



Mark Scheme (Results)

Summer 2025

Pearson Edexcel International GCSE
In Mathematics A (4WM2H) Paper 01R

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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
- indep – independent

- awrt – answer which rounds to
- eero – 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. Eg. 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.

- **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: eg. 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 eg algebra.

Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

- **Parts of questions**

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

International GCSE Mathematics

Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.

Question	Working	Answer	Mark	Notes	
<p>1</p>	(a)	$8 < w \leq 12$	1	B1 Allow $8 - 12$ or $8 < w < 12$ or $8 \leq w \leq 12$ or $8 \leq w < 12$	
	(b)		4	<p>M2 for at least 4 correct products added (need not be evaluated)</p> <p>If not M2 then award:</p> <p>M1 for consistent use of values within the intervals (including end points) for at least 4 products using the corresponding frequencies from the given table, which must be added</p> <p>or</p> <p>correct midpoints used for at least 4 products with the corresponding frequencies from the table, and may not be added</p>	
	"660" ÷ "50"			M1	<p>dep their sum of products scoring at least M1</p> <p>Allow division by their Σf provided addition or total under column seen</p>
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>		13.2	A1	<p>Allow 13 only from correct working</p> <p>Accept $\frac{66}{5}$ or $13\frac{1}{5}$</p>
				Total 5 marks	

<p>2</p>	<p>eg $2 \times 2 \times 350$ or $2 \times 7 \times 100$ or $2 \times 5 \times 140$ or $5 \times 5 \times 56$ or $7 \times 5 \times 40$ or $(14 \times 100 = 14 \times 25 \times 4 =) 2 \times 7 \times 25 \times 4$</p>		<p>3</p> <p>M1 for finding 2 prime factors after at least 2 stages of prime factorisation with 0 incorrect stages or for finding 2 prime factors after at least 3 stages of prime factorisation with no more than 1 incorrect stage</p> <p>Each stage gives 2 factors – may be in a factor tree or a table or listed (see LHS for examples of the amount of work needed for the award of this mark) but we want to see 2 prime factors.</p> <p>Example of finding 2 prime factors after at least 3 stages with 1 incorrect stage: $1400 = 10 \times 14 = 2 \times 5 \times 2 \times 7$</p>												
	<p>eg</p> <table border="1" data-bbox="268 478 560 598"> <tr><td>2</td><td>1400</td></tr> <tr><td>2</td><td>700</td></tr> <tr><td></td><td>350</td></tr> </table>	2	1400	2	700		350	<p>eg</p> <pre> graph TD 1400 --- 2 1400 --- 700 700 --- 2 700 --- 350 350 --- 2 350 --- 350 </pre>							
2	1400														
2	700														
	350														
	<p>eg $2 \times 2 \times 2 \times 5 \times 5 \times 7$</p>		<p>M1 dep on M1 for factors 2, 2, 2, 5, 5, 7 identified with no others in any form, eg listed, multiplied, added</p> <p>Ignore 1s</p> <p>May be seen in a fully correct factor tree or ladder</p>												
	<p>eg</p> <table border="1" data-bbox="268 893 560 1133"> <tr><td>2</td><td>1400</td></tr> <tr><td>2</td><td>700</td></tr> <tr><td>2</td><td>350</td></tr> <tr><td>5</td><td>175</td></tr> <tr><td>5</td><td>35</td></tr> <tr><td></td><td>7</td></tr> </table>	2	1400	2	700	2	350	5	175	5	35		7	<p>eg</p> <pre> graph TD 1400 --- 2 1400 --- 700 700 --- 2 700 --- 350 350 --- 2 350 --- 175 175 --- 5 175 --- 35 35 --- 5 35 --- 7 </pre>	
2	1400														
2	700														
2	350														
5	175														
5	35														
	7														
	<p><i>Working required</i></p>	<p>$2^3 \times 5^2 \times 7$</p>	<p>A1 dep on M2 May be in any order and allow $2^3 \cdot 5^2 \cdot 7$</p>												
			<p>Total 3 marks</p>												

