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Mark Scheme (Results)

Summer 2023

Pearson Edexcel International GCSE
In Mathematics A (4MA1) Paper 2HR

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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
    - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
    - cao – correct answer only
    - ft – follow through
    - isw – ignore subsequent working
    - SC – special case
    - oe – or equivalent (and appropriate)
    - dep – dependent

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- indep – independent
- awrt – answer which rounds to
- eeoo – each error or omission

- **No working**

  If no working is shown, then correct answers normally score full marks.

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

- **With working**

  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams) and award any marks appropriate from the mark scheme.

  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. E.g. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review. If there is a choice of methods shown, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.

  If there is no answer on the answer line, then check the working for an obvious answer.

- **Parts of question**

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

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Brackets and speech marks:

0.32 × 200 (= 64) the brackets here mean that the calculation is required for the mark and not the answer – however the answer would also secure the mark. If a student gave 0.32 × 200 = 68 they would still gain the mark as the method is correct and does not require the calculation to be correct for the award of the mark.

64 alone would also gain the mark.

200 – "146"
This shows that the calculation requires 200 minus the calculation that gave 146; if the calculation was shown but inaccurately worked out then the method mark would still be gained.

Eg 146 should have come from 0.73 × 200
If the student had given 0.73 × 200 = 156 and then given 200 – 156 this would have gained the method mark…. the 156 came from a correct calculation even though the arithmetic was incorrect.

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International GCSE Maths				
Apart from questions 16, 21, 23, 24 and 25 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Q	**Working**	**Answer**	**Mark**	**Notes**
1 (a)	25 ± ……. **or** ……. – 12 **or** $(-5)^2 - 4 \times 3$ or $(-5)^2 - 4(3)$ or $-5 \times -5 - 4 \times 3$ or $-5 \times -5 - 4(3)$		2	M1 for either 25 or –12 in the correct place **or** the correct substitution shown with brackets around –5
	Correct answer scores full marks (unless from obvious incorrect working)	13		A1 (M0A0 for −37 without any working)
(b)	$x^2 + 5x - 7x - 35$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $x^2 - 2x \ldots$ **or** for $\ldots -2x - 35$
	Correct answer scores full marks (unless from obvious incorrect working)	$x^2 - 2x - 35$		A1 oe Ignore solutions/roots if correct expansion seen
				Total 4 marks

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<table>
<tr><td>2</td><td>9, 18, 27, 36 and 12, 24, 36
or 36
or a multiple of 36
or
(9 × 12 =) 108
or
$3^2 \times 4$ (= 36) (from Venn diagram or table)</td><td></td><td>4</td><td>M1 for at least two multiples of 9 and 12
or
36
or
a multiple of 36</td></tr>
<tr><td></td><td>“4” × 7.6(0) or “3” × 4.8(0) or
“30.4” or “14.4” or
“4n” × 7.6(0) or “3n” × 4.8(0)</td><td></td><td></td><td>M1 for a correct method to find the cost of 4 or 8 or 12 etc of packets of pens
or
3 or 6 or 9 etc packets of pencils</td></tr>
<tr><td></td><td>“4” × 7.6(0) + “3” × 4.8(0)
or
“30.4” + “14.4”
or
“4n” × 7.6(0) + “3n” × 4.8(0)</td><td></td><td></td><td>M1 for a correct combination of
number of packets of pens × 7.6(0) +
number of packets of pencils × 4.8(0)
with an intention to add
eg
<table>
<tr><td>pens pencils</td><td></td></tr>
<tr><td>4 × 7.60 + 3 × 4.8 =</td><td>44.8(0)</td></tr>
<tr><td>8 × 7.60 + 6 × 4.8 =</td><td>89.6(0)</td></tr>
<tr><td>12 × 7.60 + 9 × 4.8 =</td><td>134.4(0)</td></tr>
<tr><td>16 × 7.60 + 12 × 4.8 =</td><td>179.2(0)</td></tr>
<tr><td>36 × 7.60 + 27 × 4.8 =</td><td>403.2(0)</td></tr>
<tr><td>48 × 7.60 + 36 × 4.8 =</td><td>537.6(0)</td></tr>
</table></td></tr>
<tr><td></td><td>Correct answer scores full marks (unless from obvious incorrect working)</td><td>44.8(0)</td><td></td><td>A1 allow 45 if 44.8(0) seen
allow 4480 p or pence if £ sign crossed out
M3A0 for 44.8n where n is an integer (eg 134.4(0))</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Total 4 marks</td></tr>
</table>

