KS5 "Full Coverage": Sequences

This worksheet is designed to cover one question of each type seen in past papers, for each A Level topic. This worksheet was automatically generated by the DrFrostMaths Homework Platform: students can practice this set of questions interactively by going to www.drfrostmaths.com, logging on, *Practise* → *Past Papers* (or *Library* → *Past Papers* for teachers), and using the 'Revision' tab.

Question 1

Categorisation: Determine the nth term in an arithmetic sequence.

[Edexcel C1 June 2018 Q4a]

Each year, Andy pays into a savings scheme. In year one he pays in £600. His payments increase by £120 each year so that he pays £720 in year two, £840 in year three and so on, so that his payments form an arithmetic sequence.

Find out how much Andy pays into the savings scheme in year ten.

£ ....

Question 2

Categorisation: Determine the common difference in an arithmetic sequence.

[Edexcel C1 May 2017 Q4a]

A company, which is making 140 bicycles each week, plans to increase its production. The number of bicycles produced is to be increased by d each week, starting from 140 in week 1, to 140 + d in week 2, to 140 + $2d$ in week 3 and so on, until the company is producing 206 in week 12.

Find the value of d .

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Question 3

Categorisation: Deal with arithmetic sequences involving algebraic terms.

[Edexcel C1 May 2011 Q9c]

Find, in terms of k , the 50th term of the arithmetic sequence

$(2k + 1)$, $(4k + 4)$, $(6k + 7)$, ...

giving your answer in its simplest form.

....

Question 4

Categorisation: Determine the total of the first n terms of an arithmetic sequence.

[Edexcel C1 May 2016 Q9a Edited]

On John's 10th birthday he received the first of an annual birthday gift of money from his uncle. This first gift was £60 and on each subsequent birthday the gift was £15 more than the year before. The amounts of these gifts form an arithmetic sequence.

Determine the total of these gifts immediately after his 12th birthday.

£ ....

Question 5

Categorisation: Determine the sum of an arithmetic sequence where the terms are explicitly written out.

[Edexcel C1 May 2011 Q9a]

Calculate the sum of all the even numbers from 2 to 100 inclusive.

$$2 + 4 + 6 + \cdots + 100$$

……………………

Question 6

Categorisation: Form equations involving information about arithmetic sequences.

[Edexcel C1 Jan 2011 Q6a Edited]

An arithmetic sequence has first term a and common difference d. The sum of the first 10 terms of the sequence is 162.

Write an equation involving a and d.

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Question 7

Categorisation: Solve equations from two sequences simultaneous, e.g. to find the first term and common difference.

[Edexcel C1 Jan 2011 Q6c Edited] (Continued from above)

Given also that the sixth term of the sequence is 17, write down a second equation in a and d, and hence determine the values of a and the value of d.

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Question 8

Categorisation: As above.

[Edexcel C1 Jan 2012 Q9c]

A company offers two salary schemes for a 10-year period, Year 1 to Year 10 inclusive.

Scheme 1: Salary in Year 1 is £P .
Salary increases by £($2T$) each year, forming an arithmetic sequence.

Scheme 2: Salary in Year 1 is £$(P + 1800)$.
Salary increases by £ T each year, forming an arithmetic sequence.

If $T = 400$, the salary in Year 10 under Salary Scheme 2 is £29 850. Find the value of P .

$P =$ £ ....

Question 9

Categorisation: As above, but involving some other relationship between the two sequences.

[Edexcel C1 June 2018 Q4b]

Each year, Andy pays into a savings scheme. In year one he pays in £600. His payments increase by £120 each year so that he pays £720 in year two, £840 in year three and so on, so that his payments form an arithmetic sequence.

Kim starts paying money into a different savings scheme at the same time as Andy. In year one she pays in £130. Her payments increase each year so that she pays £210 in year two, £290 in year three and so on, so that her payments form a different arithmetic sequence.

At the end of year N , Andy has paid, in total, twice as much money into his savings scheme as Kim has paid, in total, into her savings scheme.

Find the value of N .

....

Question 10

Categorisation: Show the sum of terms in an arithmetic sequence exhibits some property.

[Edexcel A2 Specimen Papers P2 Q11 Edited]

The second, third and fourth terms of an arithmetic sequence are $2k$, $5k - 10$ and $7k - 14$ respectively, where k is a constant.

