International GCSE Maths

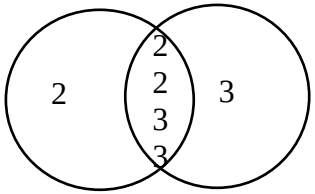
Apart from questions 3, 5, 6b, 11, 17 and 24 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method

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

Q	Working	Answer	Mark	Notes
1 (a)			2	M1 for $3n + k$ ($k \neq -2$) or $3 \times n + k$ ($k \neq -2$) or $n \times 3 + k$ ($k \neq -2$) (k may be zero or absent)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$3n - 2$		A1 oe eg $1 + (n - 1)3$ oe or $3 \times n - 2$ oe or $n \times 3 - 2$ oe NB: award full marks for eg $x = 3n - 2$ oe or $x = 3 \times n - 2$ oe or $x = n \times 3 - 2$ oe or nth term $= 3n - 2$ oe or nth term $= 3 \times n - 2$ oe or nth term $= n \times 3 - 2$ oe or $3x - 2$ Allow eg T_n or U_n or a_n for nth term **but** only M1 for $n = 3n - 2$ oe or $x = 3x - 2$
(b)		77	1	B1 cao
				Total 3 marks

2	1 – (0.20 + 0.26) oe or 0.54 oe or $x + 2x + 0.26 + 0.20 = 1$ oe or $x + 2x = 0.54$ oe or		4	M1 showing clear understanding that the total of probabilities is 1 If probabilities are given as percentages then % sign must be seen
	$\frac{"0.54"}{3} (= 0.18)$ or $\frac{2}{3} \times "0.54" (= 0.36)$ oe or "0.54" × 450 (= 243)			M1 for a correct method to find x or $2x$
	(2 ×) "0.18" × 450 oe or 81 or "0.36" × 450 oe			M1 or for $\frac{81}{450}$ or $\frac{162}{450}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	162		A1
				Total 4 marks

2 **ALT**	(0.2 × 450) + (0.26 × 450) (= 207) oe or 90 + 117 (= 207) or 0.46 × 450 (= 207)		4	M1
	450 – "207" (= 243)			M1
	$\frac{1}{3} \times "243"$ or 81 or $\frac{2}{3} \times "243"$			M1 or for $\frac{81}{450}$ or $\frac{162}{450}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	162		A1
				Total 4 marks

3	1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, 72 **and** 1, 2, 3, 4, 6, 9, 12, 18, 27, 36, 54, 108 **or** 2 2 2 3 3 oe **and** 2 2 3 3 3 oe **or**  12 | 72 | 108 3 | 6 | 9 | 2 | 3		2	M1 for any correct valid method and no errors eg for starting to list at least **four** different factors of each number and no errors **or** 2 2 2 3 3 **and** 2 2 3 3 3 seen or 4 2 3 3 **and** 4 3 3 3 seen or 2 2 2 9 **and** 2 2 3 9 seen or 4 2 9 **and** 4 3 9 seen or 2 36 **and** 3 36 etc (may be in a factor tree or a ladder diagram with no errors and ignore 1) **or** a fully correct Venn diagram **or** other clear method, eg table
	Working required	36		A1 dep on M1 Accept $2^2 \times 3^2$ oe
				Total 2 marks

4	1 + 0.15 (= 1.15) **or** x + 0.15x = 943 **or** 100(%) + 15(%) (= 115(%)) **or** $\frac{943}{115}$ (= 8.2) oe		3	M1
	943 ÷ "1.15" **or** 943 ÷ "115" × 100 **or** 943 × 100 ÷ "115" oe **or** 8.2 × 100			M1 dep on M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	820		A1
				Total 3 marks

5	(5 – 2) × 180 (= 540) **or** $360 \div 5$ (= 72)		4	M1 NB If angles are on the diagram they must be from correct working and correctly assigned
	$\frac{"540"}{5}$ (= 108) or 180 – "72" (= 108) **or** 180 – 96 (= 84)			M1
	"72" + "84" **or** 360 – (96 + "108") **or** 180 – ("108" – "84")			M1 for a complete method
	Working required	156		A1 dep on M2
				Total 4 marks

