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MATHEMATICS **0580/42**

Paper 4 (Extended) **October/November 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.

Cambridge International will not enter into discussions about these mark schemes.

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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)	26 122 cao	**2**	**M1** for $28\,240 \times \left(1-\frac{7.5}{100}\right)$ oe or **B1** for answer 2118
1(a)(ii)	62.5	**2**	**M1** for $C \times \frac{72}{100}$ = 45 oe or better
1(b)	17.5	**4**	**M3** for $\frac{31900 - 11490 - (47\times330)}{28000}$ [× 100] or **M2** for 31 900 – 11 490 – (47 × 330) or **M1** for 47 × 330 or for 31 900 – 11 490
1(c)	4.43 or 4.427…	**2**	**M1** for $\frac{2.5+6}{64+128}$ [× 100] oe
1(d)	31 620	**2**	**M1** for $46\,500 \times \left(1-\frac{20}{100}\right)\left[\times\left(1-\frac{15}{100}\right)\right]$ or $46\,500 \times \left(1-\frac{15}{100}\right)\left[\times\left(1-\frac{20}{100}\right)\right]$ or for $\left(1-\frac{20}{100}\right)\times\left(1-\frac{15}{100}\right)$
2(a)	–4, –1	**2**	**B1** for each correct value
2(b)	Correct graph	**4**	**B3FT** for 7 or 8 correct points or **B2FT** for 5 or 6 correct points or **B1FT** for 3 or 4 correct points
2(c)(i)	Ruled tangent at $x = 1$	**1**	
2(c)(ii)	6 to 14 nfww	**2**	**dep** on correct tangent or a close attempt at the tangent at $x = 1$ **M1** for rise/run for *their* tangent, or close attempt at tangent at any point. Must see correct or implied calculation from a drawn tangent.
2(d)	$y = x + 2$ ruled	**M2**	**M1** for [y =] $x + 2$ soi or $y = x + k$ ruled or $y = kx + 2$ ruled, but not $y = 2$
	x = –3.95 to –3.75 x = –1.4 to –1.25 x = 1.1 to 1.25	**A2**	**A1** for any two values If A0, **SC1** for three correct values

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Question	Answer	Marks	Partial Marks
3(a)(i)	$-m + 3n$ final answer	**2**	**B1** for $-m$ or [+] $3n$ in final answer or for $-m + 3n$ seen and then spoiled
3(a)(ii)	$81a^8c^{12}$ final answer	**2**	**B1** for final answer in correct form with any two of 81, a^8, c^{12} correct or for $81a^8c^{12}$ seen and then spoiled
3(a)(iii)	$\frac{19x}{30}$ final answer	**2**	**M1** for $\frac{6\times 4x - 3\times 3x + 2\times 2x}{30}$ oe
3(b)	4.5 oe	**3**	**M1** for $a + 2(3a + 2) = 35.5$ oe **M1** for correct $ka = b$ for *their* linear equation
3(c)	$\frac{-(-4) \pm \sqrt{(-4)^2 - 4\times 5\times (-3)}}{2\times 5}$ oe	**M2**	**M1** for $\sqrt{(-4)^2 - 4\times 5\times (-3)}$ or better or for $\frac{-(-4) + \sqrt{q}}{2\times 5}$ or $\frac{-(-4) - \sqrt{q}}{2\times 5}$ or better
	–0.472 or –0.4718 to –0.4717 **and** 1.27 or 1.271 to 1.272	**B1**	
3(d)	$x^2 - 6x + 8$ [= 0] or $y^2 - 6y + 5$ [= 0]	**M2**	**M1** for $x^2 - 4x + 5 = 2x - 3$ or $y = \left(\frac{y+3}{2}\right)^2 - 4\left(\frac{y+3}{2}\right) + 5$
	$(x - 4)(x - 2)$ [= 0] or $(y - 1)(y - 5)$ [=0] OR [x =] $\frac{-(-6) \pm \sqrt{(-6)^2 - 4[\times 1]\times 8}}{2[\times 1]}$ or [y =] $\frac{-(-6) \pm \sqrt{(-6)^2 - 4[\times 1]\times 5}}{2[\times 1]}$ OR [x =] $3 \pm \sqrt{-8+9}$ or [y =] $3 \pm \sqrt{-5+9}$	**M1**	FT *their* 3-term quadratic but not if $x^2 - 4x + 5$[= 0]