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3	3.3 or $\frac{33}{10}$ or $3\frac{3}{10}$ or $3\frac{18}{60}$ oe or 180 + 18 or 198 oe		3	B1 for working out the time in hours or minutes
	515 ÷ 3.3 or 515 ÷ $\frac{33}{10}$ or 515 ÷ $3\frac{3}{10}$ or $\frac{515}{"198"} \times 60$ oe			M1 Units must be consistent
	Correct answer scores full marks (unless from obvious incorrect working)	156		A1 allow 156 – 156.1 SCM1 for 515 ÷ 3.18 (= 161.9… or 162)
				Total 3 marks

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4			2	M1 for $-7n + k$ ($k \neq 45$) or $-7 \times n + k$ ($k \neq 45$) or $n \times -7 + k$ ($k \neq 45$) (k may be zero or absent or negative)
		$45 - 7n$		A1 oe eg $45 - 7 \times n$ oe or $-7 \times n + 45$ oe or $U_n = 45 - 7n$ oe or $38 - 7(n - 1)$ oe NB: award full marks for eg $x = 45 - 7n$ oe or nth term $= -7 \times n + 45$ oe or but only M1 for $n = 45 - 7n$ oe
	Correct answer scores full marks (unless from obvious incorrect working)			**Total 2 marks**

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5	$\frac{1}{2}(330+170)\times 240$ (= 60 000) oe or $\left(\frac{80\times 240}{2}\right)+(170\times 240)+\left(\frac{80\times 240}{2}\right)$ (= 60 000) oe or (2 × 9600) + 40 800 (= 60 000) oe		4	M1 for working out the area of the trapezium
	[60 000] ÷ 10 000 (= 6) or 10 000 × 6 (= 60 000)			M1 ft their area (must come from a two dimensional area) Allow $\frac{\text{their area}}{10\,000}$
	49 650 ÷ [6]			M1 dep on either previous M1 ft their number of hectares Allow $\frac{49\,650}{\text{their number of hectares}}$
	Correct answer scores full marks (unless from obvious incorrect working)	8275		A1
				Total 4 marks

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6	(a)	7 × 5 × 14 (= 490) oe **or** 7 × 14 (= 98) **and** 400 ÷ 5 (= 80)		4	M1 for working out the pay per week or pay per day
		"490" – 400 (= 90) **or** "98" – "80" (= 18) **or** "98" ÷ "80" oe **or "**490" ÷ 400 oe **or** 1.225 oe			M1
		$\frac{"90"}{400}(\times 100)(=0.225)$ oe **or** $\frac{"18"}{"80"}(\times 100)(=0.225)$ oe **or** $\frac{"98"}{"80"}\times 100(=122.5)$ oe **or** $\frac{"490"}{400}\times 100(=122.5)$ oe **or** "1.225" – 1 (= 0.225)			M1 dep on M2
		Correct answer scores full marks (unless from obvious incorrect working)	22.5		A1 oe allow 23% with M3 awarded
	(b)	E.g. 1 − 0.06 (= 0.94) or 100(%) − 6(%) (= 94(%)) or $\frac{23\,030}{94}$ (= 245) oe		3	M1
		E.g. 23 030 ÷ "0.94" or 23 030 ÷ "94" × 100 or 23 030 × 100 ÷ "94" or "245" × 100			M1
		Correct answer scores full marks (unless from obvious incorrect working)	24 500		A1
					Total 7 marks

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7	(a)		1	1	B1 cao
	(b)		-6	1	B1 Allow 3^{-6}
					Total 2 marks

