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Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE
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
  - indep – independent

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- 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. 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.

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International GCSE Maths				
Apart from Questions 3b, 13, 17 and 18 (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)	1 – (0.24 + 0.16 + 0.38) oe		2	M1
		0.22		A1 oe
(b)	0.24 + 0.16 (= 0.4) oe		2	M1
		0.4		A1 oe
				Total 4 marks

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2 (a)	720 ÷ 12 (= 60) or 78 × 12 (= 936)			4	M1	
	78 – '60' (= 18) or '936' – 720 (= 216)	$'x' \times 720 = 936$ or $720(1+\frac{P}{100}) = '936'$ or $('x'=)\ \frac{'936'}{720}\ (=1.3)$ oe			M1	
	$\frac{'18'}{60} \times 100$ or $\frac{'216'}{720} \times 100$	$'1.3' \times 100 - 100$ oe or $(1.3-1) \times 100$			M1 complete method to find *P*	
			30		A1 ignore extra % sign if given by candidate.	
(b)	0.18 × 1600 (= 288) oe or 0.82 × 1600 + 800 (= 2112)			3	M1 if 1600 × 18% seen, must have further processing of the 18% or the value (288) given.	M2 for 1.5 × 12.5 (= 18.75) or 18 ÷ 1.5 (= 12)
	0.125 × (1600 + 800) (= 300) oe or (1600 + 800) × 0.875 (= 2100)				M1	
			Coupon B and correct figures seen		A1 for Coupon B **and** 288 and 300 or 18.75(%) and 18(%) or 12(%) and 12.5(%) or 2112 and 2100	
						Total 7 marks

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3	(a)	$4y > 12 - 5$		2	M1 Allow $y = \frac{7}{4}$ oe or $y > -\frac{7}{4}$ or $y < \frac{7}{4}$
			$y > \frac{7}{4}$		A1 oe
	(b)	$12x - 10$ **or** $2(6x - 5) = 4x - 7$ **or** $6x - 5 = \frac{4}{2}x - \frac{7}{2}$ oe		3	M1 for removal of fraction **and** multiplying out LHS **or** rearranging to remove the fraction **or** separating fraction (RHS) in an equation
		$12x - 4x = -7 + 10$ oe **or** $6x - \frac{4}{2}x = -\frac{7}{2} + 5$ oe			M1 ft (dep on 4 terms) for terms in x on one side of equation and number terms on the other
			$\frac{3}{8}$		A1 (dep M1) oe
					Total 5 marks

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4	360 ÷ 8 (= 45) or 360 ÷ 5 (= 72) or 180 – (360 ÷ 8) (= 135) oe or 180 – (360 ÷ 5) (= 108) oe		4	M1 finding interior or exterior angle of octagon or pentagon Angles may be seen on diagram – but must be obtuse if interior and acute if exterior.
	‘72’ – ‘45’ (= 27) or ‘135’ – ‘108’ (= 27)			M1 (dep 1st M1) using a pair of interior or pair of exterior angles to find angle *IBC* Angle may be seen on diagram.
	$\frac{180-'27'}{2}$ (= 76.5)			M1
		76.5		A1
				Total 4 marks

5	7200 × 0.025 (= 180) or 7200 × 1.025 (= 7380) oe or 7200 × 1.075 (= 7740) oe or 7200 × 0.075 (= 540) oe		3	M1	M2 for 7200 × $(1.025)^3$
	(7200 + ‘180’) × 0.025 (= 184.5) and (7200 + ‘180’ + ‘184.5’) × 0.025 (= 189.1125) and 7200 + ‘180’ + ‘184.5’ + ‘189.1…’ (= 7753.6125)			M1 NB year end values are 7380 and 7564.5(0) 7753.6125	
		7754		A1 answer in range 7753 – 7754	
				Total 3 marks	