6	(a)	$m^2 - 8m + 5m - 40$		2	M1 for any 3 correct terms from 4 terms **or** for 4 out of 4 correct terms ignoring signs **or** for $m^2 - 3m$ … **or** for … $- 3m - 40$
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$m^2 - 3m - 40$		A1
	(b)	$9n - 12 = 5n + 6$ oe **or** $3n - 4 = \frac{5}{3}n + \frac{6}{3}$ oe		3	M1 for removal of fraction **and** multiplying out LHS **or** separating fraction (RHS) in an equation
		$9n - 5n = 12 + 6$ oe or $4n = 18$ or $-12 - 6 = 5n - 9n$ oe or $-4n = -18$ oe or $n = \frac{-18}{-4}$ **or** $3n - \frac{5}{3}n = \frac{6}{3} + 4$ oe			M1 ft (dep on 4 terms) correctly rearranging their 4 term equation for terms in n on one side of equation and number terms on the other
		Working required	$\frac{9}{2}$		A1 dep on M2 oe eg $\frac{18}{4}$ or 4.5 or $4\frac{1}{2}$
					Total 5 marks

7	(a)(i)		23, 24 ,27, 29, 30, 31, 33	1	B1 in any order with no repeats
	(a)(ii)		27, 33	1	B1 in any order with no repeats
	(b)	eg 1. Yes, no members/numbers/values in common 2. Yes, nothing in common 3. Yes, no common members/numbers/values 4. Yes, they share no common members/numbers/values 5. Yes, there is not the same members/numbers/values in both sets 6. Yes, there is no intersection or there is nothing in B and C 7. Yes, as there are no members/numbers/values the same (in B and C) 8. Yes, no members/numbers/values in B are in C or vice versa 9. Yes, there are no members/numbers in B that are multiples of 3 10. Yes, there are no members/numbers/values in that empty set 11. Yes, 23, 29, 31 not in C 12. Yes, 24, 27, 30, 33 are not in B Allow sector for set This is not an exhaustive list Allow element(s) for members/numbers/values	Yes, there are no multiples of 3 in set *B*	1	B1 for Yes and a statement which indicates correct meanings of intersection and empty set. If no box is ticked, then the 'Yes' must be stated in the answer
	(c)		23, 25, 29, 31	2	B2 for the four correct numbers and no additions (B1 for three correct values with no more than one incorrect or for four correct values with no more than one incorrect)
					Total 5 marks

8	1575 = (area) × 21 oe **or** (area =) 75 **or** 1575 = $\pi \times r^2 \times 21$ oe **or** $r^2 = \frac{1575}{21\pi}\left(= 23.8(732...)\right)$ oe **or** $r = \sqrt{\frac{1575}{21\pi}}\left(= 4.88(602...)\right)$ oe		3	M1 for finding the area using Vol = cross sectional area × height **or** finding r or r^2 using vol = $\pi r^2 h$ NB r^2 and r can be rounded or truncated
	$\frac{84}{"75"}$ oe or $\frac{84}{\pi"4.88"^2}$ oe or $\frac{84}{\pi"23.8"}$ oe			M1 for $\frac{84}{\text{area of circle}}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	1.12		A1 accept 1.06 – 1.121
				Total 3 marks

9	(a)		35 000 000	1	B1
	(b)	$8.2 \times 10^5 + 6\,780\,000$ oe or $820\,000 + 6\,780\,000$ oe or 7 600 000 or 76×10^5 oe or 7.6×10^n where $n \neq 6$		2	M1 Allow correct mixture of ordinary numbers and standard form numbers
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	7.6×10^6		A1
					Total 3 marks

10 (a)		1	1	B1
(b)		6	1	B1 Accept y^6
(c)		$125a^{12}c^6$	2	B2 for $125a^{12}c^6$ B1 for a product in the form ka^pc^q where 2 from k, p or q are correct eg $5a^{12}c^6$ or $125a^{12}3c^6$ Accept multiplication signs between terms (Allow $125a^{12}$ or $125c^6$ or $a^{12}c^6$ as long as not added to any other terms)
				Total 4 marks

