Pearson Edexcel

Mark Scheme (Results)

November 2023

Pearson Edexcel International GCSE
In Mathematics B (4MB1) Paper 02

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Types of Mark

- M marks: method marks
- A marks: accuracy marks – can only be awarded when relevant M marks have been gained
- B marks: unconditional accuracy marks (independent of M marks)

Abbreviations

- cao – correct answer only
- cso – correct solution only
- ft – follow through
- isw – ignore subsequent working
- SC – special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- awrt – answer which rounds to
- eeoo – each error or omission
- cas – Correct answer scores full marks (unless from obvious incorrect working)
- wr – working required

No working

If no working is shown then correct answers may score full marks
If no working is shown then incorrect (even though nearly correct) answers score no marks.

With working

If it is clear from the working that the “correct” answer has been obtained from incorrect working, award 0 marks.

If a candidate misreads a number from the question: eg. uses 252 instead of 255; follow through their working and deduct 2A marks from any gained provided the work has not been simplified. (Do not deduct any M marks gained.)

If there is a choice of methods shown, then award the lowest mark, unless the subsequent working makes clear the method that has been used

Examiners should send any instance of a suspected misread to review (but see above for simple misreads).

Ignoring subsequent work

It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: e.g., incorrect cancelling of a fraction that would otherwise be correct.

It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect e.g., algebra.

Parts of question

Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

Question		Working	Answer	Mark	Notes
1	(a)		3 300 000	1	B1
	(b)		5×10^5	1	B1
	(c)	$1.5\times10^7 - 2.9\times10^6$		2	M1 Allow for 1.21×10^n where n = 6 or 7
			1.21×10^7		A1cas condone a correct answer not in standard form eg 12 100 000 or 12.1×10^6 ISW
	(d)	$k = \dfrac{3.1\times10^8}{5.0\times10^7}$		2	M1 Allow for 0.62×10^n where n = 8 or 7 or 15
			6.2		A1cas allow $\dfrac{31}{5}$
	(e)	$\sqrt{\dfrac{8.9\times10^6}{\pi}}$ or $\dfrac{8.9\times10^6}{\pi}$		2	M1 for a correct expression for r or r^2 Allow 3.1, 3.14, etc or $\dfrac{22}{7}$ for π NB $\left[r^2 =\right]$awrt 2.83×10^6
			1700		A1cas awrt 1700 oe eg 1.7×10^3 ISW
	(f)	4^{-2} or 10^{-12n}		3	M1 for $\dfrac{1}{4^2}$ or $\dfrac{1}{10^{12n}}$ or $\dfrac{1}{16}$ May be embedded.
		eg $4^{-2}\times10^{-12n}$ or 0.0625×10^{-12n} or $\dfrac{1}{\left(16\times10^{12n}\right)}$ or $\dfrac{10^{-12n}}{16}$			M1 for a correct answer in any form with $\left(10^{6n}\right)^{-2}$ replaced with 10^{-12n} or $\left(10^{6n}\right)^2$ replaced with 10^{12n}. This implies the first M1 ISW
			$6.25\times10^{-12n-2}$		A1 cas
					Total 11 marks