3	eg $3x + 2y = 10$ $- 3x - 4y = 16$ $(6y = -6)$ or eg $3\left(\frac{10 - 2y}{3}\right) - 4y = 16$ or $3\left(\frac{16 + 4y}{3}\right) + 2y = 10$ or $6y = -6$ oe	Eg $6x + 4y = 20$ $+ 3x - 4y = 16$ $(9x = 36)$ or eg $3x - 4\left(\frac{10 - 3x}{2}\right) = 16$ or $3x + 2\left(\frac{3x - 16}{4}\right) = 10$ or $9x = 36$ oe		3	M1 a correct method to eliminate x or y : coefficients of x or y are the same and the correct operation to eliminate is selected; if operator not written, the correct operation can be implied by 2 out of 3 terms correct Allow one arithmetic error if multiplying to equate coefficients or for a correct substitution of one variable into the other equation NB: the mark is for the method and not for the result of the method. However, if the correct result of this method is seen, the mark can be awarded
	$3x + 2 \times "-1" = 10$ or $3x - 4 \times "-1" = 16$ or $x = \frac{10 - 2 \times "-1"}{3}$ or $x = \frac{16 + 4 \times "-1"}{3}$	$3 \times "4" + 2y = 10$ or $3 \times "4" - 4y = 16$ or $y = \frac{10 - 3 \times 4}{2}$ or $y = \frac{3 \times "4" - 16}{4}$			M1 dep on M1 a correct substitution to find the value of the second variable using their value or for starting again with elimination or substitution (as above)
	<i>Working required</i>		$x = 4$ $y = -1$		A1 dep on M1
				Total 3 marks	

4	(a)		Vertices at (-4, 3) (-1, 3) (-1, 5)	2	B2 for a fully correct triangle with correct orientation and in the correct position If not B2 then B1 for a correct triangle drawn with correct orientation in wrong position or 2 or 3 points plotted correctly
	(b)	Allow eg translated translating translate Allow misspelling of the word eg transl	Translation	2	B1 for <u>translation</u> with no other transformation stated, eg reflection, rotation, enlargement, mirrored, turned or flipped, etc Move with translation is acceptable
			$\begin{pmatrix} -9 \\ 3 \end{pmatrix}$		B1 for sight of the vector $\begin{pmatrix} -9 \\ 3 \end{pmatrix}$ Do not accept alternative descriptions that combine two translations, eg left 9, up 3 Allow missing brackets but not (-9, 3)
					Total 4 marks

5	$45 \div 1.5 (= 30)$ or $5 \times 12 (= 60)$ or $\frac{64}{1.5} \left(= \frac{128}{3} = 42.6(6\dots) \right)$		5	M1 for a method to find the number of boxes needed or the cost of adhesive or cost of tiles per m ²
	“30” × 64 (= 1920) or “42.6(6...)” × 45 (=1920)			M1 for a method to find the cost of the boxes of tiles
	“1920” + “60” (= 1980) or 3000 – 1920 – 60 (=1020)			M1 for a method to find the total cost or the profit
	eg $\frac{3000 - "1980"}{"1980"} (= 0.515\dots)$ or $\frac{3000 - "1980"}{"1980"} \times 100$ or $\frac{3000}{"1980"} (= 1.515\dots)$ or $\frac{3000}{"1980"} \times 100 (= 151.5\dots)$ or $\frac{3000}{"1980"} \times 100 - 100$			M1 for a method to find the percentage profit or be one step away
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	51.5		A1 awrt 51.5 SCB3 for answer 56.3 or 56.25 (from use of 1920 instead of 1980 as total cost)
				Total 5 marks

6	(a)		8.2×10^7	1	B1 allow trailing zeroes in the mantissa
	(b)		0.000 005 8	1	B1 allow trailing zeroes
	(c)		1.6×10^{302}	1	B1 allow trailing zeroes in the mantissa
					Total 3 marks

7	$60 \times 7 (= 420)$ or $46 \times 3 (= 138)$		70.5	3	M1 may be embedded within an equation
	“420” – “138” (= 282)				M1 for a method to find the sum of the 4 numbers Allow this mark if they do further incorrect work using 282
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>				A1 allow $\frac{141}{2}$ oe eg $\frac{282}{4}$ eg $70\frac{1}{2}$
					Total 3 marks