11	$(CM)^2 + (12 \div 2)^2 = 9^2$ oe or $9^2 - (12 \div 2)^2 \ (= 81 - 36 = 45)$		4	M1 *AM = MB* *CAM = CBM*	M2 for $(\cos^{-1}(CAM) =) \dfrac{12 \div 2}{9} = 48.1(896...)$ **and** $(CM =)(12 \div 2) \times \tan"48.1..."(= 6.7\ldots)$ or $(CM =) 9 \times \sin"48.1..."(= 6.7\ldots)$
	$\sqrt{9^2 - (12 \div 2)^2}$ oe $(= \sqrt{81-36} = \sqrt{45} = 3\sqrt{5} = 6.7(08...))$			M1	
	("7"+ 9 + 9 + 12) × 21.5(0) or 37 × 21.5(0)			M1	
	Working required	795.5(0)		A1 dep on M2 SC B3 for awrt 789 for using 6.7…	
					Total 4 marks

12	(a)	$(2y \pm 1)(3y \pm 4)$ or $(2y \pm 4)(3y \pm 1)$ or $2y(3y - 4) + 1(3y - 4)$ or $3y(2y + 1) - 4(2y + 1)$		2	M1 NB factors must be in the form $(ay + b)$ where a and b are integers Condone use of a different letter to y
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$(2y + 1)(3y - 4)$		A1 or $(3y - 4)(2y + 1)$ Ignore further working if solving a quadratic to find roots.
	(b)	$\frac{3(2x+1)}{12x} + \frac{4(7-5x)}{12x}$ **or** $\frac{3x(2x+1)}{12x^2} + \frac{4x(7-5x)}{12x^2}$ **or** $\frac{3(2x+1)+4(7-5x)}{12x}$ oe **or** $\frac{3x(2x+1)+4x(7-5x)}{12x^2}$ oe		3	M1 for two correct fractions with common denominator with the intention to add **or** a single correct fraction NB $12x$ can be written as $(3)(4x)$ or $(4)(3x)$ for this mark or $12x^2$ can be written as $(3x)(4x)$ for this mark
		$\frac{6x+3+28-20x}{12x}$ oe or $\frac{6x^2+3x+28x-20x^2}{12x^2}$ oe or $\frac{31x-14x^2}{12x^2}$ oe			M1 for a correct single fraction with **all** brackets expanded
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{31-14x}{12x}$		A1 or $\frac{14x-31}{-12x}$
					Total 5 marks

13	(a)		$\frac{3}{10}, \frac{7}{10}$ $\frac{5}{9}, \frac{4}{9}$ $\frac{5}{9}, \frac{4}{9}$	2	B2 for all 3 correct pairs of probabilities on the correct branches If not B2 then award B1 for 1 correct pair of probabilities on a correct branch Allow equivalent fractions/decimals (to 2 dp truncated or rounded ie 0.55(…) and/or 0.44(…))
	(b)	$"\frac{3}{10}"\times"\frac{5}{9}"$ oe or $"\frac{7}{10}"\times"\frac{4}{9}"$ oe or $"\frac{3}{10}"\times"\frac{4}{9}"$ oe or $"\frac{7}{10}"\times"\frac{5}{9}"$ oe or		3	M1ft (probabilities < 1) Allow equivalent fractions/decimals (to 2 dp truncated or rounded ie 0.55(…) and/or 0.44(…))
		$"\frac{3}{10}"\times"\frac{5}{9}"$ + $"\frac{7}{10}"\times"\frac{4}{9}"$ oe or $1-\left("\frac{3}{10}"\times"\frac{4}{9}"+"\frac{7}{10}"\times"\frac{5}{9}"\right)$ oe			M1 ft Allow equivalent fractions/decimals (to 2 dp truncated or rounded ie 0.55(…) and/or 0.44(…))
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{43}{90}$		A1ft oe 0.47(77..) to 2 dp truncated or rounded or 47.(77)% to 2 sf truncated or rounded
					Total 5 marks

14	1 + 1.45 (= 2.45) or 1 + $\frac{29}{20}$ (= $\frac{49}{20}$) or B = 1.45A oe or B = $\frac{29}{20}$ A oe or A + 1.45A or A + $\frac{29}{20}$ A or 2.45A or (A : B =) 100 : 145 oe or 100 + 145 (= 245) oe or (B : C =) 3 : 2 oe or $B = 1.5C$ oe			5	B1 must identify ratios with Abel and Bahira or Bahira and Chanda Allow any letters for A, B and C
	A + 1.45A = 15 435 or 15 435 ÷ "2.45" or 15 435 ÷ "$\frac{49}{20}$" or 15 435 ÷ "245" × 100 or 63 × 100 (= 6300)	M2 for 15 435 ÷ $\left(\frac{1}{1.45}+1\right)$ (= 9135) oe or 15 435 ÷ $\left(\frac{49}{29}\right)$ (= 9135) oe			M1 for a method to find Abel's savings or for 6300
	15 435 – "6300" or 1.45 × "6300" or 145 × "63" (= 9135)				M1 for a method to find Bahira's savings or for 9135
	"9135" ÷ $\frac{3}{2}$ oe or "9135" × $\frac{2}{3}$ oe				M1 for a method to find to find Chanda's savings
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		6090		A1
					Total 5 marks

