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EDEXCEL INTERNATIONAL GCSE MATHS: QUESTIONS BY TOPIC

Sequences (A3)

International GCSE Mathematics A (4MA1) · Higher tier

36 questions · 153 marks · Mark schemes included

Past papers June 2018 - June 2025 · 2 sub-topics

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HOW TO USE THIS BOOKLET

Questions are grouped by sub-topic and run from the lowest to the highest mark tariff, then oldest paper first.

Click any row below to jump straight to that sub-topic or question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme; < QUESTION brings you back.

A gold bar in the left margin marks exactly where the question sits on the original page.

Diagrams, graphs, grids and tables are printed exactly as they appear in the original papers.

Each question is filed under its main topic; longer questions may also test skills from other topics.

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26. Q25	IGCSE Paper 1HR June 2022	5	30
27. Q24	IGCSE Paper 1HR January 2023	5	31
28. Q23	IGCSE Paper 2HR June 2023	5	32
29. Q19	IGCSE Paper 1H November 2024	5	33
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A3b QUADRATIC, GEOMETRIC & OTHER SEQUENCES		1 Qs · 5 marks	45
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QUESTIONS

36 questions · 153 marks · 2 sub-topics

SUB-TOPIC A3a

LINEAR SEQUENCES & NTH TERM

Sub-topic A3a · 35 questions · 148 marks · lowest tariff first



Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** A plane has a length of 73 metres.

A scale model is made of the plane.

The scale of the model is 1 : 200

Work out the length of the scale model.

Give your answer in centimetres.

cm

(Total for Question 1 is 3 marks)

- 2** Here are the first five terms of an arithmetic sequence.

7 11 15 19 23

Write down an expression, in terms of n , for the n th term of this sequence.

(Total for Question 2 is 2 marks)



15 Use algebra to show that the recurring decimal $0.2\dot{5}\dot{4} = \frac{14}{55}$

(Total for Question 15 is 2 marks)

16 Here are the first five terms of an arithmetic sequence.

7 10 13 16 19

Find the sum of the first 100 terms of this sequence.

(Total for Question 16 is 2 marks)



Answer all TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** A plane flew from Madrid to Dubai.

The distance the plane flew was 5658 km.

The flight time was 8 hours 12 minutes.

Work out the average speed of the plane.

..... km/h

(Total for Question 1 is 3 marks)

- 2** Here are the first 4 terms of an arithmetic sequence.

85 79 73 67

Find an expression, in terms of n , for the n th term of the sequence.

.....
(Total for Question 2 is 2 marks)



- 3 Anjali travels on the Eurostar train from Paris to Amsterdam.

The distance the train travels between Paris and Amsterdam is 515 km.

The time taken by the train to travel between Paris and Amsterdam is 3 hours 18 minutes.

Work out the average speed of the train.

Give your answer in km/h correct to the nearest whole number.

..... km/h

(Total for Question 3 is 3 marks)

- 4 Here are the first four terms of an arithmetic sequence.

38 31 24 17

Find an expression, in terms of n , for the n th term of the sequence.

.....

(Total for Question 4 is 2 marks)



7 Here are the first four terms of an arithmetic sequence.

6 10 14 18

(a) Find an expression, in terms of n , for the n th term of this sequence.

.....
(2)

(b) Write down an expression, in terms of n , for the $(n + 1)$ th term of this sequence.

.....
(1)

(Total for Question 7 is 3 marks)

8 (a) Write 1 390 000 in standard form.

.....
(1)

(b) Write 0.005 in standard form.

.....
(1)

(Total for Question 8 is 2 marks)



25 Mario is going to save \$50 in the year 2021

He is going to continue to save, up to and including the year 2070, by increasing the amount he saves each year by \$ k

Mario will save a total of \$33 125 from 2021 to 2070

Work out the value of k .

$k = \dots\dots\dots$

(Total for Question 25 is 3 marks)



Answer ALL TWENTY FOUR questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** Here are the first five terms of an arithmetic sequence.

1 5 9 13 17

- (a) Find an expression, in terms of n , for the n th term of this sequence.

.....
(2)

The n th term of another arithmetic sequence is $3n + 5$

- (b) Find an expression, in terms of m , for the $(2m)$ th term of this sequence.

.....
(1)

(Total for Question 1 is 3 marks)



Answer ALL TWENTY FIVE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** Here are the first four terms of an arithmetic sequence.

1 4 7 10

- (a) Find an expression, in terms of n , for the n th term of this sequence.

.....
(2)

The n th term of a different arithmetic sequence is $5n + 17$

- (b) Find the 12th term of this sequence.

.....
(1)

(Total for Question 1 is 3 marks)



23 Work out the sum of the multiples of 3 between 1 and 1000

.....
(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



21 $(2x + 23)$, $(8x + 2)$ and $(20x - 52)$ are three consecutive terms of an arithmetic sequence.

Prove that the common difference of the sequence is 12

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



- 3 Here are the first five terms of a number sequence S .

10 16 22 28 34

- (a) Find an expression, in terms of n , for the n th term of this sequence.

(2)

The n th term of a sequence T is given by $n^2 - 3$

There are numbers that are terms in both the sequence S and the sequence T .

- (b) Find one of these numbers.

(2)

(Total for Question 3 is 4 marks)

- 4 On Saturday, Jacob walked 10 800 steps.
On Sunday, he walked 7% more steps than on Saturday.

Work out how many steps Jacob walked on Sunday.

(Total for Question 4 is 3 marks)



- 23** The 10th term of an arithmetic series, S , is 66
The sum of the first 20 terms of S is 1290

Find the 5th term of S .
Show your working clearly.

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



- 22 The first term of an arithmetic series S is -6
The sum of the first 30 terms of S is 2865

Find the 9th term of S .

(Total for Question 22 is 4 marks)

- 23 Express $7 - 12x - 2x^2$ in the form $a + b(x + c)^2$ where a , b and c are integers.

(Total for Question 23 is 3 marks)



24 Here are the first five terms of an arithmetic sequence.

8 15 22 29 36

Work out the sum of all the terms from the 50th term to the 100th term inclusive.

(Total for Question 24 is 4 marks)



- 18** In an arithmetic series, the 6th term is 39
In the same arithmetic series, the 19th term is 7.8

Work out the sum of the first 25 terms of the arithmetic series.

(Total for Question 18 is 4 marks)



24 An arithmetic series has first term a and common difference d .

The sum of the first $2n$ terms of the series is four times the sum of the first n terms of the series.

Find an expression for a in terms of d .

Show your working clearly.

$a = \dots\dots\dots$

(Total for Question 24 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



16 An arithmetic series has first term 1 and common difference 4

Find the sum of all terms of the series from the 41st term to the 100th term inclusive.

.....
(Total for Question 16 is 4 marks)



- 2 In a warehouse there are two types of shelves, type **R** and type **S**.

These two types of shelves are arranged into shelving units that form a sequence of patterns.

Here are the first three terms in the sequence.

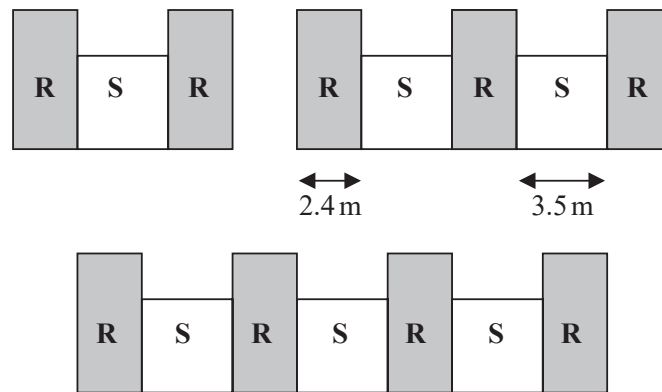


Diagram **NOT** accurately drawn

The width of each type **R** shelf is 2.4 m and the width of each type **S** shelf is 3.5 m

- (a) Work out the total width of a shelving unit that has 6 type **R** shelves.

