Sequences and Series 2 - Edexcel Past Exam Questions MARK SCHEME

Question 1

Question number	Scheme	Marks
(a)	Uses $360\times\left(\frac{7}{8}\right)^{19}$, to obtain 28.5	M1, A1 (2)
(b)	Uses $S=\dfrac{360(1-(\frac{7}{8})^{20})}{1-\frac{7}{8}}$, or $S=\dfrac{360((\frac{7}{8})^{20}-1)}{\frac{7}{8}-1}$ to obtain 2680	M1, A1 (2)
(c)	Uses $S=\dfrac{360}{1-\frac{7}{8}}$, to obtain 2880	M1, A1cao (2) **6**
Notes	**(a) M1:** Correct use of formula with power = 19 **A1:** Accept 28.47, or 28.474 or indeed 28.47446075 **(b) M1:** Correct use of formula with $n = 20$ **A1:** Accept 2681, 2680.7, 2680.68 or 2680.679 or indeed 2680.678775 (N.B. 2680.67 or 2680.0 is **A0**) **(c) M1:** Correct use of formula **A1:** Accept 2880 only	
Alternative method	**Alternative to (a)** Gives **all 20 terms** 315, 275.6(25), 241.17(1875), … (1st 3 accurate)	M1
	All correct and last term as above **A1:** Accept 28.5, 28.47, or 28.474 or indeed 28.47446075	A1
	Alternative to (b) Gives **all 20 terms** 315, 275.6(25), 241.17(1875), … (1st 3 accurate) and adds	M1
	Sum correct **A1:** Accept 2680, 2681, 2680.7, 2680.68 or 2680.679 or indeed 2680.678775	A1

Question 2

Question	Scheme	Marks
(a)	$(S_n =)\ \ a + ar + (ar^2) + \ldots \quad + ar^{n-1}$ **and** $rS_n = ar + ar^2 + (ar^3) \ldots \quad + ar^n$ $S_n - rS_n = a - ar^n$ $S_n(1-r) = a(1-r^n)$ And so result $S_n = \dfrac{a(1-r^n)}{(1-r)}$ *	M1 M1 dM1 A1 (4)
(b)	Divides one term by other (either way) to give $r^2 = \ldots$ then square roots to give $r =$ $r^2 = \dfrac{1.944}{5.4}$, $\quad r = 0.6$ (ignore -0.6) **Or:** (*Method 2)* Finds geometric mean i.e 3.24 and divides one term by 3.24 or 3.24 by one term $r = 0.6$ (ignore -0.6)	M1 A1 (2)
(c)	Uses $\quad 5.4 \div r^2$ or $1.944 \div r^4$, to give $a =$ $a = 15$	M1, A1ft (2)
(d)	Uses $\quad S = \dfrac{15}{1-0.6}$, to obtain 37.5	M1A1 ,A1 (3)
		11 marks
Notes Special Case	**(a)** **M1:** Lists **both** of these sums ($S_n =$) may be omitted, rS_n (or rS) must be stated 1st two terms must be correct in each series. Last term must be ar^{n-1} or ar^n in first series and the corresponding ar^n or ar^{n+1} in second series. Must be n and not a number. Reference made to other terms e.g. space or dots to indicate missing terms **M1:** Subtracts series for rS from series for S (or other way round) to give RHS $= \pm(a - ar^n)$. This may have been obtained by following a pattern. **If wrong power stated on line 1 M0 here**. (Ignore LHS)M0M0M0A0 d**M1**: Factorises both sides correctly– must follow from a previous M1 (It is possible to obtain M0M1M1A0 or M1M0M1A0) **A1**: completes the proof with **no errors** seen No errors seen: **First line absolutely correct**, omission of second line, third and fourth lines correct: M1M0M1A1 See next sheet of common errors. Refer any attempts involving **sigma notation**, or any **proofs by induction** to team leader. Also attempts which **begin with the answer and work backwards**. **(b)** **M1:** Deduces r^2 by dividing either term by other and attempts square root **A1:** any correct equivalent for r e.g. 3/5 Answer only is 2/2 (*Method 2*) Those who find fourth term must use $\sqrt{ab}$ and **not** $\frac{1}{2}(a+b)$ then must use it in a division with given term to obtain $r =$ **(c)** **M1:** May be done in two steps or more e.g. $5.4 \div r$ then divided by r again **A1ft:** follow through their value of r. Just $a = 15$ **with no wrong working** implies M1A1 (d) **M1**: States sum to infinity formula with values of a and r found earlier, provided $\lvert r \rvert < 1$ **A1** : uses 15 and 0.6 (or 3/5) (This is **not** a ft mark) **A1**: 37.5 or exact equivalent	
Common errors	(i) Fraction inverted in (b) $r^2 = \dfrac{5.4}{1.944}$ and $r = 1\frac{2}{3}$, then correct ft gives M1A0 M1 A1ft M0A0A0 i.e. 3/7 (ii) Uses $r = 0.36$: (b)M0A0 (c)M1A1ft (d) M1A0A0 i.e. 3/7 (iii) Uses $ar^3 = 5.4$, $ar^5 = 1.944$ Likely to have (b)M1A1 (c)M0A0 (d) M1A0A0 i.e.3/7	