15 (a)			(x =) 2	1	B1 Accept $x = 2$ and $x \neq 2$ x cannot be 2 Any response that contains 2 is also acceptable **DO NOT ACCEPT WHEN WRITTEN WITH INEQUALITY SIGNS** $x > 2$ or $x < 2$ or $x \geq 2$ or $x \leq 2$ **DO NOT ACCEPT** 2 with another number eg 2 & 3
(b)	$y(x-2)=3x+1$ oe or $yx-2y=3x+1$ oe	$x(y-2)=3y+1$ oe or $yx-2x=3y+1$ oe		3	M1
	$x(y-3)=1+2y$ oe	$y(x-3)=1+2x$ oe			M1 for factorising correctly
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		$\frac{1+2x}{x-3}$		A1 oe eg $\frac{-1-2x}{3-x}$ (must be in terms of x)
					Total 4 marks

16	$\frac{15}{20}\times\frac{14}{19}\times\frac{5}{18}\left(=\frac{35}{228}\right)$ oe or $\frac{5}{20}\times\frac{4}{19}\times\frac{15}{18}\left(=\frac{5}{114}\right)$ oe **or** $\frac{15}{20}\times\frac{14}{19}\times\frac{13}{18}\left(=\frac{91}{228}\right)$ oe or $\frac{5}{20}\times\frac{4}{19}\times\frac{3}{18}\left(=\frac{1}{114}\right)$ oe		4	M1 for *RRY* or *YYR* in any order **or** *RRR* or *YYY* Allow equivalent decimals to 2 dp truncated or rounded Products must be correct (may not be evaluated)	M2 for *RY* **and** *YR* $\frac{15}{20}\times\frac{5}{19}\left(=\frac{15}{76}\right)$ oe **and** $\frac{5}{20}\times\frac{15}{19}\left(=\frac{15}{76}\right)$ oe
	$3\times\frac{15}{20}\times\frac{14}{19}\times\frac{5}{18}$ oe or $3\times\frac{5}{20}\times\frac{4}{19}\times\frac{15}{18}$ oe **or** $\frac{15}{20}\times\frac{14}{19}\times\frac{13}{18}$ oe **and** $\frac{5}{20}\times\frac{4}{19}\times\frac{3}{18}$ oe			M1 for (3 × *RRY*) or (3 × *YYR*) **or** *RRY* **and** *YYR* (any order) **or** *RRR* **and** *YYY*	
	$3\times\frac{15}{20}\times\frac{14}{19}\times\frac{5}{18}+3\times\frac{5}{20}\times\frac{4}{19}\times\frac{15}{18}$ oe **or** $\left(\frac{15}{20}\times\frac{14}{19}\times\frac{5}{18}\right)+\left(\frac{5}{20}\times\frac{4}{19}\times\frac{15}{18}\right)+\left(\frac{15}{20}\times\frac{5}{19}\right)+\left(\frac{5}{20}\times\frac{15}{19}\right)$ oe **or** $1-\left(\frac{15}{20}\times\frac{14}{19}\times\frac{13}{18}+\frac{5}{20}\times\frac{4}{19}\times\frac{3}{18}\right)$ oe			M1 for a complete method using **correct** products	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{45}{76}$		A1 oe 0.59(21..) to 2 dp truncated or rounded or 59.(21..)% to 2 sf truncated or rounded	
					Total 4 marks