..... m
(2)

A shelving unit has n type **R** shelves.
The total width of this shelving unit is W metres.

- (b) Find an expression for W in terms of n
Give your answer in its simplest form.

$W =$
(2)

(Total for Question 2 is 4 marks)

- 22 The first term of an arithmetic series is $(2t + 1)$ where $t > 0$
The n th term of this arithmetic series is $(14t - 5)$

The common difference of the series is 3

The sum of the first n terms of the series can be written as $p(qt - 1)^r$ where p , q and r are integers.

Find the value of p , the value of q and the value of r
Show clear algebraic working.



$$p = \dots\dots\dots q = \dots\dots\dots r = \dots\dots\dots$$

(Total for Question 22 is 4 marks)

Turn over for Question 23



23 Here are the first three terms of an arithmetic sequence.

$$(4x-14) \quad , \quad (x+2) \quad , \quad (7x-9)$$

Find, as an integer, the sum of the first 40 terms of the sequence.
Show clear algebraic working.

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



- 23** The sum of the first 48 terms of an arithmetic series is 4 times the sum of the first 36 terms of the same series.

Find the sum of the first 30 terms of this series.

.....
(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS



- 19 The 25th term of an arithmetic series is 44.5
The sum of the first 30 terms of this arithmetic series is 765

Find the 16th term of the arithmetic series.
Show your working clearly.

(Total for Question 19 is 5 marks)



23 The sum of the first N terms of an arithmetic series, S , is 292

The 2nd term of S is 8.5

The 5th term of S is 13

Find the value of N .

Show clear algebraic working.

$N = \dots\dots\dots$

(Total for Question 23 is 5 marks)



20 Here are the first four terms of an arithmetic series.

$$k \quad \frac{3k}{4} \quad \frac{k}{2} \quad \frac{k}{4}$$

Given that the 15th term of the series is $(90 + 2k)$,

calculate the sum of the first 30 terms of the series.

.....
(Total for Question 20 is 5 marks)



- 26 An arithmetic series has first term a and common difference d , where d is a prime number.

The sum of the first n terms of the series is S_n and

$$S_m = 39$$

$$S_{2m} = 320$$

Find the value of d and the value of m

Show clear algebraic working.

$$d = \dots\dots\dots$$

$$m = \dots\dots\dots$$

(Total for Question 26 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS



25 The sum of the first 10 terms of an arithmetic series is 4 times the sum of the first 5 terms of the same series.

The 8th term of this series is 45

Find the first term of this series.

Show clear algebraic working.

(Total for Question 25 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS



- 24 An arithmetic sequence has first term 8 and common difference 11
The sequence has k terms, where $k > 21$

The sum of the last 20 terms of the sequence is 10 170

Find the value of k

Show clear algebraic working.

$k = \dots\dots\dots$

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER = 100 MARKS



23 Here are the first three terms of an arithmetic sequence.

$$8p \qquad 7p - 3 \qquad 4p + 2$$

The sum of the first n terms of the sequence is -1914

Work out the value of n
Show your working clearly.

$$n = \dots\dots\dots$$

(Total for Question 23 is 5 marks)



19 An arithmetic series has first term a and common difference d

The sum of the first 30 terms of the arithmetic series is 4395

The sum of the 10th term and the 20th term is 284

Work out the sum of the first 45 terms of the arithmetic series.

Show clear algebraic working.

(Total for Question 19 is 5 marks)



24 An arithmetic series has 30 terms.

The first term is a

The common difference is d

The 20th term is 123

The sum of the 30 terms is 2880

Work out the value of a and the value of d

Show clear algebraic working.



$$a = \dots\dots\dots$$

$$d = \dots\dots\dots$$

(Total for Question 24 is 5 marks)

Turn over for Question 25



- 21 The n th term of an arithmetic series is u_n where $u_n > 0$ for all n
The sum to n terms of the series is S_n

Given that $u_4 = 6$ and that $S_{11} = (u_6)^2 + 18$

find the value of u_{20}



(Total for Question 21 is 6 marks)

Turn over for Question 22



23 A polygon has n sides, where $n > 5$

When arranged in order of size, starting with the largest number, the sizes of the interior angles of the polygon, in degrees, are the terms of an arithmetic sequence.

Here are the first five terms of this sequence.

177 175 173 171 169

Find the value of n

Show clear algebraic working.



Question 23 continued

$n = \dots\dots\dots$

(Total for Question 23 is 6 marks)

Turn over for Question 24



20 The sum of the first 80 terms of an arithmetic series, S , is 470

The 75th term of S is 14.5

The sum of the first X terms of S is 171

Work out the value of X

Show your working clearly.



$$X = \dots\dots\dots$$

(Total for Question 20 is 6 marks)

21 A curve has equation $y = f(x)$

There is only one turning point on the curve.
The coordinates of this turning point are (6, 5)

Write down the coordinates of the turning point on the curve with equation

(a) $y = f(x - 4)$

$$(\dots\dots\dots, \dots\dots\dots)$$

(1)

(b) $y = f(3x)$

$$(\dots\dots\dots, \dots\dots\dots)$$

(1)

(Total for Question 21 is 2 marks)



19 Here are the first 4 terms in an arithmetic sequence.

3 7 11 15

The last term of the sequence is x

The sum of the terms of the sequence is 7260

Find the value of x

Show clear algebraic working.

$x = \dots\dots\dots$

(Total for Question 19 is 6 marks)



24 The first 3 terms of an arithmetic series are

$$(2x + 5) \quad (3y - 4) \quad (4x - 2)$$

where x and y are constants.

The sum of the first 9 terms of the series is 216

Find the value of x and the value of y
Show clear algebraic working.



$$x = \dots\dots\dots$$

$$y = \dots\dots\dots$$

(Total for Question 24 is 6 marks)

Turn over for Question 25



SUB-TOPIC A3b

QUADRATIC, GEOMETRIC & OTHER SEQUENCES

Sub-topic A3b · 1 question · 5 marks · lowest tariff first



12 Here are the first four terms of a sequence of fractions.

$$\frac{1}{1} \quad \frac{2}{3} \quad \frac{3}{5} \quad \frac{4}{7}$$

The numerators of the fractions form the sequence of whole numbers 1 2 3 4 ...

The denominators of the fractions form the sequence of odd numbers 1 3 5 7 ...

(a) Write down an expression, in terms of n , for the n th term of this sequence of fractions.