Question 3

Question Number	Scheme	Marks
(a)	$\{r =\}\ \frac{2}{3}$	B1
		(1)
(b)	$\{p =\}\ 8$	B1 cao
		(1)
(c)	$\{S_{15} =\}\ \frac{18\left(1-\left(\frac{2}{3}\right)^{15}\right)}{1-\frac{2}{3}}$	M1
	$\{S_{15} = 53.87668...\} \Rightarrow S_{15} = \text{awrt } 53.877$	A1
		(2)
		[4]
	Notes for Question	
(a)	B1: Accept $\frac{12}{18}$, $0.\dot{6}$ or 0.6 recurring, or even 0.667 (3sf) but not 0.6 or 0.67	
(b)	B1: accept 8 only	
(c)	M1: Applies this formula $S_{15} = \frac{18\left(1-(\text{their } r)^{15}\right)}{1-(\text{their } r)}$, can be implied by their answer. For this mark they may use any value for r except $r = 1$ or $r = 0$ (even 3/2 or -6 may be used) A1: Answers which round to 53.877	
Alternative method for (c)	M1: (Adding terms is an unlikely method for this question) Need to see 15 terms listed as 18+12+……0.06165877 or can be implied by correct answer A1: awrt 53.877 **Answer only** : 53.9 is M0A0 with no working, but 53.877 with no working is M1A1	

Question 4

Question Number	Scheme	Marks
(a)	$a=4p,\ ar=(3p+15)$ and $ar^2=5p+20$	B1
	(So $r=$) $\dfrac{5p+20}{3p+15}=\dfrac{3p+15}{4p}$ or $4p(5p+20)=(3p+15)^2$ or equivalent	M1
	See $(3p+15)^2=9p^2+90p+225$	M1
	$20p^2+80p=9p^2+90p+225 \rightarrow\ 11p^2-10p-225=0$ *	A1 *
		(4)
(b)	$(p-5)(11p+45)$ so $p=$	M1
	$p=5$ only (after rejecting - 45/11) **<u>N.B. Special case p = 5 can be verified in (b) (1 mark only)</u>** $11\times5^2-10\times5-225\ =275-50-225=0$ M1A0	A1
		(2)
(c)	$\dfrac{3\times5+15}{4\times5}$ or $\dfrac{5\times5+20}{3\times5+15}$	M1
	$r=\dfrac{3}{2}$	A1
		(2)
(d)	$S_{10}=\dfrac{20\left(1-\left(\text{"}\frac{3}{2}\text{"}\right)^{10}\right)}{\left(1-\text{"}\frac{3}{2}\text{"}\right)}$	M1A1ft
	$(=2266.601568\ldots)\ =2267$	A1
		(3) **Total 11**

