adamjee maths

A-LEVEL MATHS / EDEXCEL / FREE RESOURCES

Sequences and series

Mark scheme

7 questions

Exam questions and marking instructions remain credited to their board.

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4(a)	$u_1 = 6 \Rightarrow u_2 = 6k - 5$ $u_2 = 6k - 5 \Rightarrow u_3 = k(6k-5) - 5$ $\Rightarrow k(6k-5) - 5 = -1$	M1	1.1b
	$\Rightarrow 6k^2 - 5k - 4 = 0$*	A1*	2.1
		(2)	
	Alternative:		
	$u_3 = -1 \Rightarrow -1 = ku_2 - 5 \Rightarrow u_2 = \frac{4}{k}$ $u_1 = 6 \Rightarrow u_2 = 6k - 5 \Rightarrow \frac{4}{k} = 6k - 5$	M1	1.1b
	$\Rightarrow 6k^2 - 5k - 4 = 0$*	A1*	2.1
(b)(i)	$k = \frac{4}{3}$	B1	2.2a
(ii)	$k = \frac{4}{3} \Rightarrow u_2 = \frac{4}{3} \times 6 - 5 \Rightarrow \sum_{r=1}^{3} u_r = 6 + \frac{4}{3} \times 6 - 5 - 1$	M1	1.1b
	$\sum_{r=1}^{3} u_r = 8$	A1	1.1b
		(3)	
			(5 marks)

Notes

(a)

M1: Correct application of the given recurrence relation using $u_1 = 6$ to find u_2 and then u_3 in terms of k and sets $u_3 = -1$

Condone missing brackets if the intention is clear e.g. $u_2 = 6k - 5 \Rightarrow u_3 = k\,6k - 5 - 5$

A1*: Obtains the printed answer with no errors including the "= 0"
This is a given answer so do not condone slips/missing brackets unless they are recovered **before** the final printed answer.

Alternative:

M1: Correct application of the given recurrence relation using $u_3 = -1$ to find u_2 in terms of k and then uses $u_1 = 6$ to find another expression for u_2 in terms of k and equates the 2 expressions.

A1*: Obtains the printed answer with no errors including the "= 0"
This is a given answer so do not condone slips unless they are recovered **before** the final printed answer.

(b)(i)

B1: Deduces the correct value of k. Ignore any working and just look for this value.

Allow equivalent exact values e.g. $1\frac{1}{3}$ or $1.\dot{3}$ but not clearly rounded e.g. 1.333

It must be clear that $k = \frac{4}{3}$ is selected so if both roots are offered score B0 unless $k = \frac{4}{3}$ is clearly intended by the calculation in part (ii)

(ii)

M1: Attempts the second term by e.g. $\left(\text{their } k\right)\times 6-5$ and then adds 6 and -1 to their second term. E.g. $6+"\frac{4}{3}"\times 6-5-1$

If they use u_1 and u_3 they must be as given in the question but condone a clear mis-copy of their u_2 value.

The attempt at the second term may be implied by their value.

Note that they may use $u_3=-1$ to find u_2 e.g. $-1="\frac{4}{3}"u_2-5\Rightarrow u_2="\frac{3}{4}"\left(5-1\right)=3$

Condone slips when rearranging as long as the intention is clear.

The attempt at the second term may be seen embedded in their attempt at the sum e.g.

$\sum_{r=1}^{3}u_r=6+\underline{\frac{4}{3}\times 6-5-1}$ or e.g. $\sum_{r=1}^{3}u_r=6+\underline{\frac{3}{4}\left(5-1\right)}-1$

If they use both of their values for *k* allow M1.

Alternatives:

Note that $\sum_{r=1}^{3}u_r=6+6k-5-1=6k$ so you may just see an attempt at $6k$ with their $\frac{4}{3}$.

Note that $\sum_{r=1}^{3}u_r=6k^2+k-4$ so you may just see an attempt at $6k^2+k-4$ with their $\frac{4}{3}$.

A1: Correct value of 8 and no other values unless rejected.

Correct answer with no working scores both marks.