Show that the sum of the first n terms of the sequence is a square number.

Input note: write S_n in the form $(\dots)^2$

Question 11

Categorisation: Deal with sums of terms of an arithmetic sequence involving an unknown number of terms.

[Edexcel C1 May 2016 Q9d Edited]

On John's 10th birthday he received the first of an annual birthday gift of money from his uncle. This first gift was £60 and on each subsequent birthday the gift was £15 more than the year before. The amounts of these gifts form an arithmetic sequence.

When John had received n of these birthday gifts, the total money that he had received from these gifts was £3375.

Show that $n^2 + an = 25 \times b$, where a and b are constants to determine.

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Question 12

Categorisation: Determine the number of terms in an arithmetic sequence.

[Edexcel C1 May 2011 Q9bi] In the arithmetic series

$k + 2k + 3k + \cdots + 100$,

k is a positive integer and k is a factor of 100.

Find, in terms of k , an expression for the number of terms in this series.

…………………….. terms

Question 13

Categorisation: Problem solving involving sums of terms in an arithmetic sequence.

[Edexcel C1 May 2011 Q9bii] In the arithmetic series

$k + 2k + 3k + \cdots + 100$,

k is a positive integer and k is a factor of 100.

Show that the sum of this series is $a + \frac{b}{k}$, where a and b are integers to be found.

……………………..

Question 14

Categorisation: Find subsequent terms in a geometric sequence.

[Edexcel C2 June 2010 Q9a Edited] The adult population of a town is 25 000 at the end of Year 1.

A model predicts that the adult population of the town will increase by 3% each year, forming a geometric sequence.

Find the predicted adult population at the end of Year 2.

……………………..

Question 15

Categorisation: Find the nth term of a geometric sequence.

[Edexcel C2 Jan 2010 Q6c] A car was purchased for £18 000 on 1st January.

An insurance company has a scheme to cover the cost of maintenance of the car. The cost is £200 for the first year, and for every following year the cost increases by 12% so that for the 3rd year the cost of the scheme is £250.88.

Find the cost of the scheme for the 5th year, giving your answer to the nearest penny.

£ ....

Question 16

Categorisation: Continue a geometric sequence.

[Edexcel C2 May 2013 Q1b] The first three terms of a geometric series are 18 , 12 and p respectively, where p is a constant.

Find the value of p .

$p =$ ....

Question 17

Categorisation: Use the properties of a geometric sequence to generate an equation relating the first few terms.

[Edexcel C2 May 2017 Q9a Edited] The first three terms of a geometric sequence are

$7k - 5$, $5k - 7$, $2k + 10$

where k is a constant.

Show that $11k^2 + ak + b = 0$ where a and b are constants to be found.

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Question 18

Categorisation: Use logs to determine an unknown n in a geometric sequence.

[Edexcel C2 Jan 2010 Q6b] A car was purchased for £18 000 on 1st January.

On 1st January each following year, the value of the car is 80% of its value on 1st January in the previous year.

The value of the car falls below £1000 for the first time n years after it was purchased.

Find the value of n .

$n =$ ……………………

Question 19

Categorisation: Determine the sum of terms in a geometric sequence.

[Edexcel C2 Jan 2013 Q3c] A company predicts a yearly profit of £120 000 in the year 2013. The company predicts that the yearly profit will rise each year by 5%. The predicted yearly profit forms a geometric sequence with common ratio 1.05.

Find the total predicted profit for the years 2013 to 2023 inclusive, giving your answer to the nearest pound.

£ ……………………

Question 20

Categorisation: As above.

[Edexcel A2 Specimen Papers P1 Q8a] There were 2100 tonnes of wheat harvested on a farm during 2017.
The mass of wheat harvested during each subsequent year is expected to increase by 1.2% per year.

Find the total mass of wheat expected to be harvested from 2017 to 2030 inclusive, giving your answer to 3 significant figures.

…………………… tonnes

Question 21
Categorisation: Problem solving involving sum of terms in a geometric sequence.

[Edexcel A2 Specimen Papers P1 Q8b Edited] There were 2100 tonnes of wheat harvested on a farm during 2017.
The mass of wheat harvested during each subsequent year is expected to increase by 1.2% per year.

The total mass of wheat expected to be harvested from 2017 to 2030 inclusive is 31 806.9948... tonnes.