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6	(a)		1	1	B1
	(b)		6	1	B1
	(c)	$206 + m - 214 = -3$ oe or $\frac{7^{-3} \times 7^{214}}{7^{206}}$ or $\frac{7^{211}}{7^{206}}$ oe		2	M1 allow $7^{206+m-214} = 7^{-3}$ oe (must be in the form $7^x = 7^y$ where x and y are correct expressions)
			5		A1 accept 7^5
					Total 4 marks

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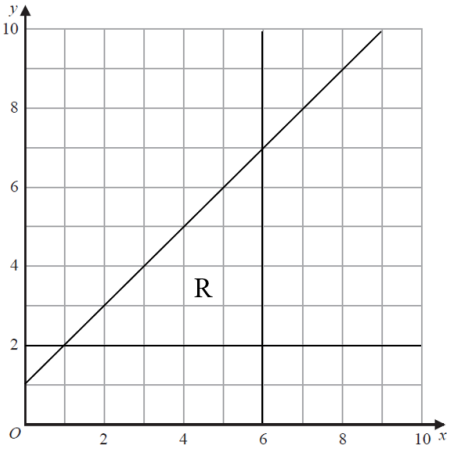
7	(a)		$y = -3x + 5$ oe	2	B2 fully correct equation eg $y = -3x + 5$ or $y - 5 = -3(x - 0)$ If not B2 then B1 for $y = -3x + a$ with $a \neq 5$ or $y = bx + 5$ ($b \neq 0, -3$) or ($L =$) $-3x + 5$
	(b)	Lines (solid or dashed) $x = 6$ **and** $y = 2$ drawn		3	B1 The lines $x = 6$ and $y = 2$ should extend far enough to intersect with each other.
		Line (solid or dashed) $y = x + 1$ drawn			B1 The line should extend from at least $x = 1$ to $x = 6$ **or** far enough to intersect with their horizontal and vertical lines.
		Region R shown (shaded or not shaded)  	Correct region identified		B1 dep on B2
					Total 5 marks

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8	22 × 260 (= 5720) or 50 × 218 (= 10 900)		3	M1
	$\frac{'10900' - '5720'}{28}$ $\left(= \frac{5180}{28}\right)$			M1
		185		A1
				Total 3 marks

9	$\cos 30 = \frac{24}{(AC)}$ or $\sin'60' = \frac{24}{(AC)}$ **or** $\frac{\sin'60'}{24} = \frac{\sin 90}{(AC)}$ oe		5	M1 for correct trig ratio involving *AC*	M2 for use of tan **and** Pythagoras to obtain *AC* (*AB* =) $24\tan 30$ (=13.856...) **and** $\sqrt{'13.856...'^2 + 24^2}$ $(= 27.712...)$ If not M2, then M1 for use of tan and Pythagoras to obtain AC^2 (*AB* =) $24\tan 30$ (=13.856...) **and** $'13.856...'^2 + 24^2$ $(= 768)$
	(*AC* =) $\frac{24}{\cos 30}$ (= $16\sqrt{3}$ = 27.712…) or (*AC* =) $\frac{24}{\sin'60'}$ (= $16\sqrt{3}$ = 27.712…) **or** (*AC* =) $\frac{24\times\sin 90}{\sin'60'}$			M1 for a correct trig ratio for *AC*	
	$\frac{1}{2}\times 2\times\pi\times 3$ (= 3π = 9.424…)			M1 for using $\pi\times 2\times 3$ or $2\pi\times 3$	
	'27.712…' + '9.424…' – 2×3			M1 for a complete method to find the length *AFEDC*	
		31		A1 accept answers in range from 31 to 31.15	
					Total 5 marks

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10	$(4.2 \times 10^{10}) \div (8.7 \times 10^{6})$ (= 4827.58…) or $(3.7 \times 10^{9}) \div (6.3 \times 10^{5})$ (= 5873.01…) **or** 42 000 000 000 ÷ 8 700 000 (= 4827.58…) or 3 700 000 000 ÷ 630 000 (= 5873.01…)		3	M1
	'5873.01…' – '4827.58…' (= 1045.42…) or $\frac{42000000000}{8700000} - \frac{3700000000}{630000}$ oe			M1 dep on M1
		1045		A1 Answer in range 1045 – 1045.5 or 1.045×10^{3} to 1.0455×10^{3}
				Total 3 marks