8	$1 - 0.15 (= 0.85)$ or $100(\%) - 15(\%) (= 85(\%))$ or $\frac{612}{85} (= 7.2)$ oe		720	3	M1 may be seen embedded Do not allow $(1 - 15\%)$ unless processed correctly
	$612 \div \text{“0.85”}$ oe or $612 \div \text{“85”} \times 100$ oe or $\text{“7.2”} \times 100$				M1 for a complete method
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>				A1
					Total 3 marks

9	(a)	$3x - 8x > -40 + 22$ or $-22 + 40 > 8x - 3x$		3	M1 for a line of working with x terms and numerical terms correctly collected on opposite sides, may be unsimplified Condone = rather than $>$ or any other inequality symbol for this mark
		$-5x > -18$ or $18 > 5x$ or $-18 < -5x$ or $5x < 18$			M1 for correctly simplifying x terms and constants on opposite sides as shown opposite Condone = rather than $>$ or any other inequality symbol for this mark Implies previous M1 when this is their first step
		<i>Working required</i>	$x < \frac{18}{5}$		A1 oe dep on M1 accept $\frac{18}{5} > x$ Must have correct inequality symbol on answer line Sight of correct answer in working space and $(x =) \frac{18}{5}$ oe on answer line gains M2 only
(b)		$x \geq 2$		3	B1 oe eg $2 \leq x$
		$y \geq 1$			B1 oe eg $1 \leq y$
		$x + y \leq 6$			B1 oe eg $y \leq 6 - x$ Allow $<$ and $>$ for \leq and \geq respectively SC B2 for all symbols reversed, eg $x \leq 2, y \leq 1$ and $x + y \geq 6$ SC B1 for the correct equations of the lines stated, eg $x = 2, y = 1, x + y = 6$ (this is given)
					Total 6 marks

10	$(10 - 2) \times 180 (= 1440)$ or $8 \times 180 (= 1440)$ or $(6 - 2) \times 180 (= 720)$ or $4 \times 180 (= 720)$ or $360 \div 10 (= 36)$		5	M1 for correct method to find total interior angle of either shape, or the exterior angle of the decagon provided it is not used as an interior angle, eg in the diagram
	“1440” $\div 10 (= 144)$ or “720” $- 113 - 120 - 129 - 121 - 127 (= 110)$ or $180 - “36” (= 144)$			M1 for method to find an unknown interior angle of either shape using their value provided it is not used as an exterior angle, eg in the diagram Implies the previous M1
	“1440” $\div 10 (= 144)$ and “720” $- 113 - 120 - 129 - 121 - 127 (= 110)$			M1 for method to find the unknown interior angles in both shapes
	$360 - “144” - “110”$ or $(180 - “144”) + (180 - “110”)$ or $36 + 70$			M1 for method to find the required angle using their values
	<i>Working required</i>	106		A1 dep on M3
				Total 5 marks

11	(a)		61 – 62	1	B1
	(b)	LQ: 54 – 55 UQ: 69 – 70		2	M1 for both UQ and LQ in range or readings from 15 and 45 indicated by corresponding marks on the horizontal axis or vertical marks at the curve
		<i>If answer is in the given range, then award the marks – unless from obvious incorrect working</i>	14 – 16		A1 Accept a single value in range provided UQ and LQ within ranges opposite
	(c)	60 – [51,53] (= [7, 9]) or $\frac{[51,53]}{60} \times 100 (= [85,88.33...])$		3	M1 for using a reading from cf diagram at 75 km, in the allowed range, and subtracting this value from 60 or read the value in range and find this as a percentage of 60 Accept values in range without marks on the diagram
		[a, b] indicates an acceptable range of values			M1 use their reading in the allowed range in a method to find the required percentage
		$\frac{[7,9]}{60} \times 100 (= [11.66...,15])$ oe or $100 - \frac{[51,53]}{60} \times 100 (= [11.66...,15])$ oe			
		<i>Working required</i>	11.6 – 15		A1 dep on M1 Accept an exact 2 sf value eg 15
(d)		Alison and correct reason	1	B1 for <u>Alison</u> has a <u>lower IQR</u> Accept range or spread for IQR	
					Total 7 marks