8	(a)	$-4x > 17 - 9$ or $-4x > 8$ or $9 - 17 > 4x$ or $-8 > 4x$ or $\frac{9}{4} - x > \frac{17}{4}$ oe or $-\frac{9}{4} + x < -\frac{17}{4}$ oe		2	M1 for a correct first step Condone = rather than > or any other sign for this mark.
		Correct answer scores full marks (unless from obvious incorrect working)	$x < -2$		A1 oe eg $-2 > x$ (sight of correct answer in working space and just (x =) –2 on answer line gains M1 only)
	(b)		$y \geq 2$ $x \leq 6$ $y \leq x$	3	B3 for all 3 correct Allow $2 \leq y, 6 \geq x$ and $x \geq y$ B2 for 2 correct B1 for 1 correct Allow < and > signs SCB2: $y \leq 2$, $y \geq x$ and $x \geq 6$ (for all 3) Allow < and > signs
		Correct answer scores full marks (unless from obvious incorrect working)			**Total 5 marks**

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9	$\sin 32 = \frac{(BC)}{50}$ or $\cos 32 = \frac{(CD)}{50}$ or $\frac{(BC)}{\sin 32} = \frac{50}{\sin 90}$ oe or $\frac{(CD)}{\sin(90-32)} = \frac{50}{\sin 90}$ oe		6	M1
	$(BC =) 50\sin 32 (= 26.4(959...))$ or $(BC =) \sqrt{50^2 - (50\cos 32)^2} (= 26.4(959...))$ or $(BC =) \sqrt{50^2 - "42.4..."^2} (= 26.4(998...))$ or $(BC =) \frac{50}{\sin 90} \times \sin 32$ oe			M1 for finding *BC* or *AD* Can be written on the diagram
	$(CD =) 50\cos 32$ (= 42.4(024)…) or $(CD =) \sqrt{50^2 - (50\sin 32)^2} (= 42.4(024...))$ or $(CD =) \sqrt{50^2 - "26.4..."^2} (= 42.4(622...))$ or $(CD =) \frac{50}{\sin 90} \times \sin(90-32)$			M1 for finding *CD* or *BA* Can be written on the diagram
	(*r* =)"42.4(024…)" ÷ 2π (= 6.74(855…))			M1 for finding the radius of the cylinder
	(*V* =) π × "6.74(855…)"^{2} × "26.4(959…)"			M1 dep on previous M mark for the use of $\pi r^2 h$
	Correct answer scores full marks (unless from obvious incorrect working)	3790		A1 allow answers in the range 3737 – 3794 Accept answers in standard form
				Total 6 marks

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10	104 × 5 (= 520) or 127 × 7 (= 889) or $\frac{\text{m+tu+w+th+f}}{5} = 104$ oe		3	M1
	"889" – "520" – 132 or "369" – 132 or $\frac{"520"+132+x}{7} = 127$ oe or $\frac{132+x}{2} = \frac{369}{2}$ oe $652 + x = 127 \times 7$			M1 (x = Sunday)
	Correct answer scores full marks (unless from obvious incorrect working)	237		A1
				Total 3 marks

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11		$\frac{m^9k^{15}}{125}$	2	B2 oe for all 3 correct eg $125^{-1}m^9k^{15}$ or $\frac{1}{125}m^9k^{15}$ Accept a =9, b = 15 and c = 125 B1 for a quotient in the form of $\frac{m^pk^q}{r}$ or a product in the form $r^{-1}m^pk^q$ where 2 from p or q or r are correct eg $\frac{m^9k^{15}}{25}$ or $125m^9k^{15}$ Allow m^9k^{15} or $\frac{m^9}{125}$ or $125^{-1}m^9$ or $\frac{k^{15}}{125}$ or $125^{-1}k^{15}$ so long as not added to any other terms Accept two from a = 9 or b = 15 or c = 125 Accept $y125^{-1}m^9k^{15}$ or $\frac{ym^9k^{15}}{125}$ where y is constant
				Total 2 marks

12	(a)		D	1	B1 allow d
	(b)		C	1	B1 allow c
	(c)		B	1	B1 allow b
					Total 3 marks