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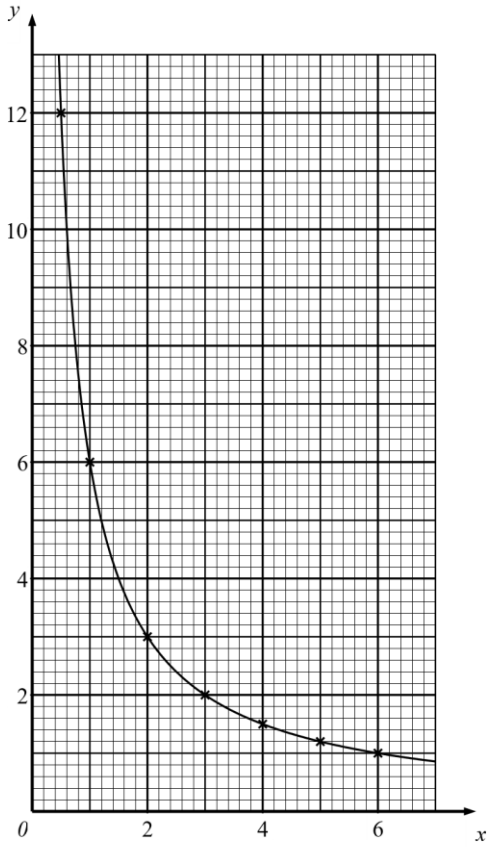
11 (a)		Correct table	2	B2 for all 4 correct values oe (ie $\frac{6}{5}$ or $\frac{3}{2}$) (B1 for 2 or 3 correct values)

x	0.5	1	2	3	4	5	6
y	**12**	6	**3**	2	**1.5**	**1.2**	1

(b)		Correct graph 7 points joined by a smooth curve.	2	M1ft (dep B1 in (a)) for 6 or 7 points plotted correctly using their values (within the circles on overlay). May be implied by curve passing through correct point. A1ft only allow one incorrect value from the table in (a), and for a curve that is decreasing throughout for $x = 0.5$ to $x = 6$. Ignore graph to the right of (6, 1) and to the left of (0.5, 12)
				Total 4 marks

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12	$\tan'x' = \frac{30.7 - 6.2}{244}$ or $\tan'x' = \frac{244}{30.7 - 6.2}$ or $\sqrt{244^2 + '24.5'^2}\left(= \sqrt{60136.25} = 245.2...\right)$ **and** $\sin'x' = \frac{'24.5'}{'\sqrt{60136.25}'}$ or $\cos'x' = \frac{244}{'\sqrt{60136.25}'}$		3	M1 for suitable trig expression for their choice of variable x to represent either of the (non right-angle) angles in the triangle.
	$\tan^{-1}\left(\frac{'24.5'}{244}\right)$ or $90 - \tan^{-1}\left(\frac{244}{'24.5'}\right)$ or $\sqrt{244^2 + '24.5'^2}\left(= \sqrt{60136.25} = 245.2...\right)$ **and** $\sin^{-1}\left(\frac{'24.5'}{'\sqrt{60136.25}'}\right)$ or $\cos^{-1}\left(\frac{244}{'\sqrt{60136.25}'}\right)$ or $\cos^{-1}\left(\frac{'245.2...'^2 + '24.5'^2 - 244^2}{2\times'245.2...'\times'24.5'}\right)$			M1 using a suitable trig expression to find the angle of depression. **or** for using Pythagoras to find hypotenuse **and** a suitable trig expression to find the angle of depression.
		5.7		A1 answers in the range 5.65 to 5.75 SC B2 for 84.3 (or in the range 84.25 to 84.35) **or** 264.3 (or in the range 264.25 to 264.35) given as answer.
				Total 3 marks