<p>12</p>	<p> $16\,000 \times \left(1 - \frac{12}{100}\right)^2$ (= 12 390.4) or $16\,000 \times 0.7744$ (= 12 390.4) oe or $16\,000 \times \left(1 - \frac{12}{100}\right)$ (= 14 080) and "14 080" $\times \left(1 - \frac{12}{100}\right)$ (=12 390.4) oe or $\left(1 - \frac{12}{100}\right)^2$ (= 0.7744) and $\frac{11461.12}{16000}$ $\left(= \frac{4477}{6250} = 0.71632\right)$ </p>		3	<p>M1 for a method to find the value of the car after two years</p> <p>or a method to find the overall percentage multiplier after two years and the overall percentage multiplier for the three years</p> <p>May be seen embedded, eg in an equation</p> <p>Do not allow (1 – 12%) unless processed correctly</p>
	<p>Eg $\frac{"12390.4"-11461.12}{"12390.4"} (\times 100) (= 0.075)$ or $1 - \frac{11461.12}{"12390.4"} (\times 100)$ or $1 - 0.925$ (= 0.075) or $\frac{11461.12}{"12390.4"} (\times 100) (= 0.925)$ or $\frac{"0.71632"}{"0.7744"} (\times 100) (= 0.925)$ </p>			<p>M1 for a complete method to find the value of the decimal equivalent of x%</p> <p>or for a complete method to find the percentage multiplier for the third year</p> <p>May be seen embedded, eg within a correct equation rearranged to one of these equivalent forms</p>
	<p><i>Correct answer only scores full marks (unless from obviously incorrect working)</i></p>	7.5		<p>A1 oe</p> <p>SCB2 for answer –7.5</p>
				Total 3 marks

13	$1.6 \times 10^{11} \times 1.5 \times 10^8 (= 2.4 \times 10^{19})$ or $1.5 \times 10^8 \div (9.5 \times 10^{12}) (= 1.578... \times 10^{-5})$ or $9.5 \times 10^{12} \div (1.5 \times 10^8) (= 63\,333.33...)$ or $1.6 \times 10^{11} \div (9.5 \times 10^{12}) (= 0.016\,8...)$ or $9.5 \times 10^{12} \div (1.6 \times 10^{11}) (= 59.375)$		3	M1 for one of the combinations of two of the values in the question that is shown opposite Condone missing brackets without recovery for this mark only
	$"2.4 \times 10^{19}" \div (9.5 \times 10^{12})$ or $1.6 \times 10^{11} \times "1.578... \times 10^{-5}"$ or $1.6 \times 10^{11} \div "63\,333.33..."$ or $"0.0168..." \times 1.5 \times 10^8$ or $1.5 \times 10^8 \div "59.375"$ or $\frac{1.6 \times 10^{11} \times 1.5 \times 10^8}{9.5 \times 10^{12}} (= 2\,526\,315.789)$ or awrt 2 500 000			M1 dep for correctly combining their previous two-term expression, or their value for it, with the remaining value in the question (does not need to be evaluated), including necessary bracketing unless there is recovery A three-term expression written directly can score M2 but only if correct, including necessary bracketing
	<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	2.5×10^6		A1 awrt 2.5×10^6 in standard form
Total 3 marks				

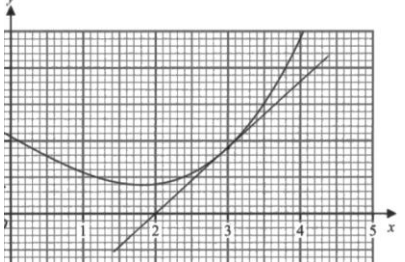
14	$7p - 3k^2p = 8k^2 + 5$		4	M1	for multiplying both sides by denominator and expanding the brackets
	$7p - 5 = 8k^2 + 3k^2p$ or $-3k^2p - 8k^2 = 5 - 7p$			M1	ft dep on 2 terms in k^2 and 2 other terms for collecting k^2 terms on one side and other terms on the other side Note: eg $8k^2 + 3k^2$ does not count as 2 terms in k^2
	eg $7p - 5 = k^2(8 + 3p)$ or $k^2(-3p - 8) = 5 - 7p$			M1ft	dep on previous M1 for correctly factorising for k^2 or $-k^2$ in their equation
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$k = (\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$		A1	oe eg $k = (\pm)\sqrt{\frac{5 - 7p}{-3p - 8}}$ or $k = (\pm)\left(\frac{7p - 5}{8 + 3p}\right)^{\frac{1}{2}}$ or $k = (\pm)\left(\frac{7p - 5}{8 + 3p}\right)^{0.5}$ (condone omission of \pm) NB to award A1 we must see $k = (\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$ in working if $(\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$ alone is given as an answer
				Total 4 marks	