Each year it costs

- £5.15 per tonne to harvest the first 2000 tonnes of wheat
- £6.45 per tonne to harvest wheat in excess of 2000 tonnes

Use this information to find the expected cost of harvesting the wheat from 2017 to 2030 inclusive. Give your answer to the nearest £1000

£ ....

Question 22
Categorisation: Sum of terms of a geometric sequence involving an unknown n.

[Edexcel C2 May 2015 Q5ii] A geometric series has a first term of 42 and a common ratio of $\frac{6}{7}$.

Find the smallest value of n for which the sum of the first n terms of the series exceeds 290.

$n =$ ....

Question 23

Categorisation: Use the formula $S_\infty = \frac{a}{1-r}$ for the convergent sum to infinity of a geometric sequence.

[Edexcel C2 June 2018 Q6a] A geometric series with common ratio $r = -0.9$ has sum to infinity 10000

For this series, find the first term.

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Question 24

Categorisation: As above.

[Edexcel C2 May 2015 Q5ia] All the terms of a geometric series are positive. The sum of the first two terms is 34 and the sum to infinity is 162.

Find the common ratio.

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Question 25

Categorisation: Problem solving involving sum to infinity.

[Edexcel C2 May 2014 Q6c Edited] The first term of a geometric series is 20 and the common ratio is $\frac{7}{8}$. The sum to infinity of the series is S_∞.

The sum to N terms of the series S_N.

Given that $S_\infty = 160$, find the smallest value of N for which $S_\infty - S_N < 0.5$.

$N =$ ....

Question 26

Categorisation: As above.

[Edexcel A2 SAM P2 Q10] In a geometric series the common ratio is r and sum to n terms is S_n. Given

$$S_\infty = \frac{8}{7} \times S_6$$

show that $r = \pm\frac{1}{\sqrt{k}}$, where k is an integer to be found.

....

Question 27

Categorisation: As above.

[Edexcel C2 May 2016 Q1b Edited]

A geometric series has first term a and common ratio $r = \frac{3}{4}$.
The sum of the first 4 terms of this series is 175.

Given that $a = 64$, find the sum to infinity of the series.

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Question 28

Categorisation: Find the nth term of a geometric sequence.

[Edexcel C2 Jan 2010 Q6a Edited]

A car was purchased for £18 000 on 1st January.

On 1st January each following year, the value of the car is 80% of its value on 1st January in the previous year.

Find the value of the car exactly 3 years after it was purchased.

£ ....

Question 29

Categorisation: Use a recurrence relation.

[Edexcel C1 May 2011 Q5ci] A sequence $a_1, a_2, a_3, ...$ is defined by

$a_1 = k$, $\quad a_{n+1} = 5a_n + 3$, $\quad n \geq 1$,

where k is a positive integer.

Find $\sum_{r=1}^{4} a_r$ in terms of k , in its simplest form.

....

Question 30

Categorisation: Find the sum of a large number of terms in a recurrence relation by identifying a repeating pattern.

[Edexcel A2 Specimen Papers P1 Q3a] A sequence of numbers a_1 , a_2 , a_3 , ... is defined by

$a_1 = 3$

$a_{n+1} = \frac{a_n - 3}{a_n - 2} \quad n \in \mathbb{N}$

Find $\sum_{r=1}^{100} a_r$

....

Question 31

Categorisation: As above.

[Edexcel A2 Specimen Papers P1 Q3b Edited] (Continued from above)

Hence find $\sum_{r=1}^{100} a_r + \sum_{r=1}^{99} a_r$

....

Question 32

Categorisation: Determine the value of a constant in a recurrence relation by using a given sum.

[Edexcel C1 May 2015 Q4iib]

A sequence $V_1, V_2, V_3, \ldots$ is defined by

$V_{n+2} = 2V_{n+1} - V_n$, $n \geq 1$,
$V_1 = k$ and $V_2 = 2k$, where k is a constant.

Given that $\sum_{r=1}^{5} V_r = 165$, find the value of k .

$k =$ ....

Question 33

Categorisation: As above.

[Edexcel C1 May 2014(R) Q3b]

A sequence $a_1, a_2, a_3, \ldots$ is defined by

$a_{n+1} = 4a_n - 3$, $n \geq 1$
$a_1 = k$,   where k is a positive integer.