	Notes for Question
(a)	B1: Correct statement (needs all three terms)– **this may be omitted and implied** by correct statement in p only as candidates may use geometric mean, or may use ratio of terms being equal and give a correct line 2 without line 1. (This would earn the B1M1 immediately) M1: Valid Attempt to eliminate a and r and to obtain equation in p only M1: Correct expansion of $(3p+15)^2 = 9p^2 + 90p + 225$ A1cso: No incorrect work seen. The printed answer is obtained. **NB Those who show $p = 5$ in part (a) obtain no credit for this**
(b)	M1: Attempt to solve quadratic by usual methods (factorisation, completion of square or formula) Must appear in part (b) – not part (a) A1: 5 **only and** -45/11 should be seen and rejected or $(11p + 45)$ seen and statement $p > 0$
(c)	M1: Substitutes $p = 5$ completely and attempt ratio (correct way up) A1: 1.5 or any equivalent
(d)	M1: Use of correct formula with $n = 10$ a and/or r may still be in terms of p A1ft: Correct expression ft on their r only – must have $a = 20$ and power = 10 here A1 2267 (accept awrt 2267)

Question 5

Question Number	Scheme		Marks
(a)	$S_\infty = \dfrac{20}{1-\frac{7}{8}}\ ; = 160$	M1: Use of a correct S_∞ formula A1: 160	M1A1
	Accept correct answer only (160)		
			[2]
(b)	$S_{12} = \dfrac{20\left(1-\left(\frac{7}{8}\right)^{12}\right)}{1-\frac{7}{8}}\ ; = 127.77324...$	M1: Use of a correct S_n formula with $n = 12$ (condone missing brackets around 7/8) A1: awrt 127.8	M1A1
	T & I in (b) requires all 12 terms to be calculated correctly for M1 and A1 for awrt 127.8		
			[2]
(c)	$160 - \dfrac{20(1-(\frac{7}{8})^N)}{1-\frac{7}{8}} < 0.5$	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 $+160\left(\frac{7}{8}\right)^N$ or $+\left(\frac{7}{8}\right)^N$ 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
	$N > \dfrac{\log\left(\frac{0.5}{160}\right)}{\log\left(\frac{7}{8}\right)} = 43.19823... \Rightarrow N = 44$	$N = 44$ (Allow $N \geq 44$ but not $N > 44$	A1 cso
	An incorrect **inequality** statement at any stage in a candidate's working loses the final mark. Some candidates do not realise that the direction of the inequality is reversed in the final line of their solution. **BUT** it is possible to gain full marks for using =, as long as no incorrect working seen.		
			[4]
			Total 8
	Trial & Improvement Method in (c):		
	1st M1: Attempts $160 - S_N$ or S_N with at least one value for $N > 40$		
	2nd M1: Attempts $160 - S_N$ or S_N with $N = 43$ or $N = 44$		
	3rd M1: For evidence of examining $160 - S_N$ or S_N for both $N = 43$ and $N = 44$ with both values correct to 2 DP Eg: $160 - S_{43} =$ awrt 0.51 and $160 - S_{44} =$ awrt 0.45 or $S_{43} =$ awrt 159.49 and $S_{44} =$ awrt 159.55		
	A1: $N = 44$ cso		
	Answer of $N = 44$ only with no working scores no marks		