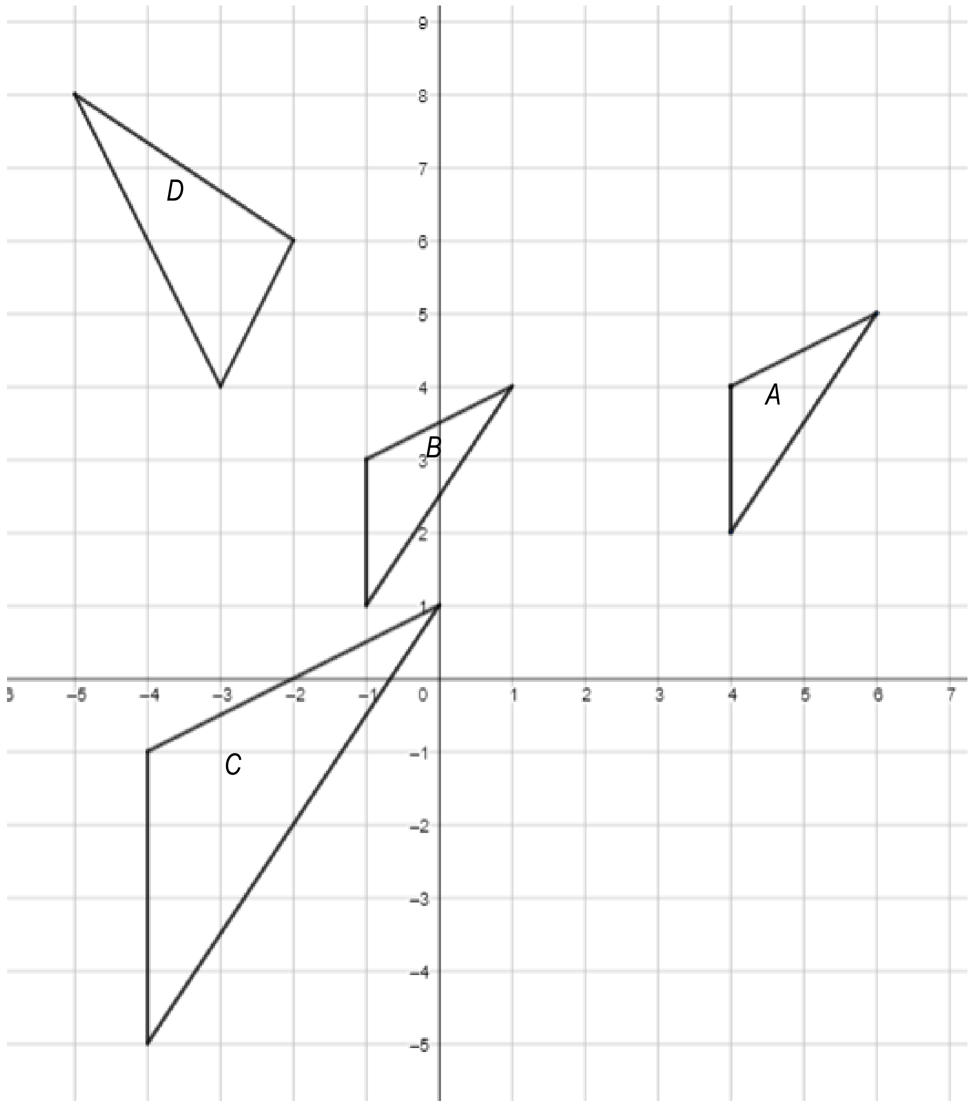
Question		Working	Answer	Mark	Notes
2		$6x+2y-10=3x+y+1$ **or** $2x+9y-14=5x+5y-9$		6	M1 for equating one pair of sides
		$3x+y=11$ oe $3x-4y=-5$ oe			M1 equating both pairs of sides (at least one equation simplified and correct) condone one incorrect term in total. Implied by eg $2x+9(11-3x)-14=5x+5(11-3x)-9$ oe
		$3x+y=11$ $(-)3x-4y=-5$ $5y=16$ **or** $12x+4y=44$ $(+)3x-4y=-5$ $15x=39$ **or** $y=11-3x$ **and** $3x-4(11-3x)=-5$ **or** $x=\frac{11-y}{3}$ **and** $3\left(\frac{11-y}{3}\right)-4y=-5$ **or** $x=\frac{4y-5}{3}$ **and** $3\left(\frac{4y-5}{3}\right)+y=11$ **or** $y=\frac{3x+5}{4}$ **and** $3x+\frac{3x+5}{4}=11$			M1 Dependent on the 1st and 2nd M being awarded. First stage of method to eliminate one variable-allow one error only in multiplication or one sign error with intention to add or subtract as appropriate **or** a correct substitution of *x* or *y*. This may be into a correct non-simplified equation eg $2x+9(11-3x)-14=5x+5(11-3x)-9$ This may implied by y = 3.2 or $\frac{16}{5}$ or x = 2.6 or $\frac{13}{5}$
		$16x+17y-32$ oe			M1 Finding perimeter in terms of *x* or *y* or *x* and *y* Allow with their *x* value and/or their *y* value if working shown eg $16\times"2.6"+17\times(11-3\times"2.6")-32$ The un-Simplified perimeter is $6x+2y-10+3x+y+1+2x+9y-14+5x+5y-9$ This may be implied by a correct perimeter in terms of *x* or *y* only
		eg $x=\frac{11-"3.2"}{3}$ or $y=11-3\times"2.6"$ **or** $16x+17(11-3x)-32$ **or** $16\left(\frac{11-y}{3}\right)+17y-32$ oe			M1 fully correct method to find the second variable using their first variable or starting again. Allow use of "their simplified equation" or any correct equation **or** for a correct perimeter in terms of *x* or *y* only
			64		A1 cas
					Total 6 marks