Given that $\sum_{r=1}^{3} a_r = 66$, find the value of k .

$k =$ ....

Question 34

Categorisation: Determine the sum of a more complicated expression.

[Edexcel C1 May 2016 Q6c] A sequence $a_1, a_2, a_3, \dots$ is defined by

$a_1 = 4$, $\quad a_{n+1} = 5 - ka_n$, $\quad n \geq 1$,

where k is a constant.

Find $\sum_{r=1}^{100}(a_{r+1} + ka_r)$

....

Question 35

Categorisation: Solve an inequality involving a sum of terms in a recurrence relation.

[Edexcel C1 May 2012 Q5c]

A sequence of numbers $a_1, a_2, a_3, \dots$ is defined by

$a_1 = 3$, $\quad a_{n+1} = 2a_n - c$, $\quad (n \geq 1)$,

where c is a constant.

Given that $\sum_{r=1}^{4} a_i \geq 23$, find a range of values for c .

....

Question 36

Categorisation: Solve a quadratic equation involving sum of terms.

[Edexcel C1 May 2013 Q4b]

A sequence $a_1, a_2, a_3, \ldots$ is defined by

$a_1 = 4 \qquad a_{n+1} = k(a_n + 2)$, for $n \geq 1$

where k is a constant.

Given that $\sum_{r=1}^{3} a_i = 2$, find the two possible values of k.

....

Question 37

Categorisation: As per Q33.

[Edexcel C1 May 2013(R) Q6d]

A sequence $x_1, x_2, x_3, \ldots$ is defined by

$x_1 = 1$, $\qquad x_{n+1} = (x_n)^2 - kx_n$, $\quad n \geq 1$

where k is a constant.

Given that $k = \frac{3}{2}$, hence find the value of $\sum_{n=1}^{100} x_n$.

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Answers

Question 1

£ 1680

$a+(n-1)d = 600+9\times120$	This mark is for: $600+9\times120$ or $600+8\times120$	M1
$=(£)1680$	1680 with or without the "£"	A1

Question 2

$d = 6$

$206 = 140+(12-1)\times d \Rightarrow d = ...$	Uses $206=140+(12-1)\times d$ and proceeds as far as $d = ...$	M1
$(d=)6$	Correct answer only can score both marks.	A1

Question 3

$100k + 148$

(c)	50^{th} term $= a+(n-1)d$ $= (2k+1)+49"(2k+3)"$ $= 100k+148$	Or $2k+49(2k)+1+49(3)$ $=100k+148$	M1 A1

Question 4

£ 225

$60+75+90=225^*$ or $S_3 = \frac{3}{2}(120+(3-1)(15)) = 225^*$	Finds and adds the first 3 terms or uses sum of 3 terms of an AP and obtains the printed answer, with no errors.	B1 *

Question 5

2550

(a)	Series has 50 terms $S = \frac{1}{2}(50)(2+100) = 2550$ or $S = \frac{1}{2}(50)(4+49\times2) = 2550$	B1 M1 A1

Question 6

$10a + 45d = 162$

(a)	$S_{10} = \frac{10}{2}[2a+9d]$ or $S_{10} = a+a+d+a+2d+a+3d+a+4d+a+5da+6d+a+7d+a+8d+a+9d$ $162 = 10a+45d$ *	M1 A1cso

Question 7

$a = 9$, $d = 1.6$

(b)	$(u_n = a + (n-1)d \;\Rightarrow\;)17 = a + 5d$	B1	
			(1)
	$10 \times (b)$ gives $10a + 50d = 170$ (a) is $10a + 45d = 162$	M1	
	Subtract $5d = 8$ so $d = \underline{1.6}$ o.e.	A1	
	Solving for a $a = 17 - 5d$	M1	
	so $a = \underline{9}$	A1	
			(4)

Question 8

$P = £\ 24450$

(c)	Scheme 2, Year 10 salary: $[a + (n-1)d =](P + 1800) + 9T$	B1ft	
	P + 1800 + "3600" = 29850	M1	
	P = (£) $\underline{24450}$	A1	(3)