Question 6

Question Number	Scheme		Marks
(a)	$S_\infty = 6a$		
	$\frac{a}{1-r} = 6a$	Either $\frac{a}{1-r} = 6a$ or $\frac{6a}{1-r} = a$ or $\frac{6}{1-r} = 1$	M1
	$\{\Rightarrow 1 = 6(1-r) \Rightarrow\}\ r = \frac{5}{6}*$	cso	A1*
	Allow verification e.g. $\frac{a}{1-r} = 6a \Rightarrow \frac{a}{1-\frac{5}{6}} = 6a \Rightarrow \frac{a}{\frac{1}{6}} = 6a \Rightarrow 6a = 6a$		
			[2]
(b)	$\{T_4 = ar^3 = 62.5 \Rightarrow\}\ a\left(\frac{5}{6}\right)^3 = 62.5$	$a\left(\frac{5}{6}\right)^3 = 62.5$ (Correct statement using the 4th term. Do not accept $a\left(\frac{5}{6}\right)^4 = 62.5$)	M1
	$\Rightarrow a = 108$	108	A1
			[2]
(c)	$S_\infty = 6(\text{their } a)$ or $\frac{\text{their } a}{1-\frac{5}{6}}\{= 648\}$	Correct method to find S_∞	M1
	$\{S_{30} =\}\ \frac{108\left(1-\left(\frac{5}{6}\right)^{30}\right)}{1-\frac{5}{6}}\ \{= 645.2701573...\}$	M1: $S_{30} = \frac{(\text{their } a)\left(1-\left(\frac{5}{6}\right)^{30}\right)}{1-\left(\frac{5}{6}\right)}$ **(Condone invisible brackets around 5/6)** A1ft: Correct follow through expression (follow through their a). **Do not condone invisible brackets around 5/6 unless <u>their</u> evaluation or final answer implies they were intended.**	M1 A1ft
	$\{S_\infty - S_{30}\} = 2.72984...$	awrt 2.73	A1
			[4]
			Total 8
(c)	**<u>Alternative:</u>** Difference $= \frac{ar^{30}}{1-r} = \frac{108\left(\frac{5}{6}\right)^{30}}{1-\frac{5}{6}} = 2.72984...$ M1M1: For an attempt to apply $\frac{ar^{30}}{1-r}$. A1ft: $\frac{(\text{their } a)\times r^{30}}{1-r}$ with their ft a. A1: awrt 2.73		

Question 7

Question Number	Scheme	Marks
(i)	**Mark (a) and (b) together**	
(a)	$a + ar = 34$ or $\dfrac{a(1-r^2)}{(1-r)} = 34$ or $\dfrac{a(r^2-1)}{(r-1)} = 34$; $\dfrac{a}{1-r} = 162$	B1; B1
(Way 1)	Eliminate a to give $(1+r)(1-r) = \dfrac{17}{81}$ or $1 - r^2 = \dfrac{34}{162}$.. (not a cubic)	aM1
	(and so $r^2 = \frac{64}{81}$ and) $r = \frac{8}{9}$ only	aA1 (4)
(b)	Substitute their $r = \frac{8}{9}$ ($0 < r < 1$) to give $a =$	bM1
	$a = 18$	bA1 (2)
(Way 2) Part (b) first	Eliminate r to give $\dfrac{34-a}{a} = 1 - \dfrac{a}{162}$	bM1
	gives $a = 18$ or 306 and rejects 306 to give $a = 18$	bA1
Then part (a) again	Substitute a = 18 to give $r =$	aM1
	$r = \frac{8}{9}$	aA1
(ii)	$\dfrac{42(1-\frac{6}{7}^n)}{1-\frac{6}{7}} > 290$ (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 $n > \dfrac{\log"(\frac{4}{294})"}{\log(\frac{6}{7})}$ 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 (4)

Notes

(i) (a) **B1**: Writes a **correct** equation connecting a and r and 34 (allow equivalent equations – may be implied)

B1: Writes a **correct** equation connecting a and r and 162 (allow equivalent equation – may be implied)

Way 1: **aM1**: Eliminates a correctly for these two equations to give $(1+r)(1-r)=\frac{17}{81}$ or $(1+r)(1-r)=\frac{34}{162}$ or equivalent – **not a cubic** – should have factorized (1 - r) to give a correct quadratic

aA1: Correct value for r. Accept 0.8 recurring or 8/9 (not 0.889) Must only have positive value.

bM1: Substitutes their r ($0 < r < 1$) into a correct formula to give value for a. Can be implied by $a = 18$

bA1: must be 18 (not answers which round to 18)