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Question	Answer	Marks	Partial Marks
	[x =] 2 , [y =] 1 [x =] 4 , [y =] 5	**B2**	**B1** for one correct pair or two correct x-values or two correct y-values If B0 scored **and** at least 2 method marks scored, **SC1** for correct substitution of both of *their x* values or *their y* values into $y = x^2 - 4x + 5$ or $y = 2x - 3$
4(a)	135	**2**	**M1** for $\frac{360}{5+3} \times k$, where k = 1, 3 or 5 oe
4(b)(i)	26	**2**	**B1** for $\angle ABD = 49$
4(b)(ii)(a)	86	**2**	**B1** for $\angle QAD = 49$ or for $\angle BDA = 45$ or for $\angle BCA = 45$
4(b)(ii)(b)	Angle in a semicircle = 90	**1**	
4(c)(i)	[2 ×] $\cos^{-1}\left(\frac{6.75}{11.5}\right)$ oe	**M2**	**M1** for $\cos(\ldots) = \frac{6.75}{11.5}$ oe
	108.117…	**A1**	
4(c)(ii)	12.7 or 12.73 to 12.74	**2**	**M1** for $\frac{108.12}{360} \times 2 \times \pi \times 6.75$
4(c)(iii)	100 or 100.1 to 100.2	**3**	**M2** for $\frac{360-108.12}{360} \times \pi \times 6.75^2$ oe or **M1** for $\frac{108.12}{360} \times \pi \times 6.75^2$ If 0 scored, **SC1** for $\frac{360-108.12}{360} \times \pi \times k$
5(a)(i)(a)	1480	**1**	
5(a)(i)(b)	440	**2**	**M1** for [UQ =] 1600 soi or [LQ =] 1160 soi
5(a)(ii)	$\frac{8}{80}$ oe	**2**	**M1** for 72 or 8 written
5(b)	236 or 235.5 to 235.6	**3**	**M2** for $\frac{5.104}{1.3} \times 60$ oe or **M1** for $\frac{5.104}{\textit{their}\ \text{time}}$

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Question	Answer	Marks	Partial Marks
5(c)(i)	(160 – 120) × 0.2 [= 8]	**1**	with no errors seen
5(c)(ii)	22, 36, 64, 30 seen	**B2**	**B1** for 2 or 3 correct frequencies or **M1** for three of 1.1 × (180 – 160), 1.8 × (200 – 180), 1.6 × (240 – 200) and 0.5 × (300 – 240) oe
	(8 × 140 + *their*22 × 170 + *their*36 × 190 + *their*64 × 220 + *their*30 × 270) ÷ 160	**M3**	**M1** for midpoints soi **M1** for Σfx , x in interval or boundary of interval **M1 dep on second M1** for $\Sigma fx \div 160$
	211.75	**B1**	
6(a)	$\begin{pmatrix} 4 \\ -3 \end{pmatrix}$	**2**	**B1** for $\begin{pmatrix} 6 \\ -10 \end{pmatrix}$ or answer $\begin{pmatrix} 4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -3 \end{pmatrix}$
6(b)(i)	(–4, –1)	**1**	
6(b)(ii)	7.21 or 7.211…	**2**	**M1** for $(-6)^2 + 4^2$
6(c)(i)(a)	2**c** – **a**	**1**	
6(c)(i)(b)	**c** – **a**	**1**	
6(c)(i)(c)	$\frac{1}{5}$ (**a** + 8**c**) final answer	**2**	**M1** for [$\overrightarrow{AP}$ =] $\frac{4}{5}$ × *their*(2**c** – **a**) or [$\overrightarrow{BP}$ =] $\frac{1}{5}$ × – *their* (2**c** – **a**) or for a correct vector route using the lines on the diagram
6(c)(i)(d)	$\frac{4}{5}$ (– **a** + **c**) final answer	**2**	**M1** for [$\overrightarrow{QP}$ =] $-\frac{4}{5}$**c** + $\frac{4}{5}$ × *their*(2**c** – **a**) or for a correct vector route
6(c)(ii)	[*QP* is] parallel [to *CB*] $QP = \frac{4}{5} CB$ oe	**2**	**Dep both statements** consistent with *their* **(c)(i)(b)** and *their* **(c)(i)(d)** and both vectors in terms of **a** and **c** **B1** for each dep on statement consistent with *their* **(c)(i)(b)** and *their* **(c)(i)(d)** and both vectors in terms of **a** and **c**
7(a)(i)	180 – 60 – 39 [= 81]	**1**	
7(a)(ii)	147 or 147.1…	**3**	**M2** for $\frac{129\sin(81)}{\sin 60}$ oe or **M1** for $\frac{\sin(81)}{CD} = \frac{\sin 60}{129}$ oe