(2)

(b) Using algebra, prove that when the square of any odd number is divided by 4 the remainder is 1

(3)

(Total for Question 12 is 5 marks)



MARK SCHEMES

official mark schemes, in the same order as the questions



Question	Working	Answer	Mark	Notes	
1	$73 \div 200 (=0.365)$ or $73 \times 100 (= 7300)$ or $1 \text{ cm} = 2 \text{ m}$ oe $"0.365" \times 100$ or $"7300" \div 200$ $73 \div 2$			M1 M1 A1	M2 for $100 \div \frac{200}{73}$ oe Allow their incorrectly converted $73 \text{ m} \div 200$
2		36.5 $4n + 3$	3 2	B2oe	e.g. $7 + 4(n - 1)$ or $4n + (7 - 4)$ etc allow $T_n = 4n + 3$ or $x = 4n + 3$ etc If not B2 then award B1 for answer of $4n + k$ ($k \neq 3$) or $n = 4n + 3$
3	$90 \div (2 + 13) (= 6)$ or $\frac{12 + x}{90 + x} = \frac{1}{3}$ $"6" \times 2 (=12)$ or $"6" \times 13 (=78)$ or $3(12 + x) = 90 + x$ $("78" \div 2) - "12"$ or $2x = 54$ or $"78" \times 3/2 - "78" - "12"$ oe			M1 M1 M1 A1	M2 for $\frac{2}{15} \times 90 (=12)$ or $\frac{13}{15} \times 90 (= 78)$ dep on a correct method for "78" and "12"
		27	4		

International GCSE Maths					
Apart from questions 7b, 11a, 11b, 13, 14, 16, 20, 23, 26 (where the mark scheme states otherwise) the correct answer, unless clearly obtained from an incorrect method, should be taken to imply a correct method.					
Question	Working	Answer	Mark	Notes	
1	For [8 hours 12 minutes =] 8.2 [hours] or $8\frac{12}{60}$ oe or $\frac{41}{5}$ oe or $8 \times 60 + 12 (= 492)$ [minutes]		3	B1	For correctly writing the time as a time in hours or minutes or for a correct calculation to do this
	[Average speed =] $\frac{5658}{8.2}$ oe eg $\frac{5658}{492} \times 60$ oe			M1	For use of speed = distance $\div$ time (use of their time in hours – if used minutes, then must multiply by 60) (allow $5658 \div 8.12 (= 696.79\dots)$ for this mark if B0 awarded (allow 696 – 697))
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	690		A1	
				Total 3 marks	
2		$91 - 6n$	2	B2	For a correct answer in any form eg $91 - 6 \times n$ or $-6n + 91$ or $85 + (n - 1)(-6)$ oe (B1 for $-6n + k$ oe (k may be zero or absent)) NB: award full marks for eg $x = 91 - 6n$ or n th term = $91 - 6n$ but only B1 for $n = 91 - 6n$
				Total 2 marks	



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 n th 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

7	(a)		$4n + 2$	2	M1 for $4n + k$ (k may be 0 or absent) oe
					A1 oe e.g $6 + (n - 1)4$
	(b)		$4n + 6$	1	B1 oe ft part (a) providing M1 in part (a) is awarded e.g $4(n + 1) + 2$
					Total 3 marks

8	(a)		1.39×10^6	1	B1
	(b)		5×10^{-3}	1	B1
					Total 2 marks

9		$2.5 - 0.6 = 1.9$	2 hours 51 minutes	4	M1
		$3 \times 12 \times "1.9" (= 68.4)$			M1 for using length $\times$ width $\times$ height to find a volume
		"68.4" $\times 1000 \div 400$ (= 171 minutes)			M1 for their volume $\times 1000 \div 400$
					A1
					Total 4 marks
		Alternative scheme			
		$250 - 60 = 190$	2 hours 51 minutes	4	M1
		$300 \times 1200 \times "190" (= 6.84 \times 10^7)$			M1 for using length $\times$ width $\times$ height to find a volume
		"6.84 $\times 10^7$ " $\div 10^6 \times 1000 \div 400$ (= 171 minutes)			M1 for their volume $\div 10^6 \times 1000 \div 400$
					A1
					Total 4 marks

25	$n = 50$		3	B1
	$33125 = \frac{50}{2} [2 \times 50 + (50 - 1) \times k]$ oe $33125 = 25 [100 + 49k]$ oe $1325 = 100 + 49k$ oe $1225 = 49k$ oe			M1 For correct equation, using formula with $a = 50$ and $n = 50$ substituted (for this mark, allow $n = 49$) (k may be written as d)
		25		A1
				Total 3 marks



International GCSE Maths				
Apart from Questions 3, 5b, 6a, 16, 19 and 23 (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)			2	M1 for $4n + k$ ($k \neq -3$) or $4 \times n + k$ ($k \neq -3$) or $n \times 4 + k$ ($k \neq -3$) (k may be zero or absent)
		$4n - 3$		A1 oe e.g. $1 + (n - 1)4$ oe or $4 \times n - 3$ oe or $n \times 4 - 3$ oe NB: award full marks for eg $x = 4n - 3$ oe or $x = 4 \times n - 3$ oe or $x = n \times 4 - 3$ oe or n th term = $4n - 3$ oe or n th term = $4 \times n - 3$ oe or n th term = $n \times 4 - 3$ oe but only M1 for $n = 4n - 3$ oe
(b)		$6m + 5$	1	B1 for $3(2m) + 5$ oe or $6m + 5$ or $3 \times 2m + 5$ oe or $6 \times m + 5$ Allow $3(2n) + 5$ or $6n + 5$ oe
				Total 3 marks

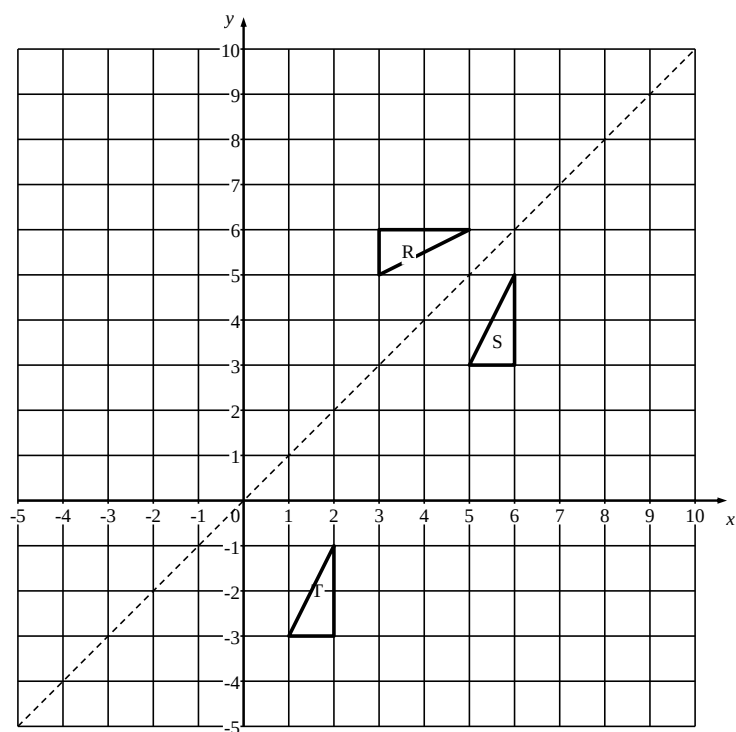
International GCSE Maths				
Apart from questions 3, 5, 6b, 11, 17 and 24 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Values in quotation marks must come from a correct method previously seen 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)
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$3n - 2$		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 n th term = $3n - 2$ oe or n th term = $3 \times n - 2$ oe or n th term = $n \times 3 - 2$ oe or $3x - 2$ Allow eg T_n or U_n or a_n for n th term but only M1 for $n = 3n - 2$ oe or $x = 3x - 2$
(b)		77	1	B1 cao
				Total 3 marks