Way 2: Finds a first - B1, B1: As before then award the (b) M and A marks before the (a) M and A marks

bM1: Eliminates r correctly to give $\frac{34-a}{a}=1-\frac{a}{162}$ or $a^2-324a+5508=0$ or equivalent

bA1: Correct value for a so $a = 18$ only. (Only award after 306 has been rejected)

aM1: Substitutes their 18 to give $r =$

aA1: $r=\frac{8}{9}$ only

(ii) **M1**: Allow n **or** $n-1$ and any symbols from ">", "<", or "=" etc **A1** : Must be power n (**not** $n-1$) with any symbol

M1: Uses logs correctly on $\left(\frac{6}{7}\right)^n$ or $\left(\frac{7}{6}\right)^n$ **not on** $(36)^n$ to get as far as n Allow any symbol

A1: $n = 28$ cso (any errors with inequalities earlier e.g. failure to reverse the inequality when dividing by the negative $\log\left(\frac{6}{7}\right)$ or any contradictory statements must be penalised here) Those with equals throughout may gain this mark if they follow 27.9 by n=28. Just $n = 28$ without mention of 27.9 is only allowed following correct inequality work.

Special case: Trial and improvement: Gives $n = 28$ as S = awrt 290.1 (M1A1)and when $n = 27$ S = (awrt) 289 so $n = 28$ (M1A1) – $n = 28$ with no working is M1A0M0A0 and insufficient accuracy is M1A0M1A0

Uses nth term instead of sum of n terms – over simplified – do not treat as misread – award 0/4

Question 8

Question Number	Scheme		Marks
	$r=\frac{3}{4},\ S_4=175$		
(a) Way 1	$\frac{a\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}}$ or $\frac{a\left(1-\frac{3}{4}^4\right)}{1-\frac{3}{4}}$ or $\frac{a\left(1-0.75^4\right)}{1-0.75}$	Substituting $r=\frac{3}{4}$ or 0.75 and $n=4$ into the formula for S_n	M1
	$175=\frac{a\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}}\Rightarrow a=\frac{175\left(1-\frac{3}{4}\right)}{\left(1-\left(\frac{3}{4}\right)^4\right)}\left\{\Rightarrow a=\frac{\left(\frac{175}{4}\right)}{\left(\frac{175}{256}\right)}\Rightarrow\right\}\ \underline{a=64}\,*$	Correct proof	A1*
			[2]
(a) Way 2	$a+a\left(\frac{3}{4}\right)+a\left(\frac{3}{4}\right)^2+a\left(\frac{3}{4}\right)^3$	$a+a\left(\frac{3}{4}\right)+a\left(\frac{3}{4}\right)^2+a\left(\frac{3}{4}\right)^3$	M1
	$\frac{175}{64}a=175\left(\Rightarrow a=\frac{175}{\left(\frac{175}{64}\right)}\right)\Rightarrow \underline{a=64}\,*$ or $2.734375a=175\Rightarrow \underline{a=64}$	Correct proof	A1*
			[2]
(a) Way 3	$\{S_4=\}\ \frac{64\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}}$ or $\frac{64\left(1-\frac{3}{4}^4\right)}{1-\frac{3}{4}}$ or $\frac{64\left(1-0.75^4\right)}{1-0.75}$	Applying the formula for S_n with $r=\frac{3}{4}$, $n=4$ and a as 64.	M1
	$=175$ so $a=64*$	Obtains 175 with no errors seen and concludes $a=64*$.	A1*
			[2]
(b)	$\{S_\infty\}=\frac{64}{\left(1-\frac{3}{4}\right)}$; $=256$	$S_\infty=\frac{(\text{their } a)}{1-\frac{3}{4}}$ or $\frac{64}{1-\frac{3}{4}}$	M1;
		256	A1cao
			[2]
(c)	$\{D=T_9-T_{10}=\}\ 64\left(\frac{3}{4}\right)^8-64\left(\frac{3}{4}\right)^9$	Writes down either "64"$\left(\frac{3}{4}\right)^8$ or awrt 6.4 or "64"$\left(\frac{3}{4}\right)^9$ or awrt 4.8, using $a=64$ or their a	M1
		A correct expression for the difference (i.e. $\pm(T_9-T_{10})$) using $a=64$ or their a.	dM1
	$\left\{=64\left(\frac{3}{4}\right)^8\left(\frac{1}{4}\right)=1.6018066...\right\}=\underline{1.602}$ (3dp)	1.602 or -1.602	A1 cao
			[3]
			7