Allow recovery from an inexact value from part (i) e.g. 1.333

Question	Scheme	Marks	AOs

2(a)(i) **(ii)**	e.g. $(u_2 =)35+7\cos\left(\frac{\pi}{2}\right)-5(-1)^1=40$ *	**B1***	2.1
	$u_3=40+7\cos\left(\frac{2\pi}{2}\right)-5(-1)^2\ (=28)$ **or** $u_4=\text{"28"}+7\cos\left(\frac{3\pi}{2}\right)-5(-1)^3\ (=33)$	**M1**	1.1b
	$u_3=28$ and $u_4=33$	**A1**	1.1b
		(3)	
(b)(i) **(ii)**	$(u_5 =)35$	**B1**	2.2a
	e.g. $\sum_{r=1}^{25}u_r=6(35+40+\text{"28"}+\text{"33"})+35$	**M1**	3.1a
	$=851$	**A1**	1.1b
		(3)	
			(6 marks)

Notes

(a)

(i)

B1*: Correct application of the formula with $n = 1$ and proceeds correctly to achieve an answer of 40 with no errors. Note that e.g., $(u_2 =)35+7\cos\left(\frac{35\pi}{2}\right)-5(-1)^{35}=35+0+5=40$ scores B0

As a minimum need to see e.g. $(u_2 =)35+7\cos\left(\frac{\pi}{2}\right)-5(-1)^1=40,\quad 35+0+5=40,\quad 35+5=40,\quad 35-5(-1)^1=40$

(ii)

M1: A correct attempt to use the formula to find a value for u_3 or u_4

Look for $n = 2$ substituted correctly into the given formula with $u_2=40$. May be implied by $u_3=28$

Or their calculated value of u_3 used with $n = 3$ substituted correctly into the given formula to find u_4

Condone use of calculator in degree mode which gives $u_3=41.989...$ which may imply this mark if no working is shown. If there is **no** working and u_3 is incorrect and u_4 is correct score M0A0

A1: Both correct $u_3=28$ and $u_4=33$ If 28, 33 are listed then allow M1A1.

For both correct values only score M1A1

(b)(i)

B1: $(u_5 =)35$

(ii)

M1: Attempts a **correct** method to find $\sum_{r=1}^{25}u_r$

There are various ways e.g. attempts to add 35 to $6\times$the sum of their four values.

Some other examples are:

$\sum_{r=1}^{25}u_r=7\times35+6\times40+6\times\text{"28"}+6\times\text{"33"}$, $\sum_{r=1}^{25}u_r=7(35+40+\text{"28"}+\text{"33"})-(40+\text{"28"}+\text{"33"})$,

$\sum_{r=1}^{25}u_r=\frac{25}{4}(35+40+\text{"28"}+\text{"33"})+1$, $2(35+40+\text{"28"}+\text{"33"})=272$, $272\times3=816$, $816+35$

There may be other methods seen but the calculation must be correct for their values.

If there is no working, with incorrect u_3 and/or u_4 you will need to check if their answer implies a correct method using $6(35+40+\text{"28"}+\text{"33"})+35$

Attempts to use an AP/GP formula score M0

A1: 851 (Correct answer with no working scores both marks)

Question	Scheme	Marks	AOs

3(a)	$u_2 = k-12,\ u_3 = k-\dfrac{24}{k-12}$	M1	1.1b
	$u_1+2u_2+u_3=0 \Rightarrow 2+2(k-12)+k-\dfrac{24}{k-12}=0$	dM1	1.1b
	$\Rightarrow 3k-22-\dfrac{24}{k-12}=0 \Rightarrow (3k-22)(k-12)-24=0$ $\Rightarrow 3k^2-36k-22k+264-24=0$ $\Rightarrow 3k^2-58k+240=0*$	A1*	2.1
		(3)	
(b)	$k=6,\ \left(\dfrac{40}{3}\right)$	M1	1.1b
	k = 6 as k must be an integer	A1	2.3
		(2)	
(c)	$(u_3=)10$	B1	2.2a
		(1)	
			(6 marks)

Notes

(a)

M1: Attempts to apply the sequence formula once for either u_2 **or** u_3.

Usually for $u_2 = k-\dfrac{24}{2}$ o.e. but could be awarded for $u_3 = k-\dfrac{24}{their\ "u_2"}$

dM1: Award for

- attempting to apply the sequence formula to find both u_2 **and** u_3
- using $2+2"u_2"+"u_3"=0 \Rightarrow$ an equation in k . The u_3 may have been incorrectly adapted

A1*: Fully correct work leading to the printed answer.

There must be

- (at least) one correct intermediate line between $2+2(k-12)+k-\dfrac{24}{k-12}=0$ (o.e.) and the given answer that shows how the fractions are "removed". E.g. $(3k-22)(k-12)-24=0$
- no errors in the algebra. The = 0 may just appear at the answer line.