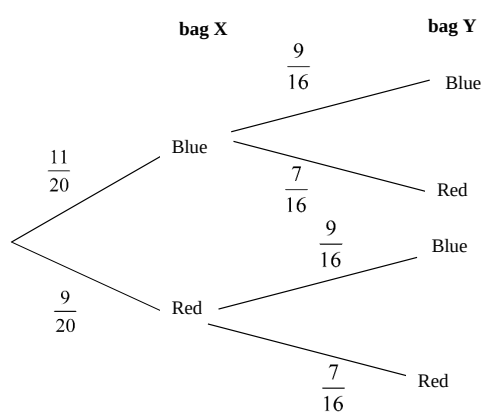
22	$\frac{4}{3} \times \pi \times R^3 - \frac{4}{3} \times \pi \times 1.2^3$ or $\frac{4}{3} \times \pi \times (1.2 + t)^3 - \frac{4}{3} \times \pi \times 1.2^3$	3.9	5	M1 for an expression for the volume of the inner sphere
	$\left(\frac{4\pi}{3}R^3 - \frac{4}{3} \times \pi \times 1.2^3\right) \times 2700 = 1980$			M1
	$\frac{4\pi}{3}R^3 = \frac{4}{3} \times \pi \times 1.2^3 + \frac{1980}{2700}$ $= 7.238229474 + 0.7333333$ $= 7.97(1562807)$			M1 for a correct expression or sight of $7.23(8229474) + 0.73(33333)$ or sight of $7.97(1562807)$
	$R = \sqrt[3]{\left(\frac{3}{4\pi} \times \left(\frac{4}{3} \times \pi \times 1.2^3 + \frac{1980}{2700}\right)\right)} = 1.2392\dots$ $1.2392 - 1.2 = 0.0392$			M1 for a correct expression or sight of $\sqrt[3]{1.90(3070437)}$ or sight of $1.23(9229151)$ or sight of $0.0392(29151)$
				A1 for $3.9 - 3.92$
				Total 5 marks
23	(First term = 3 and last term = 999) or $a = 3$ and $d = 3$	166 833	4	M1
	$999 \div 3 (= 333)$			M1 for finding the number of terms Allow $1000 \div 3 = 333.3 = 333$
	Sum = $\frac{333}{2}(3 + 999)$ or Sum = $\frac{333}{2}(2 \times 3 + (333 - 1)3)$			M1 for using a correct method to find the sum
				A1
				Total 4 marks



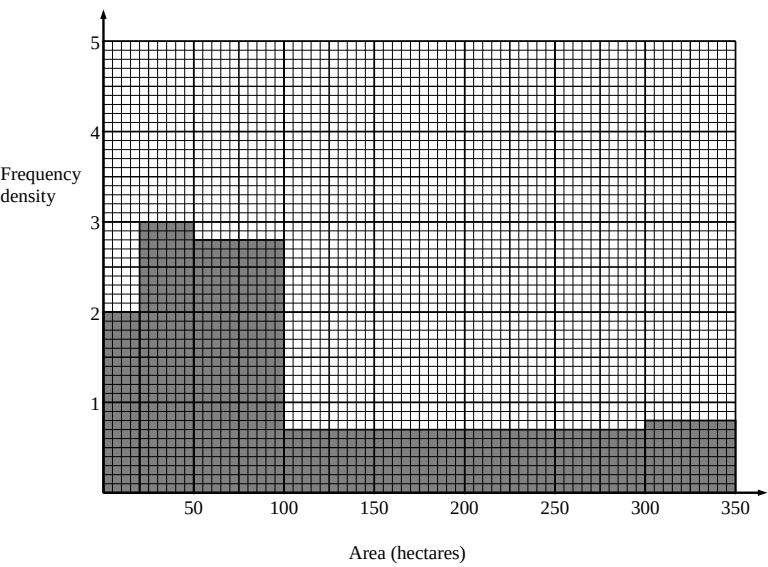
3



15



17



Question	Working	Answer	Mark	Notes
	Mark scheme 1 (see next page for alternative mark scheme)			
21	$(8x + 2) - (2x + 23) (= 6x - 21)$ or $(2x + 23) - (8x + 2) (= -6x + 21)$ or $(20x - 52) - (8x + 2) (= 12x - 54)$ or $(8x + 2) - (20x - 52) (= -12x + 54)$ $(8x + 2) - (2x + 23) = (20x - 52) - (8x + 2)$ oe or $(2x + 23) - (8x + 2) = (8x + 2) - (20x - 52)$ oe $x = 5.5$ Eg $2 \times 5.5 + 23 (=34)$ and $8 \times 5.5 + 2 (=46)$ OR $8 \times 5.5 + 2 (=46)$ and $20 \times 5.5 - 52 (=58)$	shown	4	M1 for a correct expression for the common difference in terms of x brackets must be present or removed correctly M1 for a correct equation A1 A1 for 12 from correct working



Question	Working	Answer	Mark	Notes
21	Alternative method – starts by assuming $d = 12$ E.g. $(2x + 23) + 12 = (8x + 2)$ or $(8x + 2) + 12 = (20x - 52)$ or $(2x + 23) - 12 = (8x + 2)$ or $(8x + 2) - 12 = (20x - 52)$ or $(2x + 23) + (8x + 2) + (20x - 52) = \frac{3}{2}(2(2x + 23) + 2 \times 12)$ $x = 5.5$ or $x = 1.5$ from $(2x + 23) - 12 = (8x + 2)$ or $x = 3.5$ from $(8x + 2) - 12 = (20x - 52)$ $2 \times 5.5 + 23 (=34)$ and $8 \times 5.5 + 2 (=46)$ and $20 \times 5.5 - 52 (=58)$ OR $2x + 23 + 12 = (8x + 2)$ and $(8x + 2) + 12 = (20x - 52)$ and gets $x = 5.5$ both times	shown	4	M2 for a correct equation If not M2 then award M1 for a correct expression for the common difference in terms of x brackets must be present or removed correctly e.g. $(8x + 2) - (2x + 23) (= 6x - 21)$ or $(20x - 52) - (8x + 2) (= 12x - 54)$ A1 A1 for explicitly showing both common differences are 12 OR solves both $(2x + 23) + 12 = (8x + 2)$ and $(8x + 2) + 12 = (20x - 52)$ and gets $x = 5.5$ both times



Question	Working	Answer	Mark	Notes
2	$0.5 \times 6 \times 6 \times 5 (= 90)$ $0.5 \times \pi \times 3^2 \times 5 (= 22.5\pi = 70.6858\dots)$ or $\pi \times 3^2 \times 5 (= 45\pi = 141.37166\dots)$ '90' – '70.6858.....'	19.3	4	M1 Correct method for volume of A M1 Correct method for volume of B or correct volume of cylinder M1 Correct method to find the difference in the volume A1 $19 - 19.4$
3 (a)		$6n + 4$	2	M1 for $6n + k$ (k may be 0 or absent) oe A1 oe eg $10 + (n - 1)6$ or $n \times 6 + 4$
(b)	...40, 46,... -2, 1, 6, 13, 22, 33 46 ... $6n + 4 = n^2 - 3$ oe	e.g. 22 or 46	2	M1 continuing sequence and writing at least 5 terms of 2 nd sequence – allow one error or for a correct equation ft part (a) A1 or other number in both sequences eg -2



Question	Working	Answer	Mark	Notes
23	$a + 9d = 66$ oe $\frac{20}{2}(2a + 19d) = 1290$ oe $a = 93$ or $d = -3$	81	4	M1 A correct formula involving 10 th term M1 Correct formula for sum of first 20 terms A1 A correct value for a or d A1 dep on M2