17	$\frac{1+\sqrt{5}}{3-\sqrt{5}}\times\frac{3+\sqrt{5}}{3+\sqrt{5}}$ oe or $\frac{1+\sqrt{5}}{3-\sqrt{5}}\times\frac{-3-\sqrt{5}}{-3-\sqrt{5}}$ oe		3	M1 for rationalising the denominator by multiplying numerator and denominator by $3+\sqrt{5}$ (or $-3-\sqrt{5}$)
	$\frac{3+\sqrt{5}+3\sqrt{5}+\sqrt{5}\sqrt{5}}{9+3\sqrt{5}-3\sqrt{5}-\sqrt{5}\sqrt{5}}$ oe or $\frac{3+\sqrt{5}+3\sqrt{5}+\sqrt{5}\sqrt{5}}{9-\sqrt{5}\sqrt{5}}$ oe or $\frac{3+\sqrt{5}+3\sqrt{5}+5}{9+3\sqrt{5}-3\sqrt{5}-5}$ oe or $\frac{8+\sqrt{5}+3\sqrt{5}}{9-5}$ oe or $\frac{3+4\sqrt{5}+5}{9-5}$ oe or $\frac{8+4\sqrt{5}}{4}$			M1 numerator correctly expanded and may be simplified to at least 2 terms and denominator correctly expanded and may be simplified to 1 term
	Working required	$2+\sqrt{5}$		A1 for $2+\sqrt{5}$ from correct working dep on M2
				Total 3 marks

18	$3x^2$ **or** -40		5	M1 for differentiating one of the first two terms correctly
	$3x^2 - 40$			A1 for both terms correct and no additions
	"$3x^2 - 40$" = 8			M1ft dep on M1 for equating their quadratic derivative with 8 (Derivative must be in the form $ax^2 - 40$ or $3x^2 - b$ where $a \neq 0$ and $b \neq 0$)
	$(y =)"4"^3 - 40 \times "4" + 1 (= -95)$ or $y = ("-4")^3 - 40 \times "-4" + 1$ (= 97)			M1ft dep on previous M1for substituting at least one x value into y NB Following through from $ax^2 - 40 = 8$ or $3x^2 - b = 8$, their x values must be correct
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	(4, –95), (–4, 97)		A1 both coordinates must be paired correctly
				Total 5 marks

19	$\frac{(BD)}{\sin 62} = \frac{12.8}{\sin 40}$ oe or		5	M1 for correct use of sine rule for *BD*	M2 for $(CD =) \frac{12.8}{\sin 40} \times \sin 78$ (= 19.4(781…)) **and** $(BD =) \frac{"19.4(781...)"}{\sin 78} \times \sin 62$ (= 17.5(82…))
	$(BD =) \frac{12.8}{\sin 40} \times \sin 62$ (= 17.5(82…))			M1 for finding *BD* (truncated or rounded)	
	$"17.5(82...)"^2 = 13.4^2 + 15.2^2 - 2 \times 13.4 \times 15.2 \times \cos x$ or 309(.139) = 179(.56) + 231(.04) – 407(.36)cos*x* oe			M1 for correct use of cosine rule	
	$(\cos x =) \frac{13.4^2 + 15.2^2 - "17.5(82...)"^2}{2 \times 13.4 \times 15.2}$ oe or $(\cos x =) \frac{179(.56) + 231(.04) - 309(.139...)}{407(.36)}$ oe or $(\cos x =) \frac{410(.6) - 309(.139...)}{407(.36)}$ oe or $(\cos x =) 0.247 - 0.256$ oe			M1 for a correct rearrangement of cos *x*	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	75.6		A1 accept 75.1 – 75.7	
					Total 5 marks

20	eg $\pi r^2 \times \frac{60}{360} - \frac{1}{2} r^2 \sin 60$ oe or $\frac{\pi r^2}{6} - \frac{\sqrt{3}}{4} r^2$ oe		4	M1 for a correct expression for the area of the segment Expression may be embedded in an equation, eg $\pi r^2 \times \frac{60}{360} - \frac{1}{2} r^2 \sin 60 = 38$ or $\pi r^2 \times \frac{60}{360} = 38 + \frac{1}{2} r^2 \sin 60$ or $\pi r^2 \times \frac{60}{360} - 38 = \frac{1}{2} r^2 \sin 60$
	eg $\left(r^2 =\right) 38 \div \left(\frac{\pi}{6} - \frac{\sqrt{3}}{4}\right) \left(= 38 \div 0.09(058)\right)$ (= 419(.490…)) oe or $\left(r =\right) \sqrt{38 \div \left(\frac{\pi}{6} - \frac{\sqrt{3}}{4}\right)}$ (= 20.4(81…))oe			M1 dep on M1 for a **correct** expression for r^2 or r
	$\frac{\pi}{6} \times "20.4(81...)" \times 2$ (= 21.4(48…)) oe or			M1 for using the value of r to find arc length
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	41.9		A1 allow 41 - 42
				Total 4 marks