Question 9

$N = 18$

$d = 80$ for Kim	Identifies or uses $d = 80$ for Kim	B1
$\frac{N}{2}\{2\times 600 + (N-1)\times 120\}$ OR $\frac{N}{2}\{2\times 130 + (N-1)\times 80\}$	Attempts a sum formula for Andy or Kim. A correct formula must be seen or implied with: a = 600, d = 120 for Andy **or** a = 130, d = 80 for Kim. If B0 was scored, allow M1 here if Kim's incorrect "d" is used.	M1
$\frac{N}{2}\{2\times 600 + (N-1)\times 120\} = 2\times\frac{N}{2}\{2\times 130 + (N-1)\times 80\}$ A **correct** equation in any form		A1
$20N = 360 \Rightarrow N = ...$	Proceeds to find a value for N. (Allow if it leads to $N < 0$) **Dependent on the first method mark and must be an equation that uses Andy's and Kim's sum.**	dM1
$(N =)18$	Ignore $N/n = 0$ and if a correct value of N is seen, isw any further reference to years etc.	A1

Question 10

$S_n = (2n)^2$

Arithmetic sequence, $T_2 = 2k$, $T_3 = 5k - 10$, $T_4 = 7k - 14$		
$(5k-10)-(2k) = (7k-14)-(5k-10) \Rightarrow k = ...$	M1	2.1
$\{3k - 10 = 2k - 4 \Rightarrow\}$ $k = 6$	A1	1.1b
$\{k = 6 \Rightarrow\}$ $T_2 = 12$, $T_3 = 20$, $T_4 = 28$. So $d = 8$, $a = 4$	M1	2.2a
$S_n = \frac{n}{2}(2(4) + (n-1)(8))$	M1	1.1b
$= \frac{n}{2}(8 + 8n - 8) = 4n^2 = (2n)^2$ which is a square number	A1	2.1

Question 11

$a = 7$, $b = 18$

$3375 = \frac{n}{2}(120 + (n-1)(15))$	Uses correct formula for sum of n terms with $a = 60$, $d = 15$ and puts $= 3375$	M1
$6750 = 15n(8 + (n-1)) \Rightarrow 15n^2 + 105n = 6750$	**Correct three term** quadratic. E.g. $6750 = 105n + 15n^2$, $3375 = \frac{15}{2}n^2 + \frac{105}{2}n$ This may be implied by equations such as $6750 = 15n(n+7)$ or $3375 = \frac{15}{2}(n^2 + 7n)$	A1
$n^2 + 7n = 25 \times 18$ *	Achieves the printed answer with no errors but must see the 450 or 450 in factorised form or e.g. 6750, 3375 in factorised form i.e. an intermediate step.	A1*

Question 12

$\frac{100}{k}$

(b) **(i)**	$\frac{100}{k}$	B1

Question 13

$a = 50$, $b = 5000$

(ii)	Sum: $\frac{1}{2}\left(\frac{100}{k}\right)(k + 100)$ or $\frac{1}{2}\left(\frac{100}{k}\right)\left(2k + \left(\frac{100}{k} - 1\right)k\right)$	M1 A1
	$= 50 + \frac{5000}{k}$ (*)	A1 cso

Question 14

25750

(a) $25\,000 \times 1.03 = 25750$ $\left\{25000 + 750 = 25750, \text{ or } 25000\frac{(1-0.03^2)}{1-0.03} = 25750\right\}$ (*)	B1

Question 15

£ 314.70

$u_5 = 200\times(1.12)^4$, $= £314.70$ or $£314.71$	M1, A1

Question 16

$p = 8$

$\{p =\}\ 8$	B1 cao

Question 17

$a = -130$, $b = 99$

$a = 7k-5,\ ar = 5k-7$ and $ar^2 = 2k+10$	B1
(So $r =$) $\frac{5k-7}{7k-5} = \frac{2k+10}{5k-7}$ or $(7k-5)(2k+10) = (5k-7)^2$ or equivalent	M1
See $(5k-7)^2 = 25k^2 - 70k + 49$	M1
$14k^2 + 60k - 50 = 25k^2 - 70k + 49 \rightarrow 11k^2 - 130k + 99 = 0$ *	A1cso *

Question 18

$n =\ 13$

$18000\times(0.8)^n < 1000$	M1
$n\log(0.8) < \log(\frac{1}{18})$	M1
$n > \frac{\log(\frac{1}{18})}{\log(0.8)} = 12.952....$ so $n = 13$.	A1 cso