Question	Working	Answer	Mark	Notes
21 (a)	Factorising numerator as $(5x + 4)(2x + 3)$		3	M1
	Factorising denominator as $(2x + 3)(2x - 3)$			M1
		$\frac{5x + 4}{2x - 3}$		A1
	(b) $(8^{5y} =) 2^{15y}$ or $(4^n =) 2^{2n}$ or 2^{5y+2}		4	M1
	$2^{5y+2} = 2^{15y-2n}$ oe			M1 e.g. $2^{2n} = 2^{15y-5y-2}$
	$5y + 2 = 15y - 2n$ oe			M1 Correct equation using the powers
		$n = 5y - 1$		A1 Dep on M2 (accept $5y - 1$)
Total 7 marks				
22	$(2865 =) \frac{30}{2} (2 \times -6 + 29d)$		4	M1 Correct expression for sum of 30 terms
	$d = 7$			A1 Correct value for d
	$-6 + 8 \times \text{"7"} \text{ or } (nth \text{ term}) = -6 + \text{"7"}(n - 1)$			M1 fit their d . Dep on M1
		50		A1
	Total 4 marks			



24	$a = 8 \quad d = 7$		4	M1 can be implied
	$(S_{100} =) \frac{100}{2} (2 \times 8 + (100 - 1) \times 7) (= 35\,450) \text{ or}$ $(S_{49} =) \frac{49}{2} (2 \times 8 + (49 - 1) \times 7) (= 8624) \text{ or}$ $(S_{50} =) \frac{50}{2} (2 \times 8 + (50 - 1) \times 7) (= 8975)$			M1
	'35450' – '8624' or '35450' – '8975' + $(8 + (50 - 1) \times 7)$			M1
		26 826		A1
				Total 4 marks
	Alternative scheme			
	$(u_n =) 7n + 1$	$a = 8 \text{ and } d = 7$	4	M1 can be implied
	$(u_{50} =) 7 \times 50 + 1 (= 351) \text{ or}$ $(u_{100} =) 7 \times 100 + 1 (= 701)$	$(u_{50} =) 8 + (50 - 1) \times 7$ $(= 351)$		M1
	$\frac{51}{2} ('351' + '701')$	$\frac{51}{2} (2 \times 351 + (51 - 1) \times 7)$		M1
		26 826		A1
				Total 4 marks

17	(a)	$(FH =) \sqrt{12^2 + 12^2} (=16.97... \text{ or } \sqrt{288} \text{ or } 12\sqrt{2})$		3	M1
		$\tan CFH = \frac{10}{16.97...}$ oe or e.g. $(CF =) \sqrt{16.97^{n2} + 10^2} (=19.69... \text{ or } \sqrt{388} \text{ or } 2\sqrt{97})$ and e.g. $\frac{\sin CFH}{10} = \frac{\sin 90}{19.69}$			M1 for a correct trig statement involving CFH
			30.5		A1 accept 30.4 – 30.7
	(b)	$(BG =) 10 + \sqrt{15^2 - 12^2} (=19)$		3	M1
		$(BE =) \sqrt{19^{n2} + 16.97^{n2}}$ oe			M1 ft their FH
			25.5		A1 accept 25.4 – 25.6
Total 6 marks					

18	$a + 5d = 39$ or $a + 18d = 7.8$ or $13d = -31.2$ oe		4	M1
	$a = 51$ or $d = -2.4$			A1
	e.g. $\frac{25}{2}(2 \times 51 + (25 - 1) \times -2.4)$ oe or $12.5(2a + 23d + d) = 12.5(39 + 7.8 - 2.4)$ oe			M1 for substituting their values for a and d into S_n , a and d must be clearly stated.
		555		A1
				Total 4 marks



24	$\frac{2n}{2}[2a + (2n-1)d]$ oe		4	M1 for a correct expression for S_{2n}
	$\frac{2n}{2}[2a + (2n-1)d] = 4 \times \frac{n}{2}[2a + (n-1)d]$ oe			M1 dep on M1 for setting up a correct equation for $S_{2n} = 4 \times S_n$
	$2a - d = 4a - 2d$ oe			M1 for a correct linear expression in a and d
		$\frac{d}{2}$		A1 (dep on M2) for $\frac{d}{2}$ oe
				Total 4 marks



16	$\frac{100}{2}[2 \times 1 + (100 - 1) \times 4] (= 19\,900)$ oe or $1 + (41 - 1) \times 4 (= 161)$ oe or $1 + (100 - 1) \times 4 (= 397)$ oe		4	M1 for method to find the sum of the first 100 terms or for finding the 41 st term or for finding the 100 th term
	$\frac{40}{2}(2 \times 1 + (40 - 1) \times 4) (= 3160)$ oe or $\frac{41}{2}(2 \times 1 + (41 - 1) \times 4) (= 3321)$ oe or $100 - 41 + 1 (= 60)$ oe			M1 for method to find the sum of the first 40 terms or 41 terms or for finding the number of terms from the 41 st term to the 100 th term
	"19 900" – "3160" or $\frac{"60"}{2}["161" + "397"]$ or $\frac{"60"}{2}[2 \times "161" + ("60" - 1) \times 4]$ oe			M1 for finding the difference or for finding the sum from the 41 st term to the 100 th term
		16 740		A1
Total 4 marks				

17	(i)		19	1	B1
	(ii)		0	1	B1
	(iii)		11	1	B1
	(iv)		28	1	B1
Total 4 marks					



International GCSE Maths				
Apart from question 6, 14, 21, 24 and 25, 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)		0.45	1	B1 oe eg $\frac{9}{20}, \frac{45}{100}, 45\%$
(b)	eg $1 - (0.25 + 0.2 + 0.2) (= 0.35)$ or $1 - ("0.45" + 0.2) (= 0.35)$ or $300 \times (0.25 + 0.2 + 0.2)(= 195)$		3	M1 allow use of their "0.45" from part (a), check the table
	eg $300 \times "0.35"$ or $300 - "195"$			M1 for a complete method
		105		A1 cao (award $\frac{105}{300}$ M2 only)
Total 4 marks				

2 (a)	eg $6 \times 2.4 + 5 \times 3.5$		2	M1
		31.9		A1 oe
(b)	(W =) $5.9n$ or (W =) $5.9(n - 1) + 2.4$ or (W =) $2.4n + 3.5(n - 1)$		2	M1 for $2.4n + 3.5n$ or $5.9n$ seen
		$5.9n - 3.5$		A1 oe but must be in simplest form eg $-3.5 + 5.9n$
Total 4 marks				

21	$\pi \times 4.8^2 \times \frac{72}{360}$ (= 14.4(76...)) oe		5	M1 for finding the area of the sector
	$\frac{1}{2} \times 4.8^2 \times \sin 72$ (= 10.9(56...) or 11) oe or $\frac{1}{2} \times 5.6(4...) \times 3.8(8...)$ oe			M1 for finding the area of the triangle (Allow use of cosine rule/sine rule/SOHCAHTOA/Pythagoras to find AC (5.6(427.8...)) and OM (3.8(8328...)) where M is the midpoint of AC)
	"14.4(76...)" – "10.9(56...)" (= 3.520...)			M1 for finding the shaded area with all figures from correct working
	"3.5(20...)" $\times 14 \times 3 \times 60$ "3.5(20...)" $\times 2520$			M1
	Award marks within the range from correct working	8870		A1 – accept 8820 – 8950 from correct working
				Total 5 marks

22	$2t + 1 + (n - 1)3 = 14t - 5$		4	M1 for the use of n th term = $a + (n - 1)d$ to find n
	$(n =) 4t - 1$ or $(n =) -1 + 4t$			A1
	$(S_n =) \frac{"4t-1"}{2} [2(2t+1) + ("4t-1"-1)3]$ or $(S_n =) \frac{"4t-1"}{2} [2t+1+14t-5]$ oe			M1 for the use of S_n formula (must be in terms of t) Allow their expression for n dep on M1
	Working required	$p = 2$ $q = 4$ $r = 2$		A1 dep on M2 allow $(S_n =) 2(4t - 1)^2$ Values of p , q and r must come from correct working
				Total 4 marks