Question		Working	Answer	Mark	Notes
3	(a)		12,13,14,15	1	B1
	(b)		16, 17, 18, 19, 20	1	B1
	(c)	7,8,9,10,11,12,13,14,15,16,17,18,19,20		2	M1 Finding $A \cup B$ ignore any incorrect set notation
			6, 21		A1 cas
					Total 4 marks

Question		Working		Answer	Mark	Notes
4	(a)	$y = 10y^{-1} - 3$ or $x^{\frac{2}{3}} = 10 - 3x^{\frac{1}{3}}$			2	M1 replacing $x^{\frac{1}{3}}$ by y in both terms to form a correct equation. Allow equivalent eg $y = \frac{10}{y} - 3$ or $y - 10y^{-1} + 3 = 0$ **or** for removing the $x^{-\frac{1}{3}}$ to gain a correct equation in terms of x eg $x^{\frac{1}{3}}(x^{\frac{1}{3}} + 3) = 10$ This may be implied by eg $x^{\frac{2}{3}} + 3y = 10$ or $x^{\frac{1}{3}}\left(y+3\right) = 10$
			$y = \frac{10}{y} - 3 \Rightarrow y^2 + 3y - 10 = 0$ **or** $y^2 = 10 - 3y \Rightarrow y^2 + 3y - 10 = 0$ **or** $y\left(y+3\right) = 10 \Rightarrow y^2 + 3y - 10 = 0$			A1 wr dep on M1. For both $x^{\frac{1}{3}}$ replaced by y to form a correct equation leading to the given equation with no errors.
ALT		$x^{\frac{2}{3}} + 3x^{\frac{1}{3}} - 10\left[=0\right]$				M1 For substituting $y = x^{\frac{1}{3}}$ into $y^2 + 3y - 10$
			$x^{\frac{1}{3}}\left(10x^{-\frac{1}{3}} - 3 + 3\right) - 10 \Rightarrow 10 - 10 = 0$			A1 For taking out the $x^{\frac{1}{3}}$ as a factor and substituting $10x^{\frac{1}{3}} - 3$ for $x^{\frac{1}{3}}$ leading to zero with no errors.
	(b)(i)	$\left(y+5\right)\left(y-2\right)$			2	M1 If factorising must expand to give at least two correct terms for their quadratic. If using quadratic formula then must be correct substitution (condone missing brackets around the b in b^2) If using completing the square, allow one numerical or sign error
				2, −5		A1 cas Do not accept un-simplified values but award if seen in (ii)
	(ii)	$x = 2^3$ or $x = \left(-5\right)^3$			2	M1 for cubing at least 1 of their y values. If y values incorrect, we need to see the cube
				8, −125		A1 cas ignore any y values given
						Total 6 marks

Question		Working	Answer	Mark	Notes
5	(a)	1525, 1475, 12.5, 11.5, 7.985, 7.975		4	B1 for one correct UB or LB stated or used
		$[V=]\dfrac{1475}{7.985}$ or $[V=]12.5^2h$			M1 Correct method to find the volume using $V=\dfrac{m}{d}$ where ($1475\leqslant m\leqslant 1525$ **and** $7.975\leqslant d\leqslant 7.985$) **or** using $V=s^2h$ where $11.5\leqslant s\leqslant 12.5$ May be implied by use of $d=\dfrac{m}{hs^2}$ or $h=\dfrac{m}{ds^2}$ or $h=\dfrac{V}{s^2}$ where ($11.5\leqslant s\leqslant 12.5$, m and d any value) **or** where ($1475\leqslant m\leqslant 1525$ **and** $7.975\leqslant d\leqslant 7.985$, s any value) **or** where ($11.5\leqslant s\leqslant 12.5$ and V is any value)
		$\left[h=\dfrac{m}{ds^2}=\right]\dfrac{1475}{7.985\times 12.5^2}$ or $7.985=\dfrac{1475}{h\times 12.5^2}$			M1 Correct method/equation to enable h to be found where $7.98<d\leqslant 7.985$ and $1475\leqslant m<1500$ and $12<s\leqslant 12.5$ This implies the first M mark.
			1.2		A1wr awrt 1.2 working must be shown and the correct calculation with correct bounds seen. NB An answer of 1.2 with no working gains no marks
	(b)	$2(s^2+2s\times h)$ **or** $2\times s^2+4\times s\times h$ oe		3	M1 for a correct expression in 2 variables. If the correct expression is not seen allow if consistent positive values are used for s and h
		$2(12.5^2+2\times 12.5\times 2.35)$ or $2\times 12.5^2+4\times 12.5\times 2.35$			M1 allow $12.5\leqslant s<13$ and $2.35\leqslant h<2.4$
			430		A1wr working must be shown and the correct calculation with correct bounds seen. Allow 430.0 NB An answer of 430 with no working gains no marks
					Total 7 marks