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13	$80\,000\times\left(\frac{100+x}{100}\right)^3=80\,000+6151.25$ oe **or** $80\,000\times\left(1+\frac{x}{100}\right)^3=80\,000+6151.25$ oe **or** $80\,000\times(1+x\%)^3=80\,000+6151.25$ oe **or** $80\,000\times y^3=80\,000+6151.25$ oe **or** $\frac{80\,000+6151.25}{80\,000}$ (= 1.076…) oe **or** $\frac{86\,151.25}{80\,000}$ (= 1.076…) oe		5	M1
	$\sqrt[3]{\frac{80\,000+6151.25}{80\,000}}$ (= 1.025) oe **or** $\sqrt[3]{\text{"1.076..."}}$ (= 1.025) **or** $\left(1+\frac{x}{100}=\right)\frac{41}{40}(=1.025)$			M1
	Correct answer scores full marks (unless from obvious incorrect working)	2.5		A1 Accept answers in the range 2.4 – 2.6 from correct working NB Do not allow an answer in the range 2.4 – 2.6 if it comes from awrt 7.6% oe or 7.7% oe divided by 3 Do not accept an answer if it is in the range that comes from a simple interest method
				Total 3 marks

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14	(a)	20 20 22 23 25 26 26 27 28 29 29		3	M1 for ordering the numbers Allow one omission or error in the list
		22 and 28 identified for LQ and UQ eg 20 20 <u>22</u> 23 25 26 26 27 <u>28</u> 29 29			M1 for identifying 22 **and** 28 (22 **and** 28 implies the first M1)
		Correct answer scores full marks (unless from obvious incorrect working)	6		A1
	(b)		<u>Akari</u> and reason using IQR	1	B1 ft from part (a) Akari as the IQR is lower/smaller oe (IQR must be part of the statement) Must have a value in (a) to compare the IQRs
					Total 4 marks

15	$\sqrt[3]{\frac{27}{64}}\left(=\frac{3}{4}=0.75\right)$		3	M1 for finding the probability of a head
	$\left(1-"\frac{3}{4}"\right)^3$ or $\left(\frac{1}{4}\right)^3$ or 0.25^3			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{1}{64}$		A1 oe Accept 0.015(625) or 1.55(625)% truncated or rounded
				Total 3 marks

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16	$\frac{2\sqrt{3}}{\sqrt{3}-1}\times\frac{\sqrt{3}+1}{\sqrt{3}+1}$ or $\frac{2\sqrt{3}}{\sqrt{3}-1}\times\frac{-\sqrt{3}-1}{-\sqrt{3}-1}$		3	M1 for explicitly multiplying the numerator and the denominator by $\sqrt{3}+1$ or $-\sqrt{3}-1$
	$\frac{2\times3+2\sqrt{3}}{3-1}$ or $\frac{6+2\sqrt{3}}{3-1}$ or $\frac{6+2\sqrt{3}}{2}$ oe $\frac{-2\times3-2\sqrt{3}}{-3+1}$ or $\frac{-6-2\sqrt{3}}{-3+1}$ or $\frac{-6-2\sqrt{3}}{-2}$ oe			M1 dep on M1 (numerator expanded for 2 terms which need to be all correct and denominator may be 4 terms which need to be all correct)
	Working required	$3+\sqrt{3}$		A1 allow $\sqrt{3}+3$ (dep on M2)
				Total 3 marks