23	$(7x - 9) - (x + 2) = (x + 2) - (4x - 14)$ oe eg $6x - 11 = 16 - 3x$ OR $x + 2 = 4x - 14 + d$ and $7x - 9 = 4x - 14 + 2d$ oe eg $-3x + 16 = d$ and $3x + 5 = 2d$		4	M1 for setting up an equation in x OR two simultaneous equations in x and d
	$x = 3$ and $a = -2$ and $d = 7$ OR $x = 3$ and eg $(S_{40}) = \frac{40}{2} [2(4x - 14) + 39(-3x + 16)]$ or $x = 3$ and eg $(S_{40}) = \frac{40}{2} [2(4x - 14) + 39(6x - 11)]$			M1 correct values or values from correct substitution OR $x = 3$ and S_{40} expressed in terms of x allow $(40 - 1)$ for 39
	$(S_{40}) = \frac{40}{2} (2 \times " - 2 " + 39 \times " 7 ")$ or eg $(S_{40}) = \frac{40}{2} [2(4 \times " 3 " - 14) + 39(-3 \times " 3 " + 16)]$ or $(S_{40}) = \frac{40}{2} [2(4 \times " 3 " - 14) + 39(6 \times " 3 " - 11)]$			M1 allow use of their a and their d or their x as long as clearly stated allow $(40 - 1)$ for 39
	Working required	5380		A1 (dep on M1)
Total 4 marks				

Incorrect working giving the radius as 16 cm gains M0A0				
Question	Working	Answer	Mark	Notes
22	$7 \times 4 = 2(2r - 2)$ or $7 \times 4 = 2(d - 2)$		6	M1 Or a correct equation in r eg $5.5^2 - 1.5^2 = 4r - 4$
	$r = 8$ or $d = 16$			A1
	$5 \times (5 + 4 + 7) = x \times (2 \times "8" + x)$			M1 Accept $5 \times 16 = x(2r + x)$
	$x^2 + 16x - 80 (= 0)$			A1
	$(x - 4)(x + 20) (= 0)$ $\frac{-16 \pm \sqrt{16^2 - 4 \times 1 \times (-80)}}{2 \times 1}$ or $\frac{-16 \pm \sqrt{576}}{2}$			M1 Correct factors or evidence of correct use of quadratic formula.
		4		A1 dep on first 2 method marks
				Total 6 marks
23	$\frac{48}{2}(2a + (48 - 1)d)$ or $\frac{36}{2}(2a + (36 - 1)d)$ oe		5	M1 For a correct expression for the first 48 terms or the first 36 terms
	$\frac{48}{2}(2a + (48 - 1)d) = 4 \times \frac{36}{2}(2a + (36 - 1)d)$ oe			M1 For a correct equation.
	$96a + 1392d = 0$ oe eg $4a + 58d = 0$, $2a + 29d = 0$ or $a = -14.5d$ etc			M1
	$\frac{30}{2}(2a + (30 - 1)d)$			M1 Indep Allow substitution of any 'found' values of a and d
		0		A1
				Total 5 marks

					Total 6 marks
19	$a + 24d = 44.5$		5	M1	oe
	$\frac{30}{2}(2a + (30-1)d) = 765$ oe, eg $(15(2a + 29d) = 765), (2a + 29d = 51)$, etc			M1	oe (may be simplified)
	e.g. $2(44.5 - 24d) + 29d = 51$ oe or $2a + 48d = 89$ $2a + 29d = 51$ oe			M1	dep on M2, a complete method to eliminate one variable, allow one arithmetic error
		26.5		A2	dep on M2, oe
				(A1)	dep on M2. If not A2, award A1 for $a = -3.5$ or $d = 2$
					Total 5 marks
20	125 or 10^{21n}		3	M1	
	125×10^{21n}			M1	
		$1.25 \times 10^{21n+2}$		A1	
					Total 3 marks

23		$a + d = 8.5, a + 4d = 13$ oe		5	M1	for at least 1 correct equation or for $d = 1.5$
		$a = 7, d = 1.5$			A1	both values correct
		$\frac{N}{2}(2 \times 7 + (N - 1)1.5) = 292$ (eg $3N^2 + 25N - 1168 [= 0]$ or $1.5N^2 + 12.5N - 584 [= 0]$)			M1	A correct equation for the total of the first N terms of the series with a and d substituted in. The mark can be gained by using their values of a and d even if no previous marks awarded.
		eg $(3N + 73)(N - 16) [= 0]$ $[N =] \frac{-25 \pm \sqrt{25^2 - 4 \times 3 \times -1168}}{2 \times 3}$			M1	A correct method dep on the previous M1 for solving their 3 term quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-25 \pm \sqrt{625 + 14016}}{6}$) oe (may be $\pm$ or just $+$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct, or if completing the square allow as far as the stage $3((N + \frac{25}{6})^2 - \frac{25^2}{6^2}) - 1168 (= 0)$
		Working required	16		A1	dep on M2
					Total 5 marks	

20	$\frac{3k}{4} - k$ or $\frac{k}{2} - \frac{3k}{4}$ or $\frac{k}{4} - \frac{k}{2} (= -\frac{k}{4})$ or $\frac{90+2k-k}{14} = \frac{(90+k)}{14}$		5	M1 for finding the common difference (d) in terms of k
	eg $90+2k = k + (15-1)\left(\frac{3k}{4} - k\right)$, oe or , $\frac{3k}{4} - k = \frac{90+k}{14}$, oe			M1 dep equating 2 different expressions in terms of k using their value(s) of d in terms of k (or from working using k) or other correct method to find k
	$k = -20$			A1
	$\frac{30}{2} \left[2(-20) + (30-1)\left(\frac{-20}{4}\right) \right]$ oe			M1 dep on previous M1 for correctly substituting, into $(S_n =) \frac{30}{2} [2k + (30-1)d]$ or $\frac{30}{2} (k+l)$ where $l = k + 29d$ all values to be numerical
	Correct answer scores full marks (unless from obvious incorrect working)	1575		A1
				Total 5 marks

26	$(Sm =) \frac{m}{2}(2a + (m-1)d) = 39$ oe or $(S_2m =) \frac{2m}{2}(2a + (2m-1)d) = 320$ oe		5	M1 one correct equation for S_m or S_{2m} (condone consistent use of n instead of m)
	$(Sm =) \frac{m}{2}(2a + (m-1)d) = 39$ oe and $(S_2m =) \frac{2m}{2}(2a + (2m-1)d) = 320$ oe			M1 both equations correct
	eliminate to get $dm^2 = 242$ oe			M1
	$242 = 2 \times 11 \times 11$ or $242 = 2 \times 121$ oe			M1
		$d = 2$ $m = 11$		A1 Dep on M2 Both correct
				Total 5 marks