Question		Working	Answer	Mark	Notes
6	(a)		$15 < t \leqslant 25$	1	B1 condone < for $\leqslant$ and $\leqslant$ for <
	(b)	$7.5\times15+20\times21+27.5\times20+35\times8+50[\times1][=1412.5]$		4	M2 for at least 3 correct products using midpoints with intention to add. Allow 112.5 + 420 + 550 + 280 + 50 or seeing 1412.5 (M1 for at least 3 products using frequency and a value within the interval with the intention to add. (condone use of lower class bound) **or** for at least 3 correct products using midpoints without adding)
		$\frac{\text{"1412.5"}}{65}$			M1 dep on at least M1 previously scored. For dividing their sum by 65
			21.7		A1cas must have 21.7 as their final answer. However if 21.7 seen condone further rounding to 22
	(c)		$\frac{9}{65}$	1	B1 awrt 0.14
	(d)	Fd for 5 – 10 class = 3 **or** 1 small square = 0.05 **or** 1 medium square = 1.25 **or** 1 large square = 5 **or** [freq for $10 < t \leqslant 15 =$] $\frac{15}{1.2}\times0.8$		3	M1 finding fd oe eg 12 medium square = 15 Implied by a frequency of 6, 14, 20 or 10 seen Any fd / frequency may be seen in the correct place on the histogram
		[Number > 3=] $10\times2+15+2\times5$ **or** $65-6\times1-7\times2$ $(10\times40+25\times12+25\times8)\times\text{"0.05"}$ **or** $65-(5\times24+10\times28)\times\text{"0.05"}$ $(8\times2+5\times2.4+5\times1.6)\times\text{"1.25"}$ **or** $65-(1\times4.8-2\times5.6)\times\text{"1.25"}$ $(4\times1+1.2\times2.5+0.8\times2.5)\times\text{"5"}$ **or** $65-(0.5\times2.4+1\times2.8)\times\text{"5"}$			M1 Correct method ft their fd eg for fd $\frac{\text{"3"}}{2.4}\times8\times2+15+\frac{\text{"3"}}{2.4}\times1.6\times5$
			45		A1cas
					Total 9 marks



D
A
B
C

Question		Working	Answer	Mark	Notes
7	(a)	Translation or $\begin{pmatrix}-5\\-1\end{pmatrix}$		2	M1 If multiple transformations given award M0. Multiple transformation are when more than one of reflection, rotation (turn), translation(move), enlargement(stretch/squash) is stated. Giving an equation of a line, SF, vector does not count as multiple transformations
			Translation $\begin{pmatrix}-5\\-1\end{pmatrix}$		A1
	(b)		Triangle C drawn	3	B3 (0, 1) (−4, −1)(−4, −5) plotted and triangle drawn (B2 2 points plotted correctly B1 correct enlargement from any centre)
	(c)		$4x$	1	B1
	(d)	$3\times4-5\times2=2y-(-1\times-2)$		5	M1 ISW for using the determinant to set up an equation. eg $2y-2=2$ We will condone 1 sign error eg $2y+2=2$
		$y=\dfrac{3\times4-5\times2+(-1\times-2)}{2}[=2]$			M1 rearranging to find a correct expression or value for y
		$\begin{pmatrix}\text{"2"} & -1\\-2 & 2\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\1 & 3 & 4\end{pmatrix}$			M1 Correct order of multiplication using their y. The points can be in any order
		$\begin{pmatrix}-3 & -5 & -2\\4 & 8 & 6\end{pmatrix}$			M1 dep on previous M1 for multiplying out to give a 2×3 matrix with at least 2 correct entries. The points can be in any order. Allow if two points plotted correctly
			Triangle *D* plotted		A1cas (−3, 4) (−5, 8) (−2, 6)
					Total 11 marks