		Question Notes
(a)		**Allow invisible brackets around fractions throughout all parts of this question.**
	M1	There are three possible methods as described above.
	A1	Note that this is a "show that" question with a printed answer. In **Way 1** this mark **usually** requires $a = p/q$ where p and q may be unsimplified brackets from the formula (or could be 11200/175 for example) as an intermediate step before the conclusion $a = 64$. Exceptions include $a = 175/4 * 256/175$ i.e. multiplication by reciprocal rather than division or 175 = $175a/64$ followed by the obvious $a = 64$ These also get A1. In "reverse" methods such as **Way 3** we need a conclusion "so $a = 64$" or some implication that their argument is reversible. Also a conclusion can be implied from a preamble, eg: "If I assume a = 64 then find S= 175 as given this implies $a = 64$ as required". This is a show that question and there should be no loss of accuracy. In all the methods **if** decimals are used there should **not be rounding.** If 0.68359375 appears this is correct. If it is rounded it would not give the exact answer. $64(1-0.31640625)$ or 43.75 are each correct – if they are rounded then treat this as incorrect e.g. **Way 3:** "43.75/0.25 = 175 so $a = 64$ is A1" but "43/0.25 = 175 so $a = 64$ is A0" and "44/0.25 = 175 so a = 64 is A0". **Yet another variant on Way 3:** take a=64 then find the next 3 terms as 48, 36, 27 then add 64+48+36+27 to get 175. Again need conclusion that $a = 64$ or some implication that their argument is reversible. Otherwise M1 A0
(b)	M1	$S_\infty = \dfrac{64}{1-\frac{3}{4}}$ or $\dfrac{(\text{their } a \text{ found in part } (a))}{1-\frac{3}{4}}$
	A1	256 cao
(c)	NB	Using **Sum of 10 terms** minus **Sum of 9 terms** is NOT a misread Scores **M0M0A0**
	M1	Can be **implied.** Writes down either $64\left(\frac{3}{4}\right)^8$ or $64\left(\frac{3}{4}\right)^9$, using $a = 64$ (or their a found in part (a)).
	Note	Ignore candidate's labelling of terms.
	Note	$64\left(\frac{3}{4}\right)^8 = 6.407226563...$ and $64\left(\frac{3}{4}\right)^9 = 4.805419922...$
	dM1	**This is dependent on previous M mark and can be implied.** Either $64\left(\frac{3}{4}\right)^8 - 64\left(\frac{3}{4}\right)^9$ or $64\left(\frac{3}{4}\right)^9 - 64\left(\frac{3}{4}\right)^8$ or awrt 6.4 – awrt 4.8, using $a = 64$ (or their a from part (a)) .
	Note	1st M1 and 2nd M1 can be implied by the value of their difference = "their a found in part (a)" $\times \dfrac{3^8}{4^9} \approx \dfrac{\text{"their } a \text{ found in part (a)"}}{40}$
	Note	Either $64\left(\frac{3}{4}\right)^9 - 64\left(\frac{3}{4}\right)^{10}$ or $64\left(\frac{3}{4}\right)^{10} - 64\left(\frac{3}{4}\right)^9$ is 1st M1, 2nd M0.
	A1	1.602 or −1.602 cao **(This answer with no working is M1M1A1) But 1.6 with no working is M0M0A0**
	Note	$\left\{D = \frac{1}{4}T_9 \Rightarrow\right\}$ $D = \frac{1}{4}(64)\left(\frac{3}{4}\right)^8$ is 1st M1, 2nd M1
	Special case	Obtains awrt 6.4, then obtains awrt 4.8 but rounds to 6 – 5 when subtracting – award M1M1A0