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Question	Answer	Marks	Partial Marks
7(a)(iii)	[cos =] $\frac{85^2+129^2-72^2}{2\times85\times129}$	**M2**	**M1** for $72^2 = 85^2 + 129^2 - 2\times85\times129\cos ABD$
	31.58…	**A2**	**A1** for 0.851 to 0.852 or $\frac{9341}{10965}$ or equivalent fraction
7(a)(iv)	44.5 or 44.51 to 44.54	**3**	**M2** for implicit correct method e.g. $\frac{d}{85} = \sin 31.6$ oe or **M1** for recognition that the line from *A* is perpendicular to *BD*
7(a)(v)	247 or 247.4…	**2**	**M1** for 180 + (180 – 81 – 31.6) oe or for ∠*NBC* = 180 – 81 – 31.6 oe or for ∠*NCB* = 81 + 31.6 oe
7(a)(vi)	972 or 973	**4**	**M1** for [△*ABD*] $\frac{1}{2}$ × 85 × 129sin31.6 oe or $\frac{1}{2}$ × 129 × *their* 44.5 oe **M1** for [△*BCD*] $\frac{1}{2}$ × 129 × *their*147×sin39 oe **M1** for $\frac{\textit{their}\text{ total area}}{10000} \times 1100$
7(b)	126 nfww	**3**	**M2** for $\frac{9400+50}{70\text{ to }80}$ or $\frac{9400\text{ to }9500}{80-5}$ or **M1** for 9350 or 9450 or 75 or 85 seen
8(a)(i)	$\frac{5}{12}$ oe	**1**	
8(a)(ii)	$\frac{7}{12}$ oe	**1**	**FT** 1 – *their* **(a)(i)**
8(b)(i)	$\frac{4}{35}$ oe	**2**	**M1** for $\frac{4}{15}\times\frac{6}{14}$

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Question	Answer	Marks	Partial Marks
8(b)(ii)	$\frac{74}{105}$ oe	**4**	**M3** for $1-\left(\frac{5}{15}\times\frac{4}{14}+\frac{6}{15}\times\frac{5}{14}+\frac{4}{15}\times\frac{3}{14}\right)$ oe or **M2** for $\frac{5}{15}\times\frac{4}{14}+\frac{6}{15}\times\frac{5}{14}+\frac{4}{15}\times\frac{3}{14}$ oe or **M1** for $\frac{k}{15}\times\frac{k-1}{14}$ where k is 4, 5 or 6 oe If 0 scored, **SC1** for $\frac{148}{225}$ ALTERNATIVE 1 **M3** for $\frac{5}{15}\times\frac{10}{14}+\frac{6}{15}\times\frac{9}{14}+\frac{4}{15}\times\frac{11}{14}$ oe or **M2** for two of these products added oe or **M1** for $\frac{k}{15}\times\frac{15-k}{14}$ where k is 4, 5 or 6 oe If 0 scored, **SC1** for $\frac{148}{225}$ ALTERNATIVE 2 **M3** for $\frac{5}{15}\times\frac{6}{14}\times2+\frac{5}{15}\times\frac{4}{14}\times2+\frac{6}{15}\times\frac{4}{14}\times2$ oe or **M2** for at least two of these different products added oe or **M1** for one correct product If 0 scored, **SC1** for $\frac{148}{225}$
9(a)(i)	9	**1**	
9(a)(ii)	63	**1**	**FT** (*their* **(a)(i)**)^2 – 2 × *their* **(a)(i)**
9(a)(iii)	$\frac{x+5}{2}$ oe final answer	**2**	**M1** for $x = 2y - 5$ or $y + 5 = 2x$ or $\frac{y}{2} = x - \frac{5}{2}$
9(b)	$x^2 - 18x + 35$ final answer	**4**	**M1** for $(2x - 5)^2 - 2(2x - 5) - 3(x^2 - 2x)$ **B1** for $4x^2 - 10x - 10x + 25$ **B1** for $-4x + 10 - 3x^2 + 6x$
10(a)	$3x^2 - 18x - 48$ final answer	**2**	**B1** for two correct terms or for correct answer seen then spoiled

Question	Answer	Marks	Partial Marks
10(b)	*their* $\frac{dy}{dx} = 0$ soi	**M1**	
	[3](*x* – 8)(*x* + 2) oe or $\frac{-(-18) \pm \sqrt{(-18)^2 - 4(3)(-48)}}{2 \times 3}$ oe or $3 \pm \sqrt{16 + 3^2}$	**M1**	oe $\frac{18 \pm \sqrt{900}}{6}$
	(–2, 52) (8, –448)	**B2**	**B1** for one correct pair of coordinates or for two correct values of *x*
10(c)	(–2, 52) maximum with reason and $(8, -448)$ minimum with reason and no incorrect statement	**3**	Reasons could be e.g. 1. A reasonable sketch of a positive cubic 2. Correct evaluation and use of 2nd derivative 6*x* – 18 = –30, –30 < 0, so (–2, 52) is a maximum oe. 6*x* – 18 = 30, 30 > 0 , so $(8, -448)$ is a minimum oe. 3. Evaluates correctly values of *y* on both sides of both correct stationary points 4. Finds gradient on each side of both correct stationary points. Any incorrect statement MAX B2 **B2** for 1 correct with correct reason for that stationary point or for **both** *x*-values correct and reasonable sketch of a positive cubic or for correct substitution and evaluation of **both** of *their x*-values into *their* second derivative or substitution and evaluation for one *x*-value on both sides of **both** of *their* stationary points to find the gradients soi or **M1** for showing [2nd derivative =] 6*x* – 18 or correct FT *their* 2nd derivative from part **(a)** or substitution and evaluation shown for one *x*-value on both sides of **one** of *their* stationary points to find the gradients soi or for sketch of any positive cubic.

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