Question		Working	Answer	Mark	Notes
8	(a)		1, −8, 1	2	B2 all 3 correct (B1 for 2 correct)
	(b)			2	B2 Fully correct graph. (B1 All points plotted correctly or at least 4 points plotted correctly with a smooth curve joining them. Do not ft any incorrect values)
	(c)	Draw the line $y=-2x+1$		3	M1 Line should touch the curve or go through the curve at both ends allow plus or minus one small square
			−1.4, 3.4		A2 dep on line drawn allow ± 0.2 (A2 for both, A1 for one) ignore any y values given. May be seen written on the graph.
	(d)	A clear tangent drawn		2	M1 Accept a hand drawn line with the intention for it to be drawn so it touches the curve once at x = -1
			− 6		A1 dep on tangent drawn. Allow ± 1
					Total 9 marks

Question		Working	Answer	Mark	Notes
9	(a) (i)		$4\mathbf{a}-2\mathbf{b}$	4	B1
	(ii)		$-4\mathbf{a}+3\mathbf{b}$		B1
	(iii)	$4\mathbf{a}+\frac{1}{2}(\text{"}-4\mathbf{a}+3\mathbf{b}\text{"})$ or $3\mathbf{b}-\frac{1}{2}(\text{"}-4\mathbf{a}+3\mathbf{b}\text{"})$			M1
			$2\mathbf{a}+\frac{3}{2}\mathbf{b}$		A1 cas allow $\frac{1}{2}(4a+3b)$
	(b)	$\left[\overrightarrow{CE}=\overrightarrow{CO}+\overrightarrow{OE}=\right]-2\mathbf{b}+\beta\left(\text{"}\mathbf{2a}+\frac{3}{2}\mathbf{b}\text{"}\right)$		4	M1 A correct method for $\overrightarrow{CE}$ (not using $\overrightarrow{CE}=\lambda\overrightarrow{CA}$**)** ft their $\overrightarrow{OD}$ (see alternative 1, 2 and 3) Allow finding $\overrightarrow{OE}$ or $\overrightarrow{CO}$ (see alternative 4 and 5)
		$\overrightarrow{CE}=\lambda(\text{"}4\mathbf{a}-2\mathbf{b}\text{"})$ leading to $\text{"}4\text{"}\lambda=\text{"}2\text{"}\beta$ **or** $-\text{"}2\text{"}\lambda=-2+\text{"}\frac{3}{2}\text{"}\beta$ oe			M1 equating coefficients using $\overrightarrow{CE}$ or $\overrightarrow{OE}$ or $\overrightarrow{CO}$ for **a** or **b** ft their part(a)
		$\text{"}4\text{"}\lambda=\text{"}2\text{"}\beta$ **and** $-\text{"}2\text{"}\lambda=-2+\text{"}\frac{3}{2}\text{"}\beta$ oe			M1 dep on the previous 2 M marks awarded . For **a** and **b** to gain 2 equations each with 2 parameters. ft their 2 vectors $\overrightarrow{CE}$ or $\overrightarrow{OE}$ or $\overrightarrow{CO}$
			$\frac{2}{5}$		A1cas Allow written as $\overrightarrow{CE}=\frac{2}{5}\overrightarrow{CA}$
	(c)	SF = $\frac{3}{2}$ or SF = $\frac{2}{3}$		4	B2 stating or using the SF eg $\frac{AP}{OC}=1.5$ or $\frac{OC}{PA}=\frac{2}{3}$ ft their lambda or $\frac{3}{2}\times 8$ or $\left(\frac{3}{2}\right)^2\times 8$ or $k\times\frac{2}{3}=8$ or $k\times\left(\frac{2}{3}\right)^2=8$ seen (B1 CE : EA = 2 : 3 ft their lambda oe) May be implied by an area of 12 or 18
		$8\times\left(\text{"}\frac{3}{2}\text{"}\right)^2$ or $k\times\left(\text{"}\frac{2}{3}\text{"}\right)^2=8$			M1 condone $8\times(5)^2$ or any combinations of letter(s) for k eg ADP
			18		A1cas do not ISW This must be their final answer or clearly labelled as APE
					Total 12 marks