(b)

M1: Attempts to solve the quadratic which is implied by sight of k = 6.

This may be awarded for any of

- $3k^2-58k+240=(ak\pm c)(bk\pm d)=0$ where $ab=3, cd=240$ followed by k =
- an attempt at the correct quadratic formula (or completing the square)
- a calculator solution giving at least k = 6

A1: Chooses k = 6 and gives a minimal reason

Examples of a minimal reason are

- 6 because it is an integer
- 6 because it is a whole number
- 6 because $\dfrac{40}{3}$ or $13.3\dot{}$ is not an integer

(c)

B1: Deduces the correct value of u_3.

Question	Scheme	Marks	AOs

Question	Scheme	Marks	AOs
5 (a)	Uses $115 = 28 + 5d \Rightarrow d = (17.4)$	M1	3.1b
	Uses $28 + 2 \times "17.4" = ...$	M1	3.4
	= 62.8 (km h $^{-1}$)	A1	1.1b
		(3)	
(b)	Uses $115 = 28r^5 \Rightarrow r = (1.3265)$	M1	3.1b
	Uses $28 \times "1.3265^4" = ...$ or $\frac{115}{"1.3265"}$	M1	3.4
	= 86.7 (km h $^{-1}$)	A1	1.1b
		(3)	
			(6 marks)
Notes:			

(a)

M1: Translates the problem into maths using n^{th} term $= a + (n-1)d$ and attempts to find d

Look for either $115 = 28 + 5d \Rightarrow d = ...$ or an attempt at $\frac{115 - 28}{5}$ condoning slips

It is implied by use of $d = 17.4$ Note that $115 = 28 + 6d \Rightarrow d = ...$ is M0

M1: Uses the model to find the fastest speed the car can go in 3rd gear using $28 + 2"d"$ or equivalent.
This can be awarded following an incorrect method of finding $"d"$

A1: 62.8 km/ h Lack of units are condoned. Allow exact alternatives such as $\frac{314}{5}$

(b)

M1: Translates the problem into maths using n^{th} term $= ar^{n-1}$ and attempts to find r
It must use the 1st and 6th gear and not the 3rd gear found in part (a)

Look for either $115 = 28r^5 \Rightarrow r = ...$ o.e. or $\sqrt[5]{\frac{115}{28}}$ condoning slips.

It is implied by stating or using $r =$ awrt 1.33

M1: Uses the model to find the fastest speed the car can go in 5th gear using $28 \times "r^4"$ or $\frac{115}{"r"}$ o.e.

This can be awarded following an incorrect method of finding $"r"$
A common misread seems to be finding the fastest speed the car can go in 3rd gear as in (a).
Providing it is clear what has been done, e.g. $u_3 = 28 \times "r^2"$ it can be awarded this mark.

A1: awrt 86.7 km/h Lack of units are condoned. Expressions must be evaluated.

Question	Scheme	Marks	AOs

Question	Scheme	Marks	AOs
13 (a)	Uses the sequence formula $a_{n+1}=\dfrac{k(a_n+2)}{a_n}$ once with $a_1=2$	M1	1.1b
	$(a_1=2),\ a_2=2k,\ a_3=k+1,\ a_4=\dfrac{k(k+3)}{k+1}$ Finds four consecutive terms and sets a_4 equal to a_1 (oe)	M1	3.1a
	$\dfrac{k(k+3)}{k+1}=2\Rightarrow k^2+3k=2k+2\Rightarrow k^2+k-2=0$ *	A1*	2.1
		(3)	
(b)	States that when $k=1$, all terms are the same and concludes that the sequence does not have a period of order 3	B1	2.3
		(1)	
(c)	Deduces the repeating terms are $a_{1/4}=2, a_{2/5}=-4, a_{3/6}=-1,$	B1	2.2a
	$\sum_{n=1}^{80} a_k = 26\times(2+-4+-1)+2+-4$	M1	3.1a
	$=-80$	A1	1.1b
		(3)	
			(7 marks)
Notes:			

(a)

M1: Applies the sequence formula $a_{n+1}=\dfrac{k\left(a_n+2\right)}{a_n}$ seen once.

This is usually scored in attempting to find the second term. E.g. for $a_2=2k$ or $a_{1+1}=\dfrac{k\left(2+2\right)}{2}$

M1: Attempts to find $a_1 \to a_4$ and sets $a_1=a_4$. Condone slips.