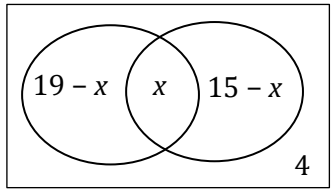
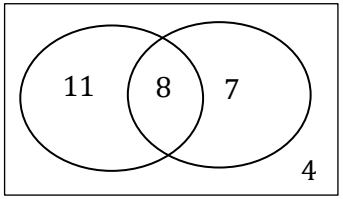
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17	$y^3 = \frac{6+5x}{x+4}$		4	M1 for removing cube root
	$xy^3 + 4y^3 = 6 + 5x$ oe **or** $x - \frac{5x}{y^3} = \frac{6}{y^3} - 4$			M1 for multiplying by denominator and expanding in a **correct** equation **or** for gathering x terms on one side and the other terms on the other side in a **correct** equation in fractional form
	$xy^3 - 5x = 6 - 4y^3$			M1 for gathering terms in x on one side and other terms the other side in a **correct** equation **or** for removing all fractions
	Correct answer scores full marks (unless from obvious incorrect working)	$x = \frac{6-4y^3}{y^3-5}$		A1 or $x = \frac{4y^3-6}{5-y^3}$ SCB2 for $x = \frac{6-4y^{\frac{1}{3}}}{y^{\frac{1}{3}}-5}$ or $x = \frac{4y^{\frac{1}{3}}-6}{5-y^{\frac{1}{3}}}$ $y^{\frac{1}{3}}$ can also be y^2
				Total 4 marks

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18	$DP \times 12 = 30 \times 14$ or $DP \times 12 = 420$ or $(DC + 12) \times 12 = 30 \times 14$ or $(DC + 12) \times 12 = 420$ or $12DC + 144 = 420$ or $DC + 12 = 35$ or $(DP) = \frac{30 \times 14}{12} (= 35)$		3	M1
	"35" – 12 or 23 + 12 = 35 or $(DC =) \frac{"420" - "144"}{12}$ or $(DC =) \frac{"276"}{12}$			M1
	Correct answer scores full marks (unless from obvious incorrect working)	23		A1
				Total 3 marks

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19	(19 + 15 + 4) – 30 or 38 – 30 or 19 + 15 – 26 or  or 19 – x + x + 15 – x + 4 = 30 oe		4	M1 for a **correct** method to find the number of people booking breakfast and dinner	M1A1 for a fully correct Venn diagram  or for $\frac{8}{30}$
	8			A1 can be shown in a Venn diagram or a valid calculation	
	$\frac{8}{30}\times\frac{7}{29}$ or $\frac{8}{30}\times\frac{8}{30}=\frac{64}{900}$ or $\frac{16}{225}$ oe			M1 for the use of $\frac{k}{30}\times\frac{k-1}{29}$ where $k < 30$ or $\frac{"8"}{n}\times\frac{"8"-1}{n-1}$ where $n > 8$	
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{435}$		A1 oe awrt 0.064 or awrt to 6.4%	
					Total 4 marks

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20	180 – 78 – 78 oe or (90 – 78) × 2 oe		2	M1 for a complete **correct** method to find angle *ABC*. This is not awarded if the angles are incorrectly labelled unless they have clearly started again (Ignore incorrect angles on the diagram if a student shows a correct method leading to the required answer)
	Correct answer scores full marks (unless from obvious incorrect working)	24		A1 award full marks if 24 is seen in the correct place on the diagram unless contradicted on the answer line
				Total 2 marks

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21	Eg $(2x+1)^2 + x(2x+1) = 7$	eg $y^2 + \left(\frac{y-1}{2}\right)y = 7$		5	M1 for substitution of $y = \pm 2x \pm 1$ (or $x = \frac{\pm y \pm 1}{2}$) into $y^2 + xy = 7$ to obtain an equation in x only (or y only)
	E.g. $6x^2 + 5x - 6 (= 0)$ $6x^2 + 5x = 6$	E.g. $3y^2 - y - 14 (= 0)$ $3y^2 - y = 14$			M1ft dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2 + bx + c$ (= 0) where at least 2 coefficients (a or b or c) are correct
	E.g. $(2x+3)(3x-2)(=0)$ or $x = \frac{-5 \pm \sqrt{5^2 - 4\times 6 \times -6}}{2\times 6}$ or $\left(x + \frac{5}{12}\right)^2 - \left(\frac{5}{12}\right)^2 = 1$ $\left(x = -\frac{3}{2} \text{ and } x = \frac{2}{3}\right)$	E.g. $(y+2)(3y-7)(=0)$ or $y = \frac{-(-1) \pm \sqrt{(-1)^2 - 4\times 3 \times -14}}{2\times 3}$ or $\left(y - \frac{1}{6}\right)^2 - \left(\frac{1}{6}\right)^2 = \frac{14}{3}$ $\left(y = -2 \text{ and } y = \frac{7}{3}\right)$			M1ft dep on first M1 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{-5 \pm \sqrt{25+144}}{12}$ **or** $\frac{1 \pm \sqrt{1+168}}{6}$ or if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for x **or** correct values for y Accept (x =) 0.6(66..) rounded or truncated or (y =) 2.3(33…)
	$y = 2\left("-\frac{3}{2}"\right) + 1 (= -2)$ **and** $y = 2\left("\frac{2}{3}"\right) + 1\left(= \frac{7}{3}\right)$	$-2 = 2x + 1$ or $x = -\frac{3}{2}$ **and** $\frac{7}{3} = 2x + 1$ or $x = \frac{2}{3}$			M1ft dep on previous M1 for substituting **their** 2 found values of x or y into one of the two given equations **or** fully correct values for the other variable (correct labels for x / y)