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13	$\sqrt{8}+4-\left(\sqrt{8}-4\right)\left(=8\right)$**and** $\sqrt{8}+4+\left(\sqrt{8}-4\right)\left(=2\sqrt{8}=4\sqrt{2}\right)$	$(a+b)(a-b)=a^2-b^2$ **and** $(\sqrt{8}+4)^2-(\sqrt{8}-4)^2$		3	M1 for correct substitutions into expression for $a+b$ **and** $a-b$ **or** expand the expression to get a^2-b^2 **and** substitute into this expression.
	$\left('8'\right)\left('2\sqrt{8}'\right)$ or $\sqrt{2048}$ or $16\sqrt{8}$ or $32\sqrt{2}$ or $8\sqrt{32}$ or $8\sqrt{8\times 4}$ oe				M1 (dep M1)
			8		A1 (dep both M marks)
					Total 3 marks

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14	(a)		48	1	B1 allow 47 – 49 Accept $\frac{n}{110}$ where n is in the range 47 – 49
	(b)		46	1	B1 allow 45.5 – 46.5
	(c)	40 **and** 56		2	M1 for both values. LQ of 40 – 41 and UQ in the range 56 – 58. **or** for use of 15 and 45 (eg indicated by marks on horizontal axis that correspond to 15 and 45 on the vertical axis.) **or** for use of 15.25 and 45.75 (eg indicated by marks on horizontal axis that correspond to 15.25 and 45.75 on the vertical axis.
			16 to 18		A1 accept 16 to 18
	(d)		Yes and correct reason	1	B1ft dep on M1 in (c) but ft their reading of the horizontal axis. For stating yes **and** the <u>IQR</u> for the <u>Algebra</u> test is <u>greater</u> than IQR for the Geometry test oe If using value in (c) less than 9, only accept 'no' and <u>IQR</u> for the <u>Algebra</u> test is <u>less</u> than the IQR for the Geometry test oe.
	(e)	60 – '50' (= 10)		3	M1 may be seen embedded as $\frac{10}{60}$ $(=\frac{1}{6})$ oe (eg reading of 50 from graph stated or indicated by marks on vertical axis that correspond to 64 on the horizontal axis). Allow 60 – '50' – 1 (= 9) oe
		$\frac{'10'}{60}\times\frac{'10'-1}{59}$			M1 for use of $\frac{n}{60}\times\frac{n-1}{59}$ with any integer n such that $2 \le n \le 59$
			$\frac{3}{118}$		A1 oe (accept 0.025 or better) Allow $\frac{6}{295}$ (= 0.02 or better) if using $\frac{9}{60}\times\frac{8}{59}$
					Total 8 marks

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15	$n^2t^3 = 4d + t^3$	$n^2 = \frac{4d}{t^3} + 1$		4	M1 for multiplying by the denominator **or** for dividing the RHS by t^3
	$t^3\left(n^2 - 1\right) = 4d$ oe	$n^2 - 1 = \frac{4d}{t^3}$			M1 for isolating terms in t^3 **and** factorising the correct expression of the equation **or** for isolating the $\frac{4d}{t^3}$ term
	$t^3 = \frac{4d}{\left(n^2 - 1\right)}$ oe	$t^3 = \frac{4d}{\left(n^2 - 1\right)}$			M1 for making t^3 the subject
			$t = \sqrt[3]{\frac{4d}{\left(n^2 - 1\right)}}$		A1 oe eg. $t = \sqrt[3]{\frac{-4d}{\left(1 - n^2\right)}}$ or $t = \left(\frac{4d}{\left(n^2 - 1\right)}\right)^{\frac{1}{3}}$ SC B2 for $t = \sqrt[3]{\left(\frac{4d}{n^2 + 1}\right)}$
					Total 4 marks