<p>15</p>	<p>$ABC = 21 + 36 (= 57)$ or angle $ABO = 36$ and angle $CBO = 21$ and $21 + 36 (=57)$ or (reflex) $AOC = 360 - (21 + 21 + 36 + 36) (= 246)$ or (obtuse) $AOC = 2 \times (21 + 36) (=114)$ or $BAX = 90 - 36 (= 54)$ with the tangent at A drawn oe or $BCY = 90 - 21 (= 69)$ with the tangent at C drawn oe or angle $ADB = 180 - 90 - 36 (= 54)$ OR eg $x =$ angle ACO and $y = ABC$ and $x + x + 2y = 180$ oe and $y + (x + 36) + (x + 21) = 180$ oe or eg $180 - 2x = 2(180 - 2x - 21 - 36)$</p>		3	<p>M1 for a method to find one of the angles on the scheme; for this mark, values and calculations must be linked to the correct angle by notation or by being marked on the diagram. May also be awarded for a correct method to set up and solve an equation to find one of these angles; the variable must be clearly defined</p> <p>where X is a point on the tangent at A where Y is a point on the tangent at C where AD is a diameter</p> <p>OR for any correct pair of simultaneous equations with clearly defined variables one of which must be angle ACO</p> <p>or any correct equation in terms of ACO only</p>
	<p>$(ACO =) \frac{180 - 2 \times "57"}{2}$ or $(ACO =) \frac{180 - (360 - "246")}{2}$ or $(ACO =) \frac{180 - "57" - 21 - 36}{2}$ or $(ACO =) "54" - 21$ or $(ACO =) "69" - 36$ or $(ACO =) 90 - "57"$ OR eg $180 - 2x = 2(180 - 2x - 21 - 36) \Rightarrow x = \dots$</p>			<p>M1 for a complete method to find angle ACO OR forms a correct equation in terms of ACO only and solves to get a value (condone arithmetic errors)</p> <p>Implies the 1st M mark (provided no incorrect working seen)</p>
	<p><i>Correct answer only scores full marks (unless from obviously incorrect working)</i></p>	33		A1
Total 3 marks				

16	(a)		$-4\mathbf{a} + 4\mathbf{b}$	1	B1 oe eg $4(\mathbf{b} - \mathbf{a})$
	(b)	$4\mathbf{a} + \frac{1}{4}(-4\mathbf{a} + 4\mathbf{b})$ oe or $4\mathbf{a} + \frac{1}{4}[\overline{AB}]$ or $4\mathbf{b} - \frac{3}{4}(-4\mathbf{a} + 4\mathbf{b})$ oe or $4\mathbf{b} - \frac{3}{4}[\overline{AB}]$		2	M1ft for a correct expression ft their (a) where $[\overline{AB}]$ is their answer to (a) of the form $m\mathbf{a} + n\mathbf{b}$, $m, n \neq 0$
		<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	$3\mathbf{a} + \mathbf{b}$		A1 allow $\mathbf{b} + 3\mathbf{a}$
					Total 3 marks