21	(i)		(–2, –4)	1	B1
	(ii)		(5, –10)	1	B1
					Total 2 marks

22	eg 14 ÷ 5 (= 2.8) or a correct value on the FD scale or 10 small squares =1 adult oe or 1 large square = 2.5 adults oe or 51 **and** 8 assigned to correct bars (distances)		3	M1 for finding the frequency density **or** for finding the number of adults for squares **or** use of counting squares or blocks
	eg 14 + (15 × "3.4") + (20 × "0.4") (= 73) oe or 100 – [14 + (15 × "3.4") + (20 × "0.4")] (= 27) oe 14 + 51 + 8 (= 73) oe or 100 – [14 + 51 + 8] (= 27) oe or (140 + 510 + 80) × 0.1 (= 73) oe or [1000 – (140 + 510 + 80)] × 0.1 (= 27) oe or (140 + 510 + 80) (= 730) oe or [1000 – (140 + 510 + 80)] (= 270) oe or (5.6 + 20.4 + 3.2) × 2.5 (= 73) oe or [40 – (5.6 + 20.4 + 3.2)] × 2.5 (= 27) oe			M1 for a method to find the area of the bars given or for a method to find the missing area
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	Correct height of bar at 2.7 and correct width		A1 for correct bar(s) with frequency of 27 SC B2 for a bar of height 2.7 from 0 – 15 SC B2 for a bar of height 1.8 from 0 – 15
				Total 3 marks

23	$\frac{1}{3}\pi\times(5x)^2\times 6x$ oe or $50\pi x^3$ oe or $\frac{1}{2}\times\frac{4}{3}\times\pi\times(2x)^3$ or $\frac{16}{3}\pi x^3$ oe or $\frac{4}{3}\times\pi\times(2x)^3$ or $\frac{32}{3}\pi x^3$ oe		5	M1 for finding the volume of cone or hemisphere or sphere NB Ignore missing brackets around $5x$ and $2x$ for this mark
	$\frac{1}{3}\pi\times(5x)^2\times 6x-\frac{1}{2}\times\frac{4}{3}\times\pi\times(2x)^3=6948\pi$ oe or $50\pi x^3-\frac{16}{3}\pi x^3=6948\pi$ or $\frac{134}{3}\pi x^3=6948\pi$ oe			M1 for a **correct** equation for the volume of the shape NB If not expanded at this stage then must see brackets
	$\left(x^3=\right)\frac{6948\pi\times 3}{134\pi}\left(=\frac{10422}{67}=155.(552...)\right)$ oe or $\left(x=\right)\sqrt[3]{\frac{6948\pi\times 3}{134\pi}}\left(=\sqrt[3]{\frac{10422}{67}}=\sqrt[3]{155.(552...)}=5.37(8...)\right)$ oe			M1 for rearranging the **correct** equation to find the value of x^3 or x Accept 5.4 or better
	$3\times\pi\times(2\times"5.37(8...)")^2$ oe or $12\times\pi\times$ "5.37(8..)"^{2} oe			M1 for finding the surface area of the hemisphere
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	1090		A1 allow 1086 – 1100 Special case for using 6948 without π SC B3 for $x^3 = 49.5(138…)$ or $x = 3.67(205…)$ SC B4 for awrt 508
				Total 5 marks