	Alternative 1 $\overrightarrow{CE}=\overrightarrow{CB}+\overrightarrow{BD}+\overrightarrow{DE}$	Alternative 2 $\overrightarrow{CE}=\overrightarrow{CA}+\overrightarrow{AD}+\overrightarrow{DE}$	Alternative 3 $\overrightarrow{CE}=\overrightarrow{CB}+\overrightarrow{BA}+\overrightarrow{AO}+\overrightarrow{OE}$
M1	$\overrightarrow{CE}=\mathbf{b}-\frac{1}{2}(\text{"}-4\mathbf{a}+3\mathbf{b}\text{"})-\beta\left(\text{"}2\mathbf{a}+\frac{3}{2}\mathbf{b}\text{"}\right)$	$\overrightarrow{CE}=\text{"}-2\mathbf{b}+4\mathbf{a}\text{"}+\frac{1}{2}(\text{"}3\mathbf{b}-4\mathbf{a}\text{"})+\beta\left(\text{"}-2\mathbf{a}-\frac{3}{2}\mathbf{b}\text{"}\right)$	$\overrightarrow{CE}=\mathbf{b}-(\text{"}-4\mathbf{a}+3\mathbf{b}\text{"})-\delta\left(\text{"}2\mathbf{a}+\frac{3}{2}\mathbf{b}\text{"}\right)$
M1	$\overrightarrow{CE}=\lambda(\text{"}4\mathbf{a}-2\mathbf{b}\text{"})$ leading to $\text{"}4\text{"}\lambda=\text{"}2\text{"}-\text{"}2\text{"}\beta$ **or** $-\text{"}2\text{"}\lambda=\text{"}1\text{"}-\text{"}\frac{3}{2}\text{"}-\text{"}\frac{3}{2}\text{"}\beta$	$\overrightarrow{CE}=\lambda(\text{"}4\mathbf{a}-2\mathbf{b}\text{"})$ leading to $\text{"}4\text{"}\lambda=4+\text{"}-2\text{"}-\text{"}2\text{"}\beta$ **or** $-\text{"}2\text{"}\lambda=-2+\text{"}\frac{3}{2}\text{"}-\text{"}\frac{3}{2}\text{"}\beta$	$\overrightarrow{CE}=\lambda(\text{"}4\mathbf{a}-2\mathbf{b}\text{"})$ leading to $\text{"}4\text{"}\lambda=\text{"}2\text{"}\delta$ **or** $-\text{"}2\text{"}\lambda=\text{"}1\text{"}-\text{"}3\text{"}+\text{"}\frac{3}{2}\text{"}\delta$
M1	$\text{"}4\text{"}\lambda=\text{"}2\text{"}-\text{"}2\text{"}\beta$ **and** $-\text{"}2\text{"}\lambda=\text{"}1\text{"}-\text{"}\frac{3}{2}\text{"}-\text{"}\frac{3}{2}\text{"}\beta$	$\text{"}4\text{"}\lambda=4+\text{"}-2\text{"}-\text{"}2\text{"}\beta$ **and** $-\text{"}2\text{"}\lambda=-2+\text{"}\frac{3}{2}\text{"}-\text{"}\frac{3}{2}\text{"}\beta$	$\text{"}4\text{"}\lambda=\text{"}2\text{"}\mu$ **and** $-\text{"}2\text{"}\lambda=\text{"}1\text{"}-\text{"}3\text{"}+\text{"}\frac{3}{2}\text{"}\gamma$
A1	$\frac{2}{5}$	$\frac{2}{5}$	$\frac{2}{5}$

	Alternative 4 Using $\overrightarrow{OE}$	Alternative 5 Using $\overrightarrow{CO}$	
M1	$\overrightarrow{OE}=\kappa\left(\text{"}2\mathbf{a}+\frac{3}{2}\mathbf{b}\text{"}\right)$	$\overrightarrow{CO}=\overrightarrow{CE}-\eta\left(\text{"}2\mathbf{a}+\frac{3}{2}\mathbf{b}\text{"}\right)$	
M1	$\overrightarrow{OE}=\lambda(\text{"}4\mathbf{a}-2\mathbf{b}\text{"})+2\mathbf{b}$ leading to $\text{"}4\text{"}\lambda=\text{"}2\text{"}\kappa$ **or** $-\text{"}2\text{"}\lambda+2=\text{"}\frac{3}{2}\text{"}\kappa$	$\overrightarrow{CE}=\lambda(\text{"}4\mathbf{a}-2\mathbf{b}\text{"})$ and $\overrightarrow{CO}=-2\mathbf{b}$ leading to $\text{"}4\text{"}\lambda=\text{"}2\text{"}\eta$ **or** $-2=\text{"}-2\text{"}\eta-\text{"}\frac{3}{2}\text{"}\eta$	
M1	$\text{"}4\text{"}\lambda=\text{"}2\text{"}\kappa$ **and** $-\text{"}2\text{"}\lambda+2=\text{"}\frac{3}{2}\text{"}\kappa$	$\text{"}4\text{"}\lambda=\text{"}2\text{"}\eta$ **and** $-2=\text{"}-2\text{"}\eta-\text{"}\frac{3}{2}\text{"}\eta$	
A1	$\frac{2}{5}$	$\frac{2}{5}$	

