Applied Sequences and Series Exam Questions Sheet 2 Mark Scheme

Q1.

Question Number	Scheme		Marks
(a)	$206=140+(12-1)\times d \Rightarrow d=...$	Uses $206=140+(12-1)\times d$ and proceeds as far as $d=...$	M1
	$(d=)6$	Correct answer only can score both marks.	A1
			(2)
(b)	$S_{12}=\frac{12}{2}(140+206)$ or $S_{12}=\frac{12}{2}(2\times140+(12-1)\times"6")$ or $S_{11}=\frac{11}{2}(140+206-"6")$ or $S_{11}=\frac{11}{2}(2\times140+(11-1)\times"6")$	Attempts $S_n=\frac{n}{2}(a+l)$ or $S_n=\frac{n}{2}(2a+(n-1)d)$ with $n=12$, $a=140, l=206, d='6'$ **WAY 1** Or Attempts $S_n=\frac{n}{2}(a+l)$ or $S_n=\frac{n}{2}(2a+(n-1)d)$ with $n=11$, $a=140, l=206-'6', d='6'$ **WAY2** If they are using $S_n=\frac{n}{2}(2a+(n-1)d)$, the n must be used consistently.	M1
	$S=2076$ **WAY1** or $S=1870$ **WAY 2**	Correct sum (may be implied)	A1
	$(52-12)\times206=...$ or $(52-11)\times206=...$	Attempts to find $(52-12)\times206$ or $(52-11)\times206$. Does **not** have to be consistent with their n used for the first Method mark.	M1
	Total $="2076"+"8240"=...$ **(WAY 1)** or Total $="1870"+"8446"=...$ **(WAY 2)**	Attempts to find the total by adding the sum to 12 terms with (52 - 12) lots of 206 or attempts to find the total by adding the sum to 11 terms with (52 - 11) lots of 206. I.e. consistency is now required for this mark. **Dependent on both previous method marks.**	**dd**M1
	10316	cao	A1
			(5)
			(7 marks)

Q2.

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$24 + (6 \times 1.05) + (6 \times 1.05^2)$ minutes	M1	This mark is for a method to find the time taken for the competitor to run 6 km
	= 96.915 minutes = 36 minutes 55 seconds	A1	This mark is given for finding the total time as required
(b)	For example, 5th km = 6×1.05^1 6th km = 6×1.05^2 7th km = 6×1.05^3 … rth km = $6 \times 1.05^{r-4}$	B1	This mark is given for showing the time taken to run the rth km, as required
(c)	$24 + \sum_{r=5}^{20} 6 \times 1.05^{r-4}$	M1	This mark is given for showing the total time to run the race is the time taken for the first 4 km added to the time taken from 5th to 20th km
	$= 24 + 6.3 \times \frac{(1.05^{16} - 1)}{1.05 - 1}$	M1	This mark is given for using $s = a\left(\frac{1-r^n}{1-r}\right)$ where $a = 6 \times 1.05 = 6.3$, $r = 1.05$ and $n = 20 - 4 = 16$
	= 24 + 149.04	A1	This mark is given for a correct total time (represented decimally)
	= 173 minutes and 3 seconds	A1	This mark is given for finding a correct total time given in minutes in seconds

Q3.

Question	Scheme	Marks	AOs
(a)	(i) Method to find p Eg. Divides $32000 = Ap^4$ by $50000 = Ap^{11}$ $p^7 = \frac{50000}{32000} \Rightarrow p = \sqrt[7]{\frac{50000}{32000}} = \ldots$	M1	3.1a
	$p = 1.0658$	A1	1.1b
	(ii) Substitutes their $p = 1.0658$ into either equation and finds A $A = \frac{32000}{'1.0658'^4}$ or $A = \frac{50000}{'1.0658'^{11}}$	M1	1.1b
	$A = 24795 \rightarrow 24805 \simeq 24\,800$ *	A1*	1.1b
		(4)	
(b)	A / (£)24 800 is the value of the car on 1st January 2001	B1	3.4
	p /1.0658 is the factor by which the value rises each year. Accept that the value rises by 6.6 % a year (ft on their p)	B1	3.4
		(2)	
(c)	Attempts $100000 = '24800' \times '1.0658'^t$		
	$'1.0658'^t = \frac{100000}{24800}$	M1	3.4
	$t = \log_{1.0658}\left(\frac{100000}{24800}\right)$	dM1	1.1b
	$t = 21.8$ or 21.9	A1	1.1b
	cso 2022	A1	3.2a
		(4)	
			(10 marks)

Q4.

Question Number	Scheme		Marks
(a)	$32000 = 17000 + (k-1)\times 1500 \Rightarrow k = ...$	Use of 32000 with a **correct** formula in an attempt to find k. A correct formula could be implied by a correct answer.	M1
	$(k=)\ 11$	Cso (Allow $n = 11$)	A1
	Accept correct answer only.		
	$32000 = 17000 + 1500k \Rightarrow k = 10$ is M0A0 (wrong formula) $\frac{32000-17000}{1500} = 10 \therefore k = 11$ is M1A1 (correct formula implied)		
	Listing: All terms must be listed up to 32000 and 11 correctly identified. A solution that scores 2 if fully correct and 0 otherwise.		
			(2)
(b)	M1: $S = \frac{k}{2}(2\times 17000 + (k-1)\times 1500)$ or $\frac{k}{2}(17000+32000)$ $S = \frac{k-1}{2}(2\times 17000 + (k-2)\times 1500)$ or $\frac{k-1}{2}(17000+30500)$ A1: $S = \frac{11}{2}(2\times 17000+10\times 1500)$ or $\frac{11}{2}(17000+32000)$ $S = \frac{10}{2}(2\times 17000+9\times 1500)$ or $\frac{10}{2}(17000+30500)$ $(=269\ 500$ or $237\ 500)$	M1: Use of correct sum formula with their **integer** $n = k$ or $k-1$ from part (a) where $3 < k < 20$ and $a = 17000$ and $d = 1500$. **See below for special case for using $n = 20$.** A1: Any correct un-simplified numerical expression with $n = 11$ or $n = 10$	M1A1
	$32000\times\alpha$	$32000\times\alpha$ where α is an integer and $3 < \alpha < 18$	M1
	$288\ 000 + 269\ 500 = 557\ 500$ or $320\ 000 + 237\ 500 = 557\ 500$	M1: Attempts to add their two values. It is dependent upon the two previous M's being scored and must be the sum of 20 terms i.e. $\alpha + k = 20$ A1: 557 500	ddM1A1
	Special Case: If they just find S_{20} (£625 000) in (b) score the first M1 otherwise apply the scheme.		
			(5)
			(7 marks)

Listing:

n	1	2	3	4	5	6	7	8	9	10
u_n	17000	18500	20000	21500	23000	24500	26000	27500	29000	30500
n	11	12	13	14	15	16	17	18	19	20
u_n	32000	32000	32000	32000	32000	32000	32000	32000	32000	32000

Look for a sum before awarding marks. Award the M's as above then A2 for 557 500
If they sum the 'parts' separately then apply the scheme.

Q5.

Question	Scheme	Marks	AOs
(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.