24	$\frac{n}{2}\left[2(84)+(n-1)(4)\right]$ or $\frac{n}{2}[168+4n-4]$ or $\frac{n}{2}[164+4n]$ oe or $82n+2n^2$ oe		6	M1 for correctly substituting into $S_n=\frac{n}{2}\left[2a+(n-1)d\right]$
	$\frac{n}{2}\left[2(84)+(n-1)(4)\right]=(n-2)\times180$ or $\frac{n}{2}[164+4n]=(n-2)\times180$ oe or $82n+2n^2=(n-2)\times180$ oe			M1 for equating S_n with $(n-2)180$ S_n must come from correct substitution of a and d into $\frac{n}{2}\left[2a+(n-1)d\right]$
	eg $n^2-49n+180(=0)$ oe Allow $n^2-49n=-180$			M1dep on M2 for multiplying out and collecting terms, forming a three term quadratic in any form of $an^2 + bn + c$ (= 0) where at least 2 coefficients (a or b or c) are correct
	eg $(n-45)(n-4)(=0)$ $n=\frac{--49\pm\sqrt{(-49)^2-4\times1\times180}}{2}$ e.g. $\left(n-\frac{49}{2}\right)^2-\left(\frac{49}{2}\right)^2=-180$			M1ft dep on M2 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{49\pm\sqrt{2401-720}}{2}$ **or** if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct value for $n = 45$ (ignore $n = 4$)
	$("45"-2)\times180$ or $\frac{"45"}{2}\left[2(84)+("45"-1)(4)\right]$ oe or $("44"-2)\times180$ or $\frac{"44"}{2}\left[2(84)+("44"-1)(4)\right]$ oe			M1 dep on previous M1 NB $n > 5$
	Working required	7740		A1 dep on M5 Accept 7560 or 7480
				Total 6 marks

24 **ALT**	$\frac{n}{2}\left[2(96)+(n-1)(-4)\right]$ or $\frac{n}{2}[192-4n+4]$ or $\frac{n}{2}[196-4n]$ oe or $98n-2n^2$ oe		6	M1 for correctly substituting into $S_n=\frac{n}{2}\left[2a+(n-1)d\right]$ using exterior angles
	$\frac{n}{2}\left[2(96)+(n-1)(-4)\right]=360$ or $\frac{n}{2}[196-4n]=360$ oe or $98n-2n^2=360$ oe			M1 for equating S_n with 360 S_n must come from correct substitution of a and d into $\frac{n}{2}\left[2a+(n-1)d\right]$
	eg $2n^2-98n+360(=0)$ $n^2-49n+180(=0)$ oe Allow $n^2-49n=-180$			M1dep on M2 for multiplying out and collecting terms, forming a three term quadratic in any form of $an^2 + bn + c$ (= 0) where at least 2 coefficients (a or b or c) are correct
	e.g $(n-45)(n-4)(=0)$ $n=\frac{--49\pm\sqrt{(-49)^2-4\times1\times180}}{2}$ e.g. $\left(n-\frac{49}{2}\right)^2-\left(\frac{49}{2}\right)^2=-180$			M1ft dep on M2 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{49\pm\sqrt{2401-720}}{2}$ **or** if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct value for $n = 45$ (ignore $n = 4$)
	("45"$-2)\times180$ or $\frac{"45"}{2}\left[2(84)+("45"-1)(4)\right]$ oe or ("44"$-2)\times180$ or $\frac{"44"}{2}\left[2(84)+("44"-1)(4)\right]$ oe			M1 dep on previous M1 NB $n > 5$
	Working required	7740		A1 dep on M5 Accept 7560 or 7480
				Total 6 marks

25	$\pm 3\left(x^2 \pm 4x\right).....$ or $\pm 3\left(x^2 \pm 4x.....\right)$ or $b = 3$		4	M1 for factorising $-3x^2 + 12x$ or stating the correct value of b or $b = 3$ embedded in an incorrect final answer in the form $a - 3(x - c)^2$
	$-3\left[\left(x-2\right)^2 .....\right]$ or $-3\left(x-2\right)^2 .....$			M1 for a **correct** first step to complete the square
	$-3\left[\left(x-2\right)^2 - \left(2\right)^2\right].....$ oe or $-3\left(x-2\right)^2 + 12.....$ or $-3\left[\left(x-2\right)^2 - \left(2\right)^2 .....\right]$ oe			M1 for a **correct** second step to complete the square
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$29 - 3\left(x-2\right)^2$		A1 oe eg $-3\left(x-2\right)^2 + 29$
				Total 4 marks

25 **ALT**	$-bx^2 + 2bcx - bc^2 + a$ oe or $b = 3$		4	M1 for multiplying out $a - b(x - c)^2$ or stating the correct value of b or $b = 3$ embedded in an incorrect final answer in the form $a - 3(x - c)^2$
	$2bc = 12$ or $a - bc^2 = 17$ oe			M1 for equating coefficients
	$2 \times$ "3" $\times c = 12$ or $a -$ "3" $\times$ "2"$^2 = 17$ oe			M1 for finding at least 2 from a or b or c
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$29 - 3\left(x-2\right)^2$		A1 oe eg $-3\left(x-2\right)^2 + 29$
				Total 4 marks