17	(a)		2	1	B1 Accept $x = 2$ and $x \neq 2$ or any reasonable response that identifies 2 as the only answer, eg x cannot be 2 Do not accept 2 expressed in a range of values eg $x > 2$ or $x < 2$ or $x \geq 2$ or $x \leq 2$
	(b)	$y(x - 2) = 3x$ oe or $yx - 2y = 3x$ oe	$x(y - 2) = 3y$ oe or $xy - 2x = 3y$ oe	3	M1 multiplies by the denominator to reach a correct equation with no fraction At the first step, usually $g(x)$ is replaced by y , but y and x could also be exchanged as shown opposite Allow other symbols, eg g for y
		$x(y - 3) = 2y$ oe	$y(x - 3) = 2x$ oe		M1ft indep for correctly rearranging and factorising out their symbol for x as shown in the LHS panel opposite; the "x" must appear in two out of three terms Follow through one error in their expansion, missing brackets not recovered, or one sign error
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>		$\frac{2x}{x-3}$	A1 oe eg $\frac{-2x}{3-x}$ (must be in terms of x only) Ignore any attempts at the domain	
Total 4 marks					

18	$DP \times 6 = 12 \times 7$ oe or $(DP =) \frac{12 \times 7}{6}$ oe or $(DP =) 14$		3	M1 correct application of the intersecting chords theorem
	(radius =) $\frac{"14"+6}{2}$ (= 10) or (diameter =) "14" + 6 (= 20) or $\pi \times ("10")^2$ oe or $\pi \left(\frac{"20"}{2}\right)^2$ oe			M1 dep finds radius or diameter using their value for DP , which may be embedded in a correct formula, or use of their radius or diameter in the correct area formula
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	314		A1 awrt 314 Accept 100π
Total 3 marks				

19			3	<p>B1 attempts a tangent line drawn at $x = 3$</p> <p>Accept a straight line passing through $(3, 1.8)$, allowing for the thickness of their line, and below the curve otherwise</p> <p>May be seen as the hypotenuse in a right-angle triangle</p> <p>Be tolerant of poor artwork if the intention is clear</p>
	<p>Examples using $(2, 0)$ and $(3, 1.8)$</p> $\frac{1.8-0}{3-2} (=1.8) \text{ or } \frac{1.8}{1}$ <p>or</p> $0 = 2m + c \text{ and } 1.8 = 3m + c \Rightarrow m = (1.8)$ <p>or</p> $(1.8 - 0) = m(3 - 2) \Rightarrow m = (1.8)$			<p>M1 dep for a method to find the gradient of their tangent line to the curve at $x = 3$</p> <p>Dependent on having attempted a tangent line, for this mark only allow a straight line, to within half a square's diagonal length of $(3, 1.8)$, and approximately parallel to the true tangent line, their line may also be above the curve to within the same tolerance</p> <p>Applies $\frac{\text{difference in } y\text{-values}}{\text{difference in } x\text{-values}}$ either using two readings from their graph, or one reading and $(3, 1.8 \text{ or } 1.9)$ provided their tangent line passes through $(3, 1.8)$, at least 3 out of 4 values should be accurate ± 1 sq, or both coordinate differences accurate to ± 1 sq if coordinates not written</p> <p>Alternatively, uses these values to set up and solve two correct linear simultaneous equations leading to a value for their gradient variable, allow correct answers for their equations without working or one error in substitution or elimination, if two variables are found they must select the gradient</p>
	Working required	1.65 – 2.1		<p>A1 dep must have scored B1M1 and all readings should be accurate ± 1 sq for their tangent line</p> <p>Do not accept a tangent line equation alone</p>
Total 3 marks				