Other methods are available. E.g. Set $a_4=2$, work backwards to find a_3 and equate to $k+1$

There is no requirement to see either a_1 or any of the labels. Look for the correct terms in the correct order.

There is no requirement for the terms to be simplified

FYI $a_1=2, a_2=2k, a_3=k+1, a_4=\dfrac{k(k+3)}{k+1}$ and so $2=\dfrac{k(k+3)}{k+1}$

A1*: Proceeds to the given answer with accurate work showing all necessary lines. See MS for minimum

(b)

B1: States that when $k=1$, all terms are the same and concludes that the sequence does not have a period of order 3.

Do not accept "the terms just repeat" or "it would mean all the terms of the sequence are 2"

There must be some reference to the fact that it does not have order 3. Accept it has order 1.

It is acceptable to state $a_2=a_1=2$ and state that the sequence does not have order 3

(c)

B1: Deduces the repeating terms are $a_{1/4}=2, a_{2/5}=-4, a_{3/6}=-1,$

M1: Uses a clear strategy to find the sum to 80 terms. This will usually be found using multiples of the first three terms.

For example you may see $\displaystyle\sum_{r=1}^{80}a_r=\left(\sum_{r=1}^{78}a_r\right)+a_{79}+a_{80}=26\times\left(2+-4+-1\right)+2+-4$

or $\displaystyle\sum_{r=1}^{80}a_r=\left(\sum_{r=1}^{81}a_r\right)-a_{81}=27\times\left(2+-4+-1\right)-\left(-1\right)$

For candidates who find in terms of *k* award for $27\times2+27\times\left(2k\right)+26\times\left(k+1\right)$ or $80k+80$

If candidates proceed and substitute $k=-2$ into $80k+80$ to get -80 then all 3 marks are scored.

A1: -80

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Note: Be aware that we have seen candidates who find the first three terms correctly, but then find

$26\frac{2}{3}\times\left(2+-4+-1\right)=26\frac{2}{3}\times-3$ which gives the correct answer

but it is an incorrect method and should be scored B1 M0 A0

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Question	Scheme	Marks	AOs

11 (a)	Total time for 6 km = 24 minutes + $6\times1.05+6\times1.05^2$ minutes	M1	3.4
	= 36.915 minutes = 36 minutes 55 seconds *	A1*	1.1b
		(2)	
(b)	**5** th km is $6\times1.05=6\times1.05^{\mathbf{1}}$ **6**th km is $6\times1.05\times1.05=6\times1.05^{\mathbf{2}}$ **7**th km is $6\times1.05\times1.05\times1.05=6\times1.05^{\mathbf{3}}$ Hence the time for the r th km is $6\times1.05^{\,r-4}$	B1	3.4
		(1)	
(c)	Attempts the total time for the race = Eg. 24 minutes + $\sum_{r=5}^{r=20} 6\times1.05^{\,r-4}$ minutes	M1	3.1a
	Uses the series formula to find an allowable sum Eg. Time for 5 th to 20th km $=\dfrac{6.3\left(1.05^{16}-1\right)}{1.05-1}=\left(149.04\right)$	M1	3.4
	Correct calculation that leads to the **total time** Eg. Total time = $24+\dfrac{6.3\left(1.05^{16}-1\right)}{1.05-1}$	A1	1.1b
	Total time = awrt 173 minutes and 3 seconds	A1	1.1b
		(4)	
			(7 marks)

(a)

M1: For using model to calculate the total time.

Sight of 24 minutes + $6\times1.05+6\times1.05^2$ or equivalent is required. Eg $24 + 6.3 + 6.615$

Alternatively in seconds 24 minutes + 378 sec (6min 18 s) +396.9 (6 min 37 s)

A1*: 36 minutes 55 seconds following 36.915, $24+ 6.3+6.615$, $24 + 6\times1.05+6\times1.05^2$ or equivalent working in seconds

(b) Must be seen in (b)

B1: As seen in scheme. For making the link between the r th km and the index of 1.05

Or for EXPLAINING that "the time taken per km (6 mins) only starts to increase by 5% after the first 4 km"

(c) The correct sum formula $\dfrac{a\left(r^n-1\right)}{r-1}$, if seen, must be correct in part (c) for all relevant marks

M1: For the overall strategy of finding the total time.