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16	$\frac{1}{2}\times 45\times 36\times \sin 'C'$ (= 405)	**alternative** $\frac{2\times 405}{36}(=22.5)$ **or** $\frac{2\times 405}{45}(=18)$		5	M1 correct substitution into the sine area formula, with their choice of symbol to represent *C*. **or** work out the perpendicular height with *BC* or *CD* as the base.
	$\sin 'C' = \left(\frac{405\times 2}{45\times 36}\right)\left('C' = 30\right)$ oe	$\sqrt{45^2 - 22.5^2}\left(=\sqrt{1518.75} = 38.97\right)$ or $\sqrt{36^2 - 18^2}\left(=\sqrt{972} = 31.17\right)$			M1 correct rearrangement to make sin *C* the subject **or** use Pythagoras with their found perpendicular height.
	$(BD =)\sqrt{45^2 + 36^2 - 2\times 45\times 36\times \cos '30'}$ $\left(=\sqrt{3321 - 3240\times \cos '30'}\right)$ $\left(=\sqrt{515.077...} = 22.695...\right)$	$\sqrt{('38.97' - 36)^2 + 22.5^2}\left(=\sqrt{515.077...}\right)$ or $\sqrt{('45' - 31.17)^2 + 18^2}\left(=\sqrt{515.077...}\right)$			M1 (dep on 1st M1, ft 30) correct expression for *BD* ft their *C* (must be less than 90°). **or** use Pythagoras to find an expression for *BD*.
	$\cos 'ABD' = \left(\frac{'22.695...'^2 + 19^2 - 28^2}{2\times '22.695...'\times 19}\right)$ leading to '*ABD*' = **or** $(BAD =)\ \cos^{-1}\left(\frac{28^2 + 19^2 - '22.695...'^2}{2\times 28\times 19}\right)$ (= 53.7…) **and** $\sin 'ABD' = \frac{\sin '53.7'}{'22.695...'}\times 28$ leading to '*ABD*' =				M1 for a complete method to find angle *ABD*
			83.9		A1 accept 83.85 – 83.9
					Total 5 marks

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17	Line drawn at (2, 1) with a positive gradient that does not intersect the curve at any other point.		3	M1 for a tangent drawn at $x = 2$
				M1 (dep M1) for a correct method to work out the gradient of the tangent.
		1.5 to 3		A1 for 1.5 to 3 accept answers in the range 1.5 – 3 so long as a tangent at $x = 2$ has been drawn.
				Total 3 marks

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18	$3y^2+7y+16=(2y-1)^2-(2y-1)$	$3\left(\frac{x+1}{2}\right)^2+7\left(\frac{x+1}{2}\right)+16=x^2-x$		5	M1 substitution of linear equation into quadratic.
	E.g. $y^2-13y-14\,(=0)$ oe $y^2-13y=14$	E.g. $x^2-24x-81\,(=0)$ oe $x^2-24x=81$			A1 (dep on M1) writing the correct quadratic expression in form $ax^2+bx+c\,(=0)$ allow $ax^2+bx=c$
	E.g. $(y-14)(y+1)\,(=0)$ or $(y=)\frac{-(-13)\pm\sqrt{(-13)^2-4\times1\times-14}}{2}$ or $\left(y-\frac{13}{2}\right)^2-\left(\frac{13}{2}\right)^2=14$ oe	E.g. $(x+3)(x-27)\,(=0)$ or $(x=)\frac{-(-24)\pm\sqrt{(-24)^2-4\times1\times-81}}{2}$ or $\left(x-\frac{24}{2}\right)^2-\left(\frac{24}{2}\right)^2=81$oe			M1 (dep on M1) for the first stage to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{13\pm\sqrt{169+56}}{2}$ or $\frac{24\pm\sqrt{576+324}}{2}$ or eg $\left(x-\frac{24}{2}\right)^2-225$ oe
	$(x=)\ 2\times'14'-1$ and $2\times'-1'-1$	$(y=)\ \frac{'27'+1}{2}$ and $\frac{'-3'+1}{2}$oe			M1 (dep on previous M1) may be implied by values of y or x that are consistent with a correct substitution.
			(27, 14) and (−3, −1)		A1 for both solutions dep on M2 Must be paired correctly. accept $x=27$, $y=14$ and $x=-3$, $y=-1$
					Total 5 marks