<p>20</p>	<p>eg $(2x + 3)(x - 5)$ oe</p> <p>or</p> $\frac{- -7 \pm \sqrt{(-7)^2 - 4 \cdot 2 \cdot (-15)}}{2 \cdot 2}$ oe <p>or</p> $2 \left[\left(x - \frac{7}{4} \right)^2 - \left(\frac{7}{4} \right)^2 \right] - 15$ oe		<p>3</p> <p>M1 for a correct method to find the critical values</p> <p>Minimum evidence for quadratic formula is a two-term discriminant, eg $\frac{7 \pm \sqrt{49 + 120}}{4}$ (must have the \pm)</p> <p>Allow $(x + 1.5)(2x - 10)$ as a correct factorisation, but do not allow $\left(x + \frac{3}{2}\right)(x - 5)$ unless preceded by division of the quadratic by 2</p>	<p>Allow M1A1 for the correct critical values AND evidence of another algebraic method that has led to these:</p> <p>eg $x(2x + 3) - 5(2x + 3)$ and the correct critical values or $2x(x - 5) + 3(x - 5)$ and the correct critical values or $(2x + 3)(2x - 10)$ and the correct critical values</p>
	<p>$\left(x = \right) -\frac{3}{2}$ and $\left(x = \right) 5$</p>		<p>A1 dep on M1 for correct critical values oe</p>	
	<p><i>Working required</i></p>	<p>$x < -\frac{3}{2}, x > 5$</p>	<p>A1 dep on M1 for correct inequalities (must be separate inequalities)</p> <p>allow interval notation eg $\left(-\infty, -\frac{3}{2}\right) \cup (5, \infty)$ or $\left(-\infty, -\frac{3}{2}\right), (5, \infty)$ or $\left]-\infty, -\frac{3}{2}\right[\cup]5, \infty[$ or $\left]-\infty, -\frac{3}{2}\right[,]5, \infty[$</p> <p>Acceptable notation: allow a comma, space, “or”, “and” or “\cup” to link the two regions</p> <p>Do not allow as a single inequality $-\frac{3}{2} > x > 5$</p>	
Total 3 marks				

21	$(V =) x(x)(15 - 4x) (= 15x^2 - 4x^3)$		5	M1	for a correct expression for the volume (condone missing $V = \dots$)
	$\left(\frac{dV}{dx} =\right) 30x - 12x^2$			M1ft	ft their V of the form $ax^3 + bx^2$ where $a, b \neq 0$ For a two-term derivative with at least one term correct for their V , eg $15(2)x$ or $30x$ or $-3(4)x^2$ or $-12x^2$
	$30x - 12x^2 = 0 \Rightarrow x = \dots$ or $(x =) 2.5$			M1ft	dep on previous M mark for equating their 2-term first derivative to 0 and solving to get a value of x (the value of x obtained must be greater than 0 and must not be where their second derivative is equal to 0) or the correct value of x
	$(V =) "2.5" \times "2.5" \times (15 - 4 \times "2.5")$ or $(V =) 15("2.5")^2 - 4("2.5")^3$			M1	dep on M3 for a full and correct substitution of their value of x
	<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	31.25		A1	oe eg $\frac{125}{4}$ Ignore any units on the answer line
				Total 5 marks	

22	eg $(x-5)^2 + 5(x-5) + x^2 = 12$	eg $y^2 + 5y + (y+5)^2 = 12$		5	M1	for substitution of $x = y+5$ or $y = x \pm 5$ into $y^2 + 5y + x^2 = 12$ to obtain an equation in x only (or y only)
	eg $2x^2 - 5x - 12 (= 0)$	eg $2y^2 + 15y + 13 (= 0)$			M1ft	dep on previous M1 for multiplying out and collecting terms, forming a 3-term quadratic in any form, where at least 2 coefficients are correct for their substitution
	eg $(2x+3)(x-4) (= 0)$ or $\frac{- -5 \pm \sqrt{(-5)^2 - 4 \times 2 \times -12}}{2 \times 2}$ or $\left(x - \frac{5}{4}\right)^2 - \left(\frac{5}{4}\right)^2 = 6$ or $(x =) - \frac{3}{2}$ and $(x =) 4$	eg $(2y+13)(y+1) (= 0)$ or $\frac{-15 \pm \sqrt{15^2 - 4 \times 2 \times 13}}{2 \times 2}$ or $\left(y + \frac{15}{4}\right)^2 - \left(\frac{15}{4}\right)^2 = -\frac{13}{2}$ or $(y =) -1$ and $(y =) -\frac{13}{2}$			M1ft	dep on first M1 for solving <i>their</i> 3-term quadratic equation using any correct method By factorising, allow brackets which if expanded would give 2 out of 3 terms correct for their quadratic By formula allow simplification as far as: $\frac{5 \pm \sqrt{25+96}}{4} \quad \text{or} \quad \frac{-15 \pm \sqrt{225-104}}{4}$ where \pm is required; allow one sign error By completing the square look for method as far as is shown opposite Implied by the correct values for x or for y
	$y = \left(-\frac{3}{2}\right) - 5 \left(-\frac{13}{2}\right)$ and $y = ("4") - 5 (= -1)$	$x = -1 + 5 (= 4)$ and $x = -\frac{13}{2} + 5 (= -1.5)$			M1ft	dep on previous M1 for correct substitution of their values of x or y into a given equation or allowed expression used for substitution or both correct values for the other variable or a correct x - y pair
		$x = -1.5$ $y = -6.5$ $x = 4$ $y = -1$		A1	oe dep on M2 and a correct quadratic For 4 correct values correctly labelled or correctly shown as coordinates	
	<i>Working required</i>					Total 5 marks