Question		Working	Answer	Mark	Notes
10	(a)	[Area $BCHG$] $=\frac{3}{2}(1.5+2.4)[=5.85]$ oe		2	M1 Correct method for area of trapezium eg $3\times1.5+0.5\times3\times(2.4-1.5)$ May be seen as part of a volume calculation.
			23.4		A1 cas
	(b)	$[DB=]\sqrt{4^2+3^2}$ [=5]		3	M1 Finding the diagonal or $[GE=]\sqrt{4^2+3^2+0.9^2}\left[=\sqrt{25.81}=5.08...\right]$ Condone incorrect labelling
		$\tan\theta=\frac{2.4-1.5}{\sqrt{4^2+3^2}}\left[=\frac{0.9}{5}\right]$ or oe $\tan\theta=\frac{\sqrt{4^2+3^2}}{2.4-1.5}\left[=\frac{5}{0.9}\right]$			M1 A correct eq^n eg $\cos\theta=\frac{5}{\sqrt{(4^2+3^2)+0.9^2}}$ **or** $\sin\theta=\frac{0.9}{\sqrt{(4^2+3^2)+0.9^2}}$ **or** $\cos\theta=\frac{\sqrt{4^2+3^2+0.9^2}}{\sqrt{4^2+3^2}}$ **or** $\sin\theta=\frac{\sqrt{4^2+3^2+0.9^2}}{0.9}$ **or** $\cos\theta=\frac{(4^2+3^2)+(4^2+3^2+0.9^2)-0.9^2}{2\times5\times\sqrt{(4^2+3^2+0.9^2)}}$ **or** $\cos\theta=\frac{0.9^2+\text{"25.81"}-5^2}{2\times0.9\times\sqrt{\text{"25.81"}}}$
			10.2		A1cas awrt 10.2 **NB** an answer that is awrt 79.8 gains 2 marks
	(c)	$\sqrt{4^2+3^2+2.4^2}$ or $\sqrt{5^2+2.4^2}$		2	M1 Correct method to find AH
			5.55		A1cas awrt 5.55
	(d)	$PQ=1.5+\frac{2}{3}\times(2.4-1.5)[=2.1]$		4	M1 using similar triangles to find PQ eg $PQ=2.4-\frac{1}{3}\times(2.4-1.5)[=2.1]$ — Both PQ and AQ May be seen as part of $AP=\sqrt{4^2+2^2+2.1^2}$ or implied by $AP=\sqrt{24.41}[=4.94...]$
		$AQ=\sqrt{4^2+2^2}\left[=\sqrt{20}=2\sqrt{5}=4.47...\right]$			M1 Fully correct method to find AQ.
		Tan $APQ\left[=\frac{AQ}{PQ}\right]=\frac{4.47...}{2.1}$ oe			M1 dep on the previous M marks being awarded. We will not ft any values for this mark, they must be correct to 1 dp. Correct method to find $\angle APQ$ eg $\sin\theta\left[=\frac{AQ}{AP}\right]=\frac{\sqrt{20}}{\sqrt{20+2.1^2}}$ or $\cos\theta\left[=\frac{PQ}{AP}\right]=\frac{2.1}{\sqrt{20+2.1^2}}$ $\cos APQ\left[=\frac{AP^2+PQ^2-AQ^2}{2\times AP\times PQ}\right]=\frac{24.41+2.1^2-20}{2\times\sqrt{24.41}\times2.1}$
			64.8		A1cas awrt 64.8 Only allow awrt 65 from correct working
					Total 11 marks