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19	$(AC =)\ \sqrt{8^2+18^2}\ \left(=\sqrt{388}=2\sqrt{97}=19.697...\right)$ **or** $(CE =)\ \sqrt{8^2+18^2+12^2}\ \left(=\sqrt{532}=2\sqrt{133}=23.065...\right)$ oe		3	M1
	eg $\tan ECA = \left(\dfrac{12}{'\sqrt{388}'}\right)$ **or** $\sin ECA = \left(\dfrac{12}{'\sqrt{532}'}\right)$ **or** $\cos ECA = \left(\dfrac{'\sqrt{388}'}{'\sqrt{532}'}\right)$ **or** $\sin ECA = \dfrac{\sin 90 \times 12}{'\sqrt{532}'}$ **or** $\cos ECA = \left(\dfrac{('\sqrt{388}')^2+('\sqrt{532}')^2-12^2}{2\times'\sqrt{388}'\times'\sqrt{532}'}\right)$ oe			M1 for a correct trig statement with *ECA* as the only unknown. NB allow use '*x*' or other variable in place of *ECA*.
		31.4		A1 allow 31.3 – 31.5
				Total 3 marks

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20	$y = \frac{k}{\sqrt{x}}$ or $ky = \frac{1}{\sqrt{x}}$ or $x = pT^3$ or $y = \frac{k}{\sqrt{pT^3}}$ or $y = \frac{c}{\sqrt{T^3}}$ oe	**Alternative** $y^2T^3 = n$ oe		4	M1 Constant of proportionality must be a symbol such as k or p or c or n $k \neq 1$, $p \neq 1$ and $c \neq 1$ and $n \neq 1$
	$c = 8 \times \sqrt{25^3}\ (=1000)$ oe	$n = 8^2 \times 25^3$ $(=1000000)$ oe			M1 dep M1 for rearranging for c or n with (y =) 8 and (T =) 25 substituted correctly into their equation
	$27 = \frac{'1000'}{\sqrt{T^3}}$ and $T^3 = \left(\frac{'1000'}{27}\right)^2$ oe $27 = \frac{'1000'}{\sqrt{T^3}}$ and $T^{\frac{1}{2}} = \left(\frac{'1000'}{27}\right)^{\frac{1}{3}}$ oe	$T^3 = \frac{'1000000'}{27^2}$ oe			M1 for substitution of y **and** a correct rearrangement for T^3 or $T^{\frac{1}{2}}$ or T.
			$\frac{100}{9}$		A1 oe eg $11\frac{1}{9}$ or $11.1\dot{}$ or $11.111(\ldots)$
					Total 4 marks

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21	$\pi x^2 + 2\pi x \times 3x + \frac{1}{2} \times 4\pi x^2 = 81\pi$ oe or $9x^2 = 81$oe **or** $2\pi x \times 3x + \frac{1}{2} \times 4\pi x^2 = 81\pi$ oe or $8x^2 = 81$		6	M1 for setting up an equation (in a single variable ie x or r) for the total surface area of the shape **or** for the curved surface area.
	$(x =) \sqrt{\frac{81}{9}} (= 3)$			M1 solving their equation in the form $kx^2\pi = 81\pi$ (where k follows correctly from their surface area) to find x
	$\pi \times '3'^2 \times 3 \times '3' + \frac{1}{2} \times \frac{4}{3} \pi '3'^3$ oe (= 81π + 18π = 99π = 311.(017…))			M1 (indep) for substituting their value of x to find the volume of the shape.
	99π or 311.(017…)			A1
	$\frac{840}{'311'}$ (= 2.7….) oe			M1 (dep on the 3rd M) for using the formula for density
		aluminium		A1 for aluminium **and** correct working leading to 2.7
				Total 6 marks

