times \frac{5}{6} \times 2$ or **M1** for $\frac{2}{7} \times \frac{5}{6}$ or $\frac{1}{7}$ [× 1] × 3 If 0 scored SC1 for $\frac{38}{49}$
9(d)	3	**2**	**M1** for $\frac{5}{7} \times \frac{4}{6} \times \frac{2 \text{or} 3}{5}$
10(a)	$7x^6 - 42x^5$ final answer	**2**	**B1** for one correct term $7x^6$ or $42x^5$ or for $7x^6 - 42x^5$ seen and spoiled

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Question	Answer	Marks	Partial Marks
10(b)	$49x + 41$	**4**	**M1** for substituting $x = -1$ into $[y =] x^7 - 7x^6$ **M1** for $x = -1$ substituted in *their* (a) or the correct derivative to give *their m* **M1** for *their* $-8 = (\textit{their } m)(-1) + c$ oe
10(c)	(0, 0) (6, –46 656)	**5**	**B4** for (6, –46 656) or **B3** for $x = 0$ and 6 **OR** **M1** for *their* $\frac{dy}{dx} = 0$ or stating $\frac{dy}{dx} = 0$ and **M1** for a correct method to solve *their* $7x^6 - 42x^5$
11(a)	$\frac{3}{10} \times 360$ oe	**M2**	**M1** for $\frac{3}{3+7} = \frac{x}{360}$ or for $\frac{x}{360}\ [\times 2\pi r] = \frac{3}{7} \times \frac{360-x}{360}\ [\times 2\pi r]$ oe or better or $1\ [\times 2\pi r] = \frac{10}{7} \times \frac{360-x}{360}\ [\times 2\pi r]$ oe or better or $\frac{360}{7+3} \times k$ ($k = 1$ or 7)
	108	**A1**	
11(b)(i)	$\frac{1}{2}r^2 \sin y = \frac{1}{2} \times \frac{y}{360} \times \pi r^2$ or $\frac{y}{360} \times \pi r^2 = [2 \times \frac{1}{2}]\ r^2 \sin y$ and one further step leading to $360\sin y = \pi y$ with no errors	**2**	**M1** for $\frac{y}{360} \times \pi r^2$ or for $\frac{1}{2}r^2 \sin y$
11(b)(ii)	341.18 or 341.22 341.00 341.49 or 341.54	**3**	**B1** for each
11(b)(iii)	108.6 cao	**1**	

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