24	$(S_{20} =) 10[2A + 19 \times 11] = 10170$ oe (where A is the $u_{(k-19)}$ th term)		5	M1
	$A = \left(\frac{10170}{10} - 19 \times 11 \right) \div 2 (= 404)$			M1
	$8 + (P-1)11 = "404"$ oe (where P is the number of terms from 20 to the end)			M1
	$P = \frac{"404" - 8 + 11}{11} (= 37)$			M1
	Working required	56		A1 dep on M1
	ALTERNATIVE METHOD			
	$(S_k =) \frac{k}{2} [2 \times 8 + (k-1)11]$ or $(S_{k-20} =) \frac{(k-20)}{2} [2 \times 8 + (k-21)11]$ or $(u_{k-19} =) 8 + 11(k-20)$ or $(u_k =) 8 + 11(k-1)$ (allow use of letter other than k)		5	M1 for S_k or S_{k-20} or u_k or u_{k-19} a and d must be substituted correctly
	$(S_k =) \frac{k}{2} [2 \times 8 + (k-1)11]$ and $(S_{k-20} =) \frac{(k-20)}{2} [2 \times 8 + (k-21)11]$ or $(u_{k-19} =) 8 + 11(k-20)$ and $(u_k =) 8 + 11(k-1)$			M1 For correct expressions for both S_k and S_{k-20} or u_k and u_{k-19}
	$10170 = \frac{k}{2} ["16" + (k-1)11] - \frac{(k-20)}{2} ["16" + (k-21)11]$ oe or $10170 = \frac{20}{2} ([8 + 11(k-20)] + [8 + 11(k-1)])$ oe			M1
	eg $10170 = 160 + \frac{11}{2} [40k - 420]$ oe eg $440k = 24640$ or $2240 = 40k$ oe			M1 Expanding to obtain a linear equation and collecting terms in k
	Working required	56		A1 dep on M1
				Total 5 marks

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)
	$\frac{n}{2}[2(32)+(n-1)(-7)] = -1914$			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				

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)
	$\frac{n}{2} [2(32) + (n-1)(-7)] = -1914$				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 $n = -\frac{132}{7}$)
	<i>Working required</i>		29		A1 dep on M2
					Total 5 marks



4	eg $4\pi R^2 = 9 \times 4\pi r^2$ oe or		5	M1	M2 for (vol SF $\Rightarrow$) 27 or $\frac{1}{27}$ or
	$R = 3r$ 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)	3^3 or $\frac{1}{3^3}$
	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 $26 \times (\text{Vol})_B = 117\pi$ or $\frac{26}{27} \times \frac{4}{3}\pi r^3 = 117\pi$ oe or $\frac{26}{27} \times (\text{Vol})_A = 117\pi$	
	$(r =) \sqrt[3]{\frac{117 \times 3}{104}} \left(= \sqrt[3]{\frac{27}{8}} \right)$ 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



19	$\frac{30}{2}[2a + (30-1)d] = 4395$ or $30a + 435d = 4395$ or $2a + 29d = 293$		5	M1 for using $S_n = \frac{n}{2}[2a + (n-1)d]$
	$a + (10-1)d + a + (20-1)d = 284$ or $a + 9d + a + 19d = 284$ or $2a + 28d = 284$ or $a + 14d = 142$			M1 for using $U_n = a + (n-1)d$ correctly to form an equation
	eg $2a + 29d = 293$ – $2a + 28d = 284$ $(d = 9)$	eg $28a + 406d = 4102$ – $29a + 406d = 4118$ $((-) a = (-) 16)$		M1 dep on M2 for a correct method to eliminate a or d : coefficients of a or d the same and correct operator to eliminate selected variable (condone any one arithmetic error) or writing a or d in terms of the other variable and correctly substituting.
	$\frac{45}{2}[2(16) + (45-1)9]$			M1 dep on previous M1 for using $S_n = \frac{n}{2}[2a + (n-1)d]$ correctly with $a = 16$ and $d = 9$
	Working required	9630		A1 dep on M2
				Total 5 marks

24	123 = a + (20 – 1)d or 123 = a + 19d		5	M1	for using $U_n = a + (n - 1)d$	
	$2880 = \frac{30}{2}(2a + (30 - 1)d)$ or $2880 = \frac{30}{2}(2a + 29d)$ or $192 = 2a + 29d$			M1	for using $S_n = \frac{n}{2}(2a + (n - 1)d)$	
	eg $192 = 2a + 29d$ $123 = a + 19d (\times 2)$ $246 = 2a + 38d$ Subtracting $54 = 9d$ or $192 = 2(123 - 19d) + 29d$ oe or $d = 6$	eg $192 = 2a + 29d (\times 19)$ $123 = a + 19d (\times 29)$ $3648 = 38a + 551d$ $3567 = 29a + 551d$ Subtracting $81 = 9a$ or $192 = 2a + 29\left(\frac{123 - a}{19}\right)$ oe or $a = 9$		M1	(dep on M2) for a correct method to find a or d: coefficients of a or d the same in correct equations and correct operator to eliminate selected variable resulting in an equation in a only or in d only or writing a or d in terms of the other variable and correctly substituting (condone missing brackets)	
	eg $192 = 2a + 29(\text{“6”})$ oe or $123 = a + 19(\text{“6”})$ oe	eg $192 = 2(\text{“9”}) + 29d$ oe or $123 = \text{“9”} + 19d$ oe		M1	(dep on M3) for substituting their found value of a or d into a correct equation	
	Working required			$a = 9$ $d = 6$	A1	dep on M2 a and d must be clearly identified
					Total 5 marks	

21	E.g. $a + 3d = 6$ oe		6	M1	for forming an equation for the 4 th term of the sequence
	E.g. $\frac{11}{2}(2a + 10d) = (a + 5d)^2 + 18$			M1	for forming an equation for the sum of the first 11 terms of the sequence
	E.g. $a = 6 - 3d$ and $\frac{11}{2}[2(6 - 3d) + 10d] = (6 - 3d + 5d)^2 + 18$ or $d = \frac{6-a}{3}$ and $\frac{11}{2}\left[2a + 10\left(\frac{6-a}{3}\right)\right] = \left(a + 5\left(\frac{6-a}{3}\right)\right)^2 + 18$			M1	dep on M2 for a correct first step to solve the two equations (writing the equation in terms of one variable) Note: If $\frac{11}{2}(2a + 10d) = (a + 5d)^2 + 18$ is expanded then this must be a correct expansion E.g. $11a + 55d = a^2 + 10ad + 25d^2 + 18$
	E.g. $2d^2 + d - 6 (=0)$ oe or $2a^2 - 27a + 36 (=0)$ oe			A1	for a correct 3 term quadratic equation
	$d = 1.5$ oe and $a = 1.5$ oe			A1	for a correct value of d and a
		30		A1	cao
Total 6 marks					

23	$d = -2$	6	M1 for common difference
	$(S_n =) \frac{n}{2} [2(177) + (n-1)(-2)]$ or $(S_n =) \frac{n}{2} [354 - 2n + 2]$ or $(S_n =) \frac{n}{2} [356 - 2n]$ oe		M1 for correctly substituting 177 and -2 into $(S_n =) \frac{n}{2} [2a + (n-1)d]$
	$\frac{n}{2} [2(177) + (n-1)(-2)] = (n-2) \times 180$		M1 dep on M2 for equating S_n with $(n-2) \times 180$
	E.g. $2n^2 + 4n - 720 = 0$ or $n^2 + 2n - 360 = 0$ oe Allow $n^2 + 2n = 360$		A1 (dep on M3) writing a correct 3-term quadratic expression in form $ax^2 + bx + c$ ($= 0$) allow $ax^2 + bx = c$
	E.g. $(x-18)(x+20) (= 0)$ $x = \frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -360}}{2}$ e.g. $(x+1)^2 - (1)^2 = 360$		M1 (dep on M2) for a complete method to solve their 3-term quadratic equation Allow one sign error and some simplification – allow as far as $\frac{-2 \pm \sqrt{4+1440}}{2}$
		18	A1 dep on M3 for 18 only
Total 6 marks			