Award for adding 18, 24, 30.3 or awrt 36.9 and the sum of a geometric sequence

So award the mark for expressions such as $6\times4+\sum6\times1.05^n$ or $24+\dfrac{6\left(1.05^{20}-1\right)}{1.05-1}$

The geometric sequence formula, must be used with $r=1.05$ oe but condone slips on a and n

The value of r must be 1.05 oe such as 105% but you should allow a slip on the value of n used for their value of a (See below: We are going to allow the correct value of n or one less)

If you don't see a calculation it may be implied by sight of one of the values seen below

Allow for $a = 6, \quad n = 17$ or 16 Eg. $\dfrac{6\left(1.05^{17}-1\right)}{1.05-1} = (155.0)$ or $\dfrac{6\left(1.05^{16}-1\right)}{1.05-1} = (141.9)$

Allow for $a = 6.3, n = 16$ or 15 Eg $\dfrac{6.3\left(1.05^{16}-1\right)}{1.05-1} = (149.0)$ or $\dfrac{6.3\left(1.05^{15}-1\right)}{1.05-1} = (135.9)$

Allow for $a = 6.615, \ n = 15$ or 14 Eg $\dfrac{6.615\left(1.05^{15}-1\right)}{1.05-1} = (142.7)$ or $\dfrac{6.615\left(1.05^{14}-1\right)}{1.05-1} = (129.6)$

A1: For a correct calculation that will find the **total time**. It does not need to be processed

Allow for example, amongst others, $24 + \dfrac{6.3\left(1.05^{16}-1\right)}{1.05-1}$, $18 + \dfrac{6\left(1.05^{17}-1\right)}{1.05-1}$, $30.3 + \dfrac{6.615\left(1.05^{15}-1\right)}{1.05-1}$

A1: For a total time of awrt 173 minutes and 3 seconds

This answer alone can be awarded 4 marks as long as there is some evidence of where it has come from.

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Candidates that list values: Handy Table for Guidance

M1: For a correct overall strategy which would involve adding four sixes followed by at least 16 other values

The values which may be written in the form 6×1.05^2 or as numbers

Can be implied by $6+6+6+6+(6\times1.05)+.....+\left(6\times1.05^{16}\right)$

M1: For an attempt to add the numbers from (6×1.05) to $\left(6\times1.05^{16}\right)$. This could be done on a calculator in which case

expect to see awrt 149

Alternatively, if written out, look for 16 values with 8 correct or follow through correct to 1 dp

A1: Awrt 173 minutes

A1: Awrt 173 minutes and 3 seconds

Km	Time per km	Total Time
1	6.0000	
2	6.0000	12
3	6.0000	18
4	6.0000	24
5	6.3000	30.3
6	6.6150	36.915
7	6.9458	43.86075
8	7.2930	51.15379
9	7.6577	58.81148
10	8.0406	66.85205
11	8.4426	75.29465
12	8.8647	84.15939
13	9.3080	93.46736
14	9.7734	103.2407
15	10.2620	113.5028
16	10.7751	124.2779
17	11.3139	135.5918
18	11.8796	147.4714
19	12.4736	159.945
20	13.0972	173.0422

4	(i) $\sum_{r=1}^{16}\left(3+5r+2^r\right)=131\,798$; (ii) $u_1, u_2, u_3, ..., : u_{n+1}=\frac{1}{u_n}, u_1=\frac{2}{3}$		
(i) Way 1	$\left\{\sum_{r=1}^{16}\left(3+5r+2^r\right)=\right\}\ \sum_{r=1}^{16}(3+5r)+\sum_{r=1}^{16}\left(2^r\right)$	M1	3.1a
	$=\frac{16}{2}(2(8)+15(5))\ +\ \frac{2(2^{16}-1)}{2-1}$	M1	1.1b
		M1	1.1b
	$=728+131\,070\ =\ 131\,798$ *	A1*	2.1
		(4)	
(i) Way 2	$\left\{\sum_{r=1}^{16}\left(3+5r+2^r\right)=\right\}\ \sum_{r=1}^{16}3\ +\ \sum_{r=1}^{16}(5r)+\sum_{r=1}^{16}\left(2^r\right)$	M1	3.1a
	$=(3\times16)+\frac{16}{2}(2(5)+15(5))\ +\ \frac{2(2^{16}-1)}{2-1}$	M1	1.1b
		M1	1.1b
	$=48+680+131\,070\ =\ 131\,798$ *	A1*	2.1
		(4)	
(i) Way 3	Sum = $10+17+26+39+60+97+166+299+560+1077+2106$ $+4159+8260+16457+32846+65619=131\,798$ *	M1	3.1a
		M1	1.1b
		M1	1.1b
		A1*	2.1
		(4)	
(ii)	$\left\{u_1=\frac{2}{3}\right\},\ u_2=\frac{3}{2},\ u_3=\frac{2}{3}, ...$ (***can be implied by later working***)	M1	1.1b
	$\left\{\sum_{r=1}^{100}u_r=\right\}\ 50\left(\frac{2}{3}\right)+50\left(\frac{3}{2}\right)$ or $50\left(\frac{2}{3}+\frac{3}{2}\right)$	M1	2.2a
	$=\frac{325}{3}$ $\left(\text{or } 108\frac{1}{3}\text{ or } 108.\dot{3}\text{ or } \frac{1300}{12}\text{ or } \frac{650}{6}\right)$	A1	1.1b
		(3)	
			(7 marks)