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		$\left(-\frac{3}{2}, -2\right)$ $\left(\frac{2}{3}, \frac{7}{3}\right)$		A1 oe dep on M2 allow $x = -1.5$, $y = -2$ $x = 0.66(6\ldots)$, $y = 2.33(3\ldots)$ truncated or rounded
	Working required			**Total 5 marks**

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22	(a)	$\sqrt{4^2+9^2+15^2}\left(=\sqrt{322}=17.9(443...)\right)$ or $\sqrt{15^2+4^2}\left(=\sqrt{241}=15.5(241...)\right)$ **and** $\sqrt{9^2+\left("\sqrt{241}"\right)^2}\left(=\sqrt{322}=17.9(443...)\right)$		2	M1
			17.9		A1 awrt 17.9
	(b)	$(UR=)\,42\tan 30$ $(=14\sqrt{3}=24.2(487\ldots))$ or $(UR=)\dfrac{42\times\sin 30}{\sin(90-30)}$ $(=14\sqrt{3}=24.2(487\ldots))$		3	M1
		$\tan(UMR)=\left(\dfrac{"24.248..."}{42\div 2}\right)$ or $\tan(UMR)=\left(\dfrac{"24.248..."}{21}\right)$ or $\tan(UMR)=\left(\dfrac{"14\sqrt{3}"}{21}\right)$ or $(UM=)\sqrt{\left(\dfrac{42}{2}\right)^2+\left("14\sqrt{3}"\right)^2}\left(=7\sqrt{21}=32.0(780...)\right)$ **and** $\sin(UMR)=\left(\dfrac{"14\sqrt{3}"}{"7\sqrt{21}"}\right)$ or $\cos(UMR)=\left(\dfrac{21}{"7\sqrt{21}"}\right)$			M1
		Correct answer scores full marks (unless from obvious incorrect working)	49.1		A1 awrt 49.1
					Total 5 marks

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23	$(7p-3)-(8p)=(4p+2)-(7p-3)$ oe or $-p-3=-3p+5$ oe or (p =) 4		5	M1 for using $U_2-U_1=U_3-U_2$ or $U_1-U_2=U_2-U_3$ Condone missing brackets around $7p-3$
	a = 32 **or** d = –7 **or** 32 25 18			A1 dep on M1 (32 and –7 may be embedded in the S_n formula or embedded in U_n formula)
	$\frac{n}{2}\left[2(32)+(n-1)(-7)\right]=-1914$			M1 The values of a and d must be correct Condone missing brackets around $n-1$
	$7n^2-71n-3828(=0)$ oe			A1 (can be implied by n = 29 and/or $n=-\frac{132}{7}$)
	Working required	29		A1 dep on M2
				Total 5 marks