23 ALT	3, 5, 7, ... and $d = 2$ or $a = 3$ and $d = 2$		6	M1 for identifying exterior angle sequence for at least 3 terms and $d = 2$ or first term and common difference
	$(S_n =) \frac{n}{2} [2(3) + (n-1)(2)]$ or $(S_n =) \frac{n}{2} [6 + 2n - 2]$ or $(S_n =) \frac{n}{2} [4 + 2n]$ oe			M1 for correctly substituting 3 and 2 into $(S_n =) \frac{n}{2} [2a + (n-1)d]$
	$\frac{n}{2} [2(3) + (n-1)(2)] = 360$			M1 dep on M2 for equating S_n with 360
	E.g. $2n^2 + 4n - 720 = 0$ or $n^2 + 2n - 360 = 0$ oe Allow $n^2 + 2n = 360$			A1 (dep on M3) writing a correct 3-term quadratic expression in form $ax^2 + bx + c$ ($= 0$) allow $ax^2 + bx = c$
	E.g. $(x-18)(x+20) (= 0)$ $x = \frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -360}}{2}$ e.g. $(x+1)^2 - (1)^2 = 360$			M1 (dep on M2) for a complete method to solve their 3-term quadratic equation Allow one sign error and some simplification – allow as far as $\frac{-2 \pm \sqrt{4 + 1440}}{2}$
		18		A1 dep on M3 for 18 only
				Total 6 marks

20	$\frac{80}{2}(2a+79d)=470$ oe		6	M1	for substituting into the sum of arithmetic series formula
	$a+74d=14.5$ oe			M1	for substituting into the nth term of arithmetic sequence formula
	correct method to find the value of a or d eg $2a+148d=29$ – $2a+79d=11.75$			M1	solve the correct equations simultaneously, eg make the coefficients of a or d the same and show the intention to subtract or rearrange one equation to make a or d the subject and substitute into the other equation
	correct values of $a=-4$ and $d=0.25$ oe			A1	dep on M2
	$\frac{X}{2}(2\times"-4"+(X-1)"0.25")=171$ oe			M1	correctly substituting the found values of a and d into a correct equation, can be their values of a and d as long as clearly stated
	Working required	57		A1	dep on M2
Total 6 marks					

21	(a)	(10, 5)	1	B1	cao
	(b)	(2, 5)	1	B1	cao
Total 2 marks					



19	$a = 3$ and $d = 4$		6	M1 for a and d (can be embedded in the formula for S_n)
	$\frac{n}{2}[2(3) + (n-1)4] = 7260$ or $\frac{n}{2}(2 + 4n) = 7260$ oe	$\frac{n}{2}(3 + x) = 7260$ and $x = 3 + (n-1)4$		M1 Allow $n = x$
	eg $4n^2 + 2n = 14520$ oe $2n^2 + n - 7260 (= 0)$ oe $8n^2 + 4n - 29040 (= 0)$ oe	eg $x^2 + 4x - 58077 = 0$ oe $x^2 + 4x = 58077$		M1ft dep on previous M1 for 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
	eg $(2n+121)(n-60)(=0)$ eg $(n =) \frac{-1 \pm \sqrt{1^2 - 4 \times 2 \times -7260}}{4}$ eg $2\left[\left(n + \frac{1}{4}\right)^2 - \left(\frac{1}{4}\right)^2\right] = 7260$	eg $(x-239)(x+243)(=0)$ eg $(x =) \frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times -58077}}{2}$ eg $(x+2)^2 - (2)^2 = 58077$		M1ft dep on previous M1 for a method to solve their 3 term quadratic using any correct method Allow one sign error and some simplification – allow as far as eg $\frac{-1 \pm \sqrt{1 + 58080}}{4}$ or $\frac{-4 \pm \sqrt{16 + 232308}}{2}$
	$(n =) 60$ (and $(n =) -60.5$)	$(x =) 239$ (and $(x =) -243$)		A1 dep on M3 Ignore negative values
	<i>Working required</i>		239	A1 cao dep on M3 SCB2 if not shown clear algebraic working but give an answer of 239 (with method shown involving $a = 3$ and $d = 4$) as question asks for algebraic working. 239 alone gains zero marks
				Total 6 marks



24	eg $(d \Rightarrow) (3y - 4) - (2x + 5) (= 3y - 2x - 9)$ or $(2x + 5) + d = 3y - 4$ oe or $(d \Rightarrow) (4x - 2) - (3y - 4) (= 4x - 3y + 2)$ or $(3y - 4) + d = (4x - 2)$ or $(2d \Rightarrow) (4x - 2) - (2x + 5) (= 2x - 7)$ or $(2x + 5) + 2d = (4x - 2)$ oe		6	M1 for a correct expression or equation using the common difference, may be in terms of d for this mark we will allow an expression for $-d$ or $-2d$
	eg $216 = \frac{9}{2} [2(2x + 5) + (9 - 1)d]$ or $216 = \frac{9}{2} [2(2x + 5) + (9 - 1)(3y - 2x - 9)]$ or $216 = \frac{9}{2} [2(2x + 5) + (9 - 1)(4x - 3y + 2)]$ or $216 = \frac{9}{2} [2(2x + 5) + (9 - 1)(x - 3.5)]$ or $216 = \frac{9}{2} [2(2(x + 3.5) + 5) + 8d]$			M1 for a correct equation for the sum of 9 terms in x and d or in terms of x and y or in terms of d for " $3y - 2x - 9$ " we will allow $(3y - 4) - (2x + 5)$ or for using their incorrect simplification from $(3y - 4) - (2x + 5)$ shown for " $4x - 3y + 2$ " we will allow $(4x - 2) - (3y - 4)$ or for using their incorrect simplification from $(4x - 2) - (3y - 4)$ shown similarly for their " $x - 3.5$ " and their " $d + 3.5$ "
	eg $6x - 6y = -11$ oe and $12y - 6x = 55$ oe or $6x - 6y = -11$ oe and $18x - 12y = 11$ oe or $2x - 2d = 7$ oe and $8d + 4x = 38$ oe	eg $d = x - 3.5$ oe and $48 = 12x - 18$ oe or $x = d + 3.5$ oe and $48 = 12d + 24$ oe or $d = 4.75 - 0.5x$ oe and $3x - 2 = 14.5$ oe		M2 left hand column 2 correct equations in terms of x and y in the form $px + qy = r$ oe or 2 correct equations in terms of x and d in the form $px + qd = r$ oe right hand column 2 correct equations in terms of x and y where one is substituted into the other to get a correct equation in the form $px + q = r$ or $py + q = r$ or 2 correct equations in terms of x and d where one is substituted into the other to get a correct equation in the form $px + q = r$ or $pd + q = r$ If not M2 then M1 for one correct equation in any of the required forms from <u>the left hand or right hand column</u>
	one equation must be from the differences and one equation must be from the sum of the terms			
	Working required	$x = \frac{11}{2}$ $y = \frac{22}{3}$		A2 (dep on M2) oe (allow 7.3(33...)) (A1 for $x = \frac{11}{2}$ or $y = \frac{22}{3}$)
				Total 6 marks

Question	Working	Answer	Mark	Notes
11	$12 \times 5.5 (= 66)$	4.2	3	M1
	$\frac{"66"+18}{20}$			M1 for a complete method
				A1
12 (a)	$(2n - 1)^2 = 4n^2 - 4n + 1$	$\frac{n}{2n - 1}$	2	M1 for $2n \pm k$ oe as the denominator
				A1 oe
				M1 or $(2n + 1)^2 = 4n^2 + 4n + 1$ ft on $2n \pm k$ (k non zero)
				M1 or $4(n^2 + n) + 1$ or $\frac{4n^2 + 4n + 1}{4} = n^2 + n + \frac{1}{4}$
				A1 Conclusion
(b)	$4(n^2 - n) + 1$ or $\frac{4n^2 - 4n + 1}{4} = n^2 - n + \frac{1}{4}$	Proved	3	