Question 9

Question Number	Scheme	Marks
(a)	$a=7k-5,\ ar=5k-7$ and $ar^2=2k+10$	B1
	(So $r=$) $\dfrac{5k-7}{7k-5}=\dfrac{2k+10}{5k-7}$ or $(7k-5)(2k+10)=(5k-7)^2$ or equivalent	M1
	See $(5k-7)^2=25k^2-70k+49$	M1
	$14k^2+60k-50=25k^2-70k+49 \to\ 11k^2-130k+99=0$ *	A1cso * **(4)**
(b)	$(k-11)(11k-9)$ so $k=$	M1
	$k=9/11$ only* (after rejecting 11) **<u>N.B. Special case $k=9/11$ can be verified in (b) (1 mark only)</u>** $11\times\left(\dfrac{9}{11}\right)^2-130\times\left(\dfrac{9}{11}\right)+99=\dfrac{81}{11}-\dfrac{1170}{11}+\dfrac{1089}{11}=0$ M1A0	A1* **(2)**
(c)	$a=\dfrac{8}{11}$	B1
	$\dfrac{5\times\frac{9}{11}-7}{7\times\frac{9}{11}-5}$ *or* $\dfrac{2\times\frac{9}{11}+10}{5\times\frac{9}{11}-7}$ so $r=-4$	B1
	(i) Fourth term $=ar^3=-\dfrac{512}{11}$	M1A1
	(ii) $S_{10}=\dfrac{a(1-r^{10})}{(1-r)}=\dfrac{\frac{8}{11}(1-(-4)^{10})}{(1-(-4))}=-152520$	M1A1 **(6)** **[12]**

Notes

(a) Mark parts (a) and (b) together

B1: Correct statement (needs all three terms)– **this may be omitted and implied** by correct statement in k only, as candidates may use geometric mean, or may use ratio of terms being equal and give a correct line 2 without line 1. (This would earn the B1M1 immediately)

M1: Valid Attempt to eliminate a and r and to obtain equation in k only

M1: Correct expansion of $(5k-7)^2 = 25k^2 - 70k + 49$ - may have four terms $(5k-7)^2 = 25k^2 - 35k - 35k + 49$

A1cso: No incorrect work seen. The printed answer is obtained including "=0".

(b) M1: Attempt to solve quadratic by usual methods (factorisation, completion of square or formula – see notes at start of mark scheme) or see 9/11 substituted and given as "=0" for M1A0

A1*: 9/11 **only and** 11 should be seen and rejected. Accept 9/11 underlined or k= 9/11 written on following line.

Alternatively $(k - 11)$ may be seen in the factorisation and a statement 'k not integer' given with k=9/11 stated.

(c) Mark parts (i) and (ii) together

B1: $a = \dfrac{8}{11}$ or any equivalent (If not stated explicitly or used in formula may be implied by correct answer to (ii))

B1:Substitutes $k = 9/11$ completely and obtain $r = -4$ (If not stated explicitly, may be implied by correct answer to (i) or (ii))

(i) M1: Use of correct formula with $n = 4$ a and/or r may still be in terms of k or uses $(2k+10)\times r$. May assume $r = k$.

A1: Correct exact answer

(ii) M1: Use of correct formula with $n = 10$ a and/or r may still be in terms of k May assume $r = k$ A1 : -152520 cao

NB Correct formula **with negative sign** in numerator followed by the incorrect $(8/11)(1+4^{10})/(1-(-4))$ usually found equal to 152520.2909 with no negative sign can be allowed M1A0 but if the incorrect numerical expression appears on its own with no formula then M0A0

Listing terms can get: B1 (first term) B1 M1A1 (implied by correct 4^{th} term) M1A1 (implied by -152520)