Notes for Question 4

(i)	
M1:	Uses a correct methodical strategy to enable the given sum, $\sum_{r=1}^{16}\left(3+5r+2^r\right)$ to be found Allow M1 for any of the following: • expressing the given sum as either $\sum_{r=1}^{16}(3+5r)+\sum_{r=1}^{16}\left(2^r\right)$, $\sum_{r=1}^{16}3+\sum_{r=1}^{16}(5r)+\sum_{r=1}^{16}\left(2^r\right)$ or $\sum_{r=1}^{16}3+5\sum_{r=1}^{16}r+\sum_{r=1}^{16}\left(2^r\right)$ • attempting to find both $\sum_{r=1}^{16}(3+5r)$ and $\sum_{r=1}^{16}\left(2^r\right)$ separately • (3×16) and attempting to find both $\sum_{r=1}^{16}(5r)$ and $\sum_{r=1}^{16}\left(2^r\right)$ separately
M1:	**Way 1:** Correct method for finding the sum of an AP with $a=8,\ d=5,\ n=16$ **Way 2:** (3×16) and a correct method for finding the sum of an AP
M1:	Correct method for finding the sum of a GP with $a=2,\ r=2,\ n=16$
A1*:	For all steps fully shown (with correct formulae used) leading to 131 798
Note:	**Way 1:** Give 2nd M1 for writing $\sum_{r=1}^{16}(3+5r)$ as $\frac{16}{2}(8+83)$
Note:	**Way 2:** Give 2nd M1 for writing $\sum_{r=1}^{16}3+\sum_{r=1}^{16}(5r)$ as $48+\frac{16}{2}(5+80)$ or $48+680$
Note:	Give 3rd M1 for writing $\sum_{r=1}^{16}\left(2^r\right)$ as $\frac{2(1-2^{16})}{1-2}$ or $2(2^{16}-1)$ or $(2^{17}-2)$
(i)	
Way 3	
M1:	At least 6 correct terms **and** 16 terms shown
M1:	At least 10 correct terms (may not be 16 terms)
M1:	At least 15 correct terms (may not be 16 terms)
A1*:	All 16 terms correct **and** an indication that the sum is 131 798
(ii)	
M1:	For some indication that the next two terms of this sequence are $\frac{3}{2},\frac{2}{3}$
M1:	For deducing that the sum can be found by applying $50\left(\frac{2}{3}\right)+50\left(\frac{3}{2}\right)$ or $50\left(\frac{2}{3}+\frac{3}{2}\right)$, o.e.
A1:	Obtains $\frac{325}{3}$ or $108\frac{1}{3}$ or $108.\dot{3}$ or an exact equivalent
Note:	Allow 1st M1 for $u_2=\frac{3}{2}$ (or equivalent) **and** $u_3=\frac{2}{3}$ (or equivalent)
Note:	Allow 1st M1 for the first 3 terms written as $\frac{2}{3},\frac{3}{2},\frac{2}{3},...$
Note:	Allow 1st M1 for the 2nd and 3rd terms written as $\frac{3}{2},\frac{2}{3},...$ in the correct order
Note:	Condone $\frac{2}{3}$ written as 0.66 or awrt 0.67 for the 1st M1 mark
Note:	Give A0 for 108.3 or 108.333... without reference to $\frac{325}{3}$ or $108\frac{1}{3}$ or $108.\dot{3}$

Question	Scheme	Marks	AOs