Question 19

£ 1704814

$\frac{a(1-r^n)}{1-r} = \frac{120000(1-1.05^{11})}{1-1.05}$	M1: Correct sum formula with $n = 10$, 11 or 12 A1: Correct numerical expression with $n = 11$	M1 A1
1704814	Cao (Allow 1704814.00)	A1

Question 20

31800 tonnes

Total amount $= \frac{2100(1-(1.012)^{14})}{1-1.012}$ or $\frac{2100((1.012)^{14}-1)}{1.012-1}$	M1	3.1b
$= 31806.9948\ldots = 31800$ (tonnes) (3 sf)	A1	1.1b

Question 21

£ 169000

Total Cost = 5.15(2000(14)) + 6.45(31806.9948... − (2000)(14))	M1	3.1b
	M1	1.1b
= 5.15(28000) + 6.45(3806.9948...) = 144200 + 24555.116...		
= 168755.116... = £169000 (nearest £1000)	A1	3.2a

Question 22

$n =$ 28

$\frac{42(1-\frac{6}{7}^n)}{1-\frac{6}{7}} > 290$ (For trial and improvement approach see notes below)	M1
to obtain So $(\frac{6}{7})^n < (\frac{4}{294})$ or equivalent e.g. $(\frac{7}{6})^n > (\frac{294}{4})$ or $(\frac{6}{7})^n < (\frac{2}{147})$	A1
So $n > \frac{\log"(\frac{4}{294})"}{\log(\frac{6}{7})}$ or $\log_{\frac{6}{7}}"(\frac{4}{294})"$ or equivalent but must be log of positive quantity	M1
(i.e. $n >$ 27.9) so $n = 28$	A1

Question 23

$a = 19000$

$10000 = \frac{a}{1-(-0.9)}$	M1
$a = 19000$	A1

Question 24

$\frac{8}{9}$

$a + ar = 34$ or $\frac{a(1-r^2)}{(1-r)} = 34$ or $\frac{a(r^2-1)}{(r-1)} = 34$; $\frac{a}{1-r} = 162$	B1; B1
Eliminate a to give $(1+r)(1-r) = \frac{17}{81}$ or $1 - r^2 = \frac{34}{162}$ .. (not a cubic)	aM1
(and so $r^2 = \frac{64}{81}$ and) $r = \frac{8}{9}$ only	aA1 **(4)**

Question 25

$N = 44$

$160 - \frac{20(1-(\frac{7}{8})^N)}{1-\frac{7}{8}} < 0.5$	Applies S_N (**GP only**) with $a = 20$, $r = \frac{7}{8}$ and "uses" 0.5 and their S_∞ at any point in their working. (condone missing brackets around 7/8)(Allow $=, <, >, \geq, \leq$) but see note below.	M1
$160\left(\frac{7}{8}\right)^N < (0.5)$ or $\left(\frac{7}{8}\right)^N < \left(\frac{0.5}{160}\right)$	Attempt to isolate $+160(\frac{7}{8})^N$ or $+(\frac{7}{8})^N$ oe (Allow $=, <, >, \geq, \leq$) but see note below. **Dependent on the previous M1**	dM1
$N\log\left(\frac{7}{8}\right) < \log\left(\frac{0.5}{160}\right)$	Uses the power law of logarithms or takes logs base 0.875 correctly to obtain an equation or an inequality of the form $N\log\left(\frac{7}{8}\right) < \log\left(\frac{0.5}{\text{their } S_\infty}\right)$ or $N > \log_{0.875}\left(\frac{0.5}{\text{their } S_\infty}\right)$ (Allow $=, <, >, \geq, \leq$) but see note below.	M1
$N > \frac{\log(\frac{0.5}{160})}{\log(\frac{7}{8})} = 43.19823... \Rightarrow N = 44$	$N = 44$ (Allow $N \geq 44$ but not $N > 44$	A1 cso

Question 26

$k = 2$

Attempts $S_\infty = \frac{8}{7} \times S_6 \Rightarrow \frac{a}{1-r} = \frac{8}{7} \times \frac{a(1-r^6)}{1-r}$	M1
$\Rightarrow 1 = \frac{8}{7} \times (1-r^6)$	M1
$\Rightarrow r^6 = \frac{1}{8} \Rightarrow r = ..$	M1
$\Rightarrow r = \pm\frac{1}{\sqrt{2}}$ (so $k = 2$)	A1