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22	$\left(\text{gradient } AB = \right)\dfrac{10--5}{p--1}\left(=\dfrac{10+5}{p+1}=\dfrac{15}{p+1}\right)$ oe or $\left(\text{gradient } BC = \right)\dfrac{q--5}{8--1}\left(=\dfrac{q+5}{8+1}=\dfrac{q+5}{9}\right)$ oe or $\left(\text{gradient } AC = \right)\dfrac{10-q}{p-8}$ oe **or** $\sqrt{(p--1)^2+(10--5)^2}$ or $(p--1)^2+(10--5)^2$ or $\sqrt{(8--1)^2+(q--5)^2}$ or $(8--1)^2+(q--5)^2$ or $\sqrt{(8-p)^2+(q-10)^2}$ or $(8-p)^2+(q-10)^2$ oe		5	M1 for finding the gradient of *AB* or *BC* or *AC* This may be seen embedded in $m_1 \times m_2 = -1$ **or** for finding the length of *AB* or *BC* or *AC* (or AB^2 etc)
	• $'\dfrac{15}{p+1}'\times'\dfrac{q+5}{9}'=-1$ or $'\dfrac{15}{p+1}'=-'\dfrac{9}{q+5}'$ or $9p+15q=-84$ oe • $'\dfrac{10-q}{p-8}'=-\dfrac{6}{7}$ or $6p-7q=-22$ oe • $(p--1)^2+(10--5)^2+(8--1)^2+(q--5)^2=(8-p)^2+(q-10)^2$ or $18p+30q=-168$ **Alternative for the second point** • $\dfrac{6}{7}p+10=-8\times-\dfrac{6}{7}+q$ oe			M2 for two out of the three of: • using $m_1 \times m_2 = -1$ • using the gradient of *AC* to form an equation. • using Pythagoras theorem If not M2, then M1 for one of the equations. **Alternative for the second point** obtaining this equation by using $y = mx + c$ with coordinates of *A* and *C* separately, and then eliminating c)

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	Elimination E.g. $54p + 90q = -504$ $54p - 63q = -198$ With subtraction **or** $153q = -306$ **or** $63p + 105q = -588$ $90p - 105q = -330$ With the operation of addition **or** $153p = -918$	Substitution E.g. $6\left(\frac{-84-15q}{9}\right) = -22$ or $6p - 7\left(\frac{-84-9p}{15}\right) = -22$ or $9\left(\frac{-22+7q}{6}\right) + 15q = -84$ or $9p + 15\left(\frac{6p+22}{7}\right) = -84$			M1 (dep M3) for correct method to eliminate one variable – multiplying one or both equations so the coefficient of x or y is the same in both, with the correct operation to eliminate one variable (condone one arithmetic error) **or** isolating p or q in one equation and substituting into the other (condone one arithmetic error).
			$p = -6$ and $q = -2$		A1 for $p = -6$ and $q = -2$ Must be clearly identified
					Total 5 marks

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23	$x^2 - 12x + 25$		4	M1 for substituting g(x) into f(x)
	$(x-6)^2 - 6^2$ (+ 25) **or** $(x-6)^2 - 11$ **or** $x^2 - 12x + (25 - y) = 0$ oe **or** $y^2 - 12y + (25 - x) = 0$ oe			M1 ft (dep on M1) for a correct first step in order to complete the square. Allow y in place of x. **or** Correctly setting up an equation = 0
	$(x-6)^2 = y + 11$ **or** $(y-6)^2 = x + 11$ **or** $x = \dfrac{12 \pm \sqrt{144 - 4(25 - y)}}{2}$ oe or $x = 6 \pm \sqrt{11 + y}$			M1 ft (dep on M2) for a correct rearrangement for their completed the square quadratic **or** correctly substituting into the quadratic formula (allow just + or just – instead of $\pm$) Allow same equations with x and y swapped
		$6 - \sqrt{11 + x}$		A1 oe must be in terms of x and have minus only before the square root.
				Total 4 marks

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