Question		Working	Answer	Mark	Notes
11	(a)		2	1	B1
	(b)	$4x+3$		3	M2 Correct differentiation (M1for one term correct)
			-0.75		A1cas
	(c)		-3	1	B1 for – 3 Allow $x=-3$ or $x\neq-3$
	(d)	$\left[\mathrm{g}(5)=\right]2.5$ **or** $\mathrm{fg}(x)=2\left(4-\frac{x+7}{x+3}\right)^2+3\left(4-\frac{x+7}{x+3}\right)$ oe		2	M1 finding g(5) or fg(x)
			20		A1 cas
For (e) award method marks for which ever method will give the highest mark					
	(e)	$\mathrm{h}(x)=\mathrm{g}^{-1}\left(\frac{3x-4}{x-1}\right)$		7	M1 for $\mathrm{g}^{-1}\left(\frac{3x-4}{x-1}\right)$ Implied by subst into their $\mathrm{g}^{-1}(x)$
		$y(x+3)=4(x+3)-(x+7)$ **or** $x(y+3)=4(y+3)-(y+7)$			M1 for 1st step to find $\mathrm{g}^{-1}(x)$ eg $x(y+3)=3y+5$ Condone missing brackets around $(x+7)$ or $(y+7)$ eg $x(y+3)=3y+19$
		$x(y-4+1)=12-7-3y$ or $x(y-3)=5-3y$ **or** $y(x-4+1)=12-7-3x$ or $y(x-3)=5-3x$			M1 collecting x (y) terms on one side and factorising. Allow 1 error in correct equation eg $x(y-3)=19-3y$ May be implied
		$[x=]\frac{5-3y}{y-3}$ **or** $[y=]\frac{5-3x}{x-3}$			M1 rearranging to get $[x=]\frac{a-by}{y-c}$ … or $[y=]\frac{a-bx}{x-c}$ … where 2 of a,b and c are correct. oe This implies the 2nd and 3rd M1
		$\dfrac{5-3\left(\frac{3x-4}{x-1}\right)}{\left(\frac{3x-4}{x-1}\right)-3}$			M1 Subst $\frac{3x-4}{x-1}$ into their $\mathrm{g}^{-1}(x)$ Allow any letter
		$\dfrac{5(x-1)-3(3x-4)}{(3x-4)-3(x-1)}$			M1 dep on 4th and 5th M mark being awarded. For removing the embedded fractions correctly
			$\left[\mathrm{h}(x)=\right]4x-7$		A1wr dependent on at least 5 method marks being awarded. For $4x-7$ Must be in terms of x

Alternative					
Allow the use of any letters					
	(e)	$4-\frac{h+7}{h+3}=\frac{3x-4}{x-1}$			M1 for equating g(y) to gh(x) Condone the same letter on each side for this mark only
		$\frac{4(h+3)-(h+7)}{h+3}=\frac{3x-4}{x-1}$			M1 for making a single fraction of the LHS Condone missing brackets around $(h+7)$ Different variables required on each side. Allow any 2 letters
		$\frac{(3h+5)(x-1)}{h+3}=3x-4$ oe **or** $(3h+5)=\frac{(3x-4)(h+3)}{x-1}$ oe **or** $4(x-1)-\frac{(h+7)(x-1)}{h+3}=3x-4$ $4(h+3)-(h+7)=\frac{(3x-4)(h+3)}{x-1}$ **or**			M1 multiplying all terms by $(x-1)$ or $(h+3)$ Different variables required on each side. Allow any 2 letters eg $\frac{(3h+19)(x-1)}{h+3}=3x-4$ or $(3h+19)=\frac{(3x-4)(h+3)}{x-1}$ NB A correct expression here will imply the 2nd method mark
		$(3h+5)(x-1)=(3x-4)(h+3)$ or $4(x-1)(h+3)-(h+7)(x-1)=(3x-4)(h+3)$			M1 for multiplying all terms by $(x-1)$ and $(h+3)$
		$3hx-3h+5x-5=3hx-4h+9x-12$			M1 dep on 4th M mark being awarded. multiplying out the brackets. Allow one error only.
		$3hx-3hx-3h+4h=9x-12-5x+5$			M1 dep on 5th M mark being awarded. Collecting the terms in h on one side.
			$[h(x)=]4x-7$		A1 dep on at least 5 M marks being awarded. For $4x-7$. Must be in terms of x
					Total 14 marks

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