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23 **ALT**	$7p - 3 = 8p + d$ $4p + 2 = 8p + 2d$ $4p + 2 = 7p - 3 + d$	$-3 = p + d$ $2 = 4p + 2d$ $5 = 3p + d$		5	M1 for using $U_n = a + (n-1)d$ to set up 2 equations for U_2 **and** U_3
	$a = 32$ **or** $d = -7$ **or** 32 25 18				A1 dep on M1 (32 and –7 may be embedded in the S_n formula or embedded in U_n formula)
	$\frac{n}{2}\left[2(32) + (n-1)(-7)\right] = -1914$				M1 The values of a and d must be correct Condone missing brackets around $n - 1$
	$7n^2 - 71n - 3828 (= 0)$ oe				A1 (can be implied by $n = 29$ and/or $n = -\frac{132}{7}$)
	Working required		29		A1 dep on M2
					Total 5 marks

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4	eg $4\pi R^2 = 9\times 4\pi r^2$ oe or		5	M1	M2 for (vol SF =) 27 or $\frac{1}{27}$ or 3^3 or $\frac{1}{3^3}$
	$R = 3r$ oe or 1:3 or 3:1 or 3 or $\frac{1}{3}$			M1 (a correct scale factor of 3 or $R = 3r$ oe implies the first M1)	
	eg $\frac{4}{3}\pi(3r)^3 - \frac{4}{3}\pi r^3 = 117\pi$ oe or $\frac{4}{3}\pi r^3 - \frac{4}{3}\pi\left(\frac{1}{3}r\right)^3 = 117\pi$ or $27\times\frac{4}{3}\pi r^3 - \frac{4}{3}\pi r^3 = 117\pi$ oe or $\frac{4}{3}\pi r^3 - \frac{1}{27}\times\frac{4}{3}\pi r^3 = 117\pi$ oe or oe			M1 for a **correct** equation based on volumes with only one variable eg R or r or x (M3 for $26\times\frac{4}{3}\pi r^3 = 117\pi$ oe or $26\times(Vol)_B = 117\pi$ or $\frac{26}{27}\times\frac{4}{3}\pi r^3 = 117\pi$ oe or $\frac{26}{27}\times(Vol)_A = 117\pi$	
	$(r =)\sqrt[3]{\frac{117\times 3}{104}}\left(=\sqrt[3]{\frac{27}{8}}\right)$ or $(R =)\sqrt[3]{\frac{117\times 81}{104}}\left(=\sqrt[3]{\frac{729}{8}} = \frac{9}{2}\right)$			M1 dep on previous M mark	
	Working required	$\frac{3}{2}$		A1 oe dep on M2	
					Total 5 marks

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25	(gradient of AB =) "$-\frac{1}{2}$" or "2"$m=-1$		6	M1 for the use of $m_1 \times m_2 = -1$ or for "$-\frac{1}{2}$" embedded in a linear equation eg $y = "-\frac{1}{2}"x + c$
	(gradient of AB =) $\frac{k-7}{6-j}$ oe **or** (midpoint of AB =) $\left(\frac{j+6}{2}, \frac{k+7}{2}\right)$ oe			M1 for a correct expression for the gradient which may be seen in an equation **or** for a correct expression for the midpoint which may be seen in an equation.
	$\frac{k-7}{6-j} = -\frac{1}{2}$ oe or $2k - j = 8$ oe **or** $\left(\frac{k+7}{2}\right) - 2\left(\frac{j+6}{2}\right) = 7$ oe or $k - 2j = 19$ oe			M1 for setting up a **correct** equation for AB in terms of gradient **or** for setting up a **correct** equation for the line given and the midpoint
	$\frac{k-7}{6-j} = -\frac{1}{2}$ oe or $2k - j = 8$ oe **and** $\left(\frac{k+7}{2}\right) - 2\left(\frac{j+6}{2}\right) = 7$ oe or $k - 2j = 19$ oe			A1 for 2 **correct** equations
	$k = -1$ **and** $j = -10$			A1 for a correct value of k **and** a correct value of j
	Working required	(−2, 3)		A1 dep on previous M1
				Total 6 marks

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26	(a)		2	1	B1 cao
	(b)		3	1	B1 cao
	(c)		1	1	B1 cao
					Total 3 marks

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