Question 27

256

$\{S_\infty\} = \frac{64}{\left(1-\frac{3}{4}\right)}$; $= 256$	$S_\infty = \frac{(\text{their } a)}{1-\frac{3}{4}}$ or $\frac{64}{1-\frac{3}{4}}$	M1;
	256	A1cao

Question 28

£ 9216

$18000 \times (0.8)^3 = £9216$ * [may see $\frac{4}{5}$ or 80% or equivalent].	B1cso

Question 29

$156k + 114$

Question 30

$a_1 = 3$, $a_2 = 0$, $a_3 = 1.5$, $a_4 = 3$	M1	1.1b
$\sum_{r=1}^{100} a_r = 33(4.5) + 3$	M1	2.2a
$= 151.5$	A1	1.1b

Question 31

$\sum_{r=1}^{100} a_r + \sum_{r=1}^{99} a_r = (2)(151.5) - 3 = 300$	B1ft	2.2a

Question 32

$\sum_{n=1}^{n=5} V_n = k + 2k + 3k + 4k + 5k = 165$ or $\frac{1}{2} \times 5(2 \times k + 4 \times k) = 165$ or $\frac{1}{2} \times 5(k + 5k) = 165$	Attempts V_5, adds their V_1, V_2, V_3, V_4, V_5 AND sets equal to 165 or Use of a correct sum formula with $a = k$, $d = k$ and $n = 5$ or $a = k$, $l = 5k$ and $n = 5$ AND sets equal to 165	M1
$15k = 165 \Rightarrow k = ..$	Attempts to solve their linear equation in k **having set the sum of their first 5 terms equal to 165.** Solving $V_5 =$ 165 scores no marks.	M1
$k = 11$	cao and cso	A1

Question 33

$a_3 = 4(4k-3) - 3$	M1
$\sum_{r=1}^{3} a_r = k + 4k - 3 + 4(4k-3) - 3 = ..k \pm ...$	M1
$21k - 18 = 66 \Rightarrow k = ...$	dM1
$k = 4$	A1

Question 34

500	cao	B1

Question 35

$$c \leq 2$$

$a_4 = 2 \times (\text{"}12 - 3c\text{"}) - c \qquad \{= 24 - 7c\}$	M1
$\left\{\sum_{i=1}^{4} a_i =\right\} \; 3 + (6 - c) + (12 - 3c) + (24 - 7c)$	M1
$\text{"}45 - 11c\text{"} \geq 23$ or $\text{"}45 - 11c\text{"} = 23$	M1
$c \leq 2$ or $2 \geq c$	A1 cso

Question 36

$k = -\frac{1}{3}$ or $k = -1$

$a_3 = k(\text{their } a_2 + 2)\ (= 6k^2 + 2k)$	An attempt at a_3. Can follow through their answer to (a) but a_2 must be an expression in k.	M1
$a_1 + a_2 + a_3 = 4 + (6k) + (6k^2 + 2k)$	An attempt to find their $a_1 + a_2 + a_3$	M1
$4 + (6k) + (6k^2 + 2k) = 2$	A **correct** equation in any form.	A1
Solves $6k^2 + 8k + 2 = 0$ to obtain $k =$ $(6k^2 + 8k + 2 = 2(3k+1)(k+1))$	Solves their 3TQ as far as $k =$ .... according to the general principles. (An independent mark for solving their three term quadratic)	M1
$k = -1/3$	Any equivalent fraction	A1
$k = -1$	Must be from a correct equation. (Do not accept un-simplified)	B1

Question 37

25

$\sum_{n=1}^{100} x_n = 1 + \left(-\frac{1}{2}\right) + 1 + \ldots\ldots$ Or $= 1 + (1 - 'k') + 1 + \ldots\ldots..$		M1
Writing out at least 3 terms with the third term equal to the first term. Allow in terms of k as well as numerical values. Evidence that the sequence is oscillating between 1 and $1 - k$. This may be implied by a correct sum.		
$50 \times \frac{1}{2}$ or $50 \times 1 - 50 \times \frac{1}{2}$ or $\frac{1}{2} \times 50 \times (1 - \frac{1}{2})$	An attempt to combine the terms correctly. Can be in terms of k here e.g $100 - 50k$	M1
$= 25$	Allow an equivalent fraction, e.g. 50/2 or 100/4	A1