23		$a = 3$ $b = 45$ $c = 1$ OR $a = -3$ $b = 225$ $c = 1$	3	<p>B1 for $a = 3$ or $a = -3$</p> <p>B1 for $a > 0$ and $b = 45$ or for $a < 0$ and $b = 225$ if no answer for a is seen allow this mark for $b = 45$</p> <p>B1 for $c = 1$</p> <p>Allow correct alternative angles for the value of b, eg 45 or -315, 225 or -135</p>
				Total 3 marks

24	$\frac{40}{2}[2a + (40-1)d] = 2070$ oe or $4a + 78d = 207$ oe		6	M1	writes S_{40} for series P and equates to 2070, may appear simplified but must be an equation
	$2a + (25-1)3d = 186$ oe or $a + 36d = 93$ oe			M1	indep writes U_{25} for series Q and equates to 186, may appear simplified but must be an equation
	eg $4a + 78d = 207$ $a + 36d = 93 \times 4$	eg $4a + 78d = 207 \times 36$ $a + 36d = 93 \times 78$		M1	for a correct method to find a value for a or d dependent on having two linear equations in a and d only with at least one correct Coefficients of a or d made the same and correct operator to eliminate is selected (condone any one arithmetic error in multiplication); if operator not written, the correct operation can be implied by 2 out of 3 terms correct in their resultant equation in a or d only or Write a or d in terms of the other variable and substitute into a correct equation, condoning the omission of brackets Do not allow answers without working for this mark
	$4a + 78d = 207$ $4a + 144d = 372$ Subtracting $(66d = 165)$	$144a + 2808d = 7452$ $78a + 2808d = 7254$ Subtracting $(66a = 198)$			
	or $4(93 - 36d) + 78d = 207$	or $4a + 78\left(\frac{93 - a}{36}\right) = 207$			
eg. $a + 36 \times "2.5" = 93$ $a = (3)$	eg. $"3" + 36d = 93$ $d = (2.5)$	M1	dep substitution of their first value into one of their two linear equations in a and d only, leading to a value for the alternate variable Depends on the previous M1		
$\frac{40}{2}[2(2 \times "3") + (40-1)(3 \times "2.5")]$		M1	dep on previous two method marks Full substitution of their values into S_{40} for series Q implied by the correct answer		
Working required		6090	A1	dep on previous M1	
				Total 6 marks	

25	eg $\frac{1}{2} - \frac{4}{3}\rho x^3 = 6174\rho$ oe		5	M1	oe for forming a correct equation; allow use of any letter	
	$(x =) \sqrt[3]{\frac{6174\rho - 3}{2\rho}}$ ($\sqrt[3]{9261} = 21$)			M1	for a correct method to find the radius of the hemisphere	
	eg $\rho([21])^2 - \rho([21] - 2)^2 (= 441\rho - 361\rho = 80\rho)$ oe or $2\rho([21])^2 + 2\rho([21] - 2)^2 (= 882\rho + 722\rho = 1604\rho)$ oe			M1ft	for a method to find the area of the top of the bowl or the total area of the two curved surfaces of the bowl where [21] is what they believe to be radius of the hemisphere	M2 for use of formula for total surface area of hemispherical shell in a complete method, eg $3\pi([21])^2 + \pi([21] - 2)^2$ oe If not M2, allow M1 for this formula used with omission of π eg $3([21])^2 + ([21] - 2)^2$
	"1604\rho"+ "80\rho"			M1ft	ft their [21] for a complete method	
	<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	1684\rho		A1	cao SCB4 for 2028\rho (use of 23 as the outer radius)	
				Total 5 marks		

