

A level Mathematics Practice Paper – Arithmetic sequences and series – Mark scheme

Question	Scheme	Marks
1(a)	$206 = 140 + (12 - 1) \times d \Rightarrow d = \dots$	M1
	$(d =) 6$	A1
		(2)
1(b)	$S_{12} = \frac{12}{2}(140 + 206)$ or $S_{12} = \frac{12}{2}(2 \times 140 + (12 - 1) \times "6")$ or $S_{11} = \frac{11}{2}(140 + 206 - "6")$ or $S_{11} = \frac{11}{2}(2 \times 140 + (11 - 1) \times "6")$	M1
	$S = 2076$ WAY 1 or $S = 1870$ WAY 2	A1
	$(52 - 12) \times 206 = \dots$ or $(52 - 11) \times 206 = \dots$	M1
	Total = "2076" + "8240" = ... (WAY 1) or Total = "1870" + "8446" = ... (WAY 2)	ddM1
	10316	A1
		(5)
		(7 marks)

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Question	Scheme	Marks
2(a)	Boy's Sequence: 10, 15, 20, 25, ...	
	$\{a = 10, d = 5 \Rightarrow T_{15} =\} a + 14d = 10 + 14(5); = 80$ or $0.1 + 14(0.05); = £0.80$	M1 A1
		(2)
2(b)	$\{S_{60} =\} \frac{60}{2} [2(10) + 59(5)]$	M1 A1
	$= 30(315) = 9450$ or £94.50	A1
		(3)
2(c)	Boy's Sister's Sequence: 10, 20, 30, 40, ...	
	$\{a = 10, d = 10 \Rightarrow S_m =\} \frac{m}{2}(2(10) + (m-1)(10))$ $\left(\text{or } \frac{m}{2} \times 10(m+1) \text{ or } 5m(m+1) \right)$	M1 A1
	$63 \text{ or } 6300 = \frac{m}{2}(2(10) + (m-1)(10))$	dM1
	$6300 = \frac{m}{2}(10)(m+1)$ or $12600 = 10m(m+1)$	
	$1260 = m(m+1)$	
	$35 \times 36 = m(m+1)$ (*)	A1 cso
		(3)
2(d)	$\{m =\} 35$	B1
		(1)
		(10 marks)

A level Mathematics Practice Paper – Arithmetic sequences and series – Mark scheme

Question	Scheme	Marks
3(a)	$S_{10} = \frac{10}{2}[2a + 9d]$ or $S_{10} = a + a + d + a + 2d + a + 3d + a + 4d + a + 5d + a + 6d + a + 7d + a + 8d + a + 9d$	M1
	$162 = 10a + 45d$ *	A1 cso
		(2)
3(b)	$(u_n = a + (n-1)d \Rightarrow) 17 = a + 5d$	B1
		(1)
3(b)	$10 \times (b)$ gives $10a + 50d = 170$	M1
	(a) is $10a + 45d = 162$	
	Subtract $5d = 8$ so $d = \underline{1.6}$ o.e.	A1
	Solving for a $a = 17 - 5d$	M1
	so $a = \underline{9}$	A1
		(4)
		(7 marks)
4(a)	$600 = 200 + (N-1)20 \Rightarrow N = \dots$	M1
	$N = 21$	A1 cso
		(2)
4(b)	$S = \frac{21}{2}(2 \times 200 + 20 \times 20)$ or $\frac{21}{2}(200 + 600)$ or $S = \frac{20}{2}(2 \times 200 + 19 \times 20)$ or $\frac{20}{2}(200 + 580)$ (= 8400 or 7800)	M1A1
	$600 \times (52 - "N") (= 18600)$	M1A1ft
	So total is 27000	A1 cao
		(5)
		(7 marks)

A level Mathematics Practice Paper – Arithmetic sequences and series – Mark scheme

Question	Scheme		Marks
5(a)	Lewis; arithmetic series, $a = 140, d = 20$.		
	$T_{20} = 140 + (20 - 1)(20); = 520$	Or lists 20 terms to get to 520	M1 A1
	OR $120 + (20)(20)$		
			(2)
5(b)	Method 1	Method 2	
	Either: Uses $\frac{1}{2}n(2a + (n-1)d)$	Or: Uses $\frac{1}{2}n(a + l)$	M1
	$\frac{20}{2}(2 \times 140 + (20 - 1)(20))$	$\frac{20}{2}(140 + "520")$ ft 520	A1
	6600		A1
			(3)
5(c)	Sian; arithmetic series, $a = 300, l = 700, S_n = 8500$		
	Either: Attempt to use $8500 = \frac{n}{2}(a + l)$	Or: May use both $8500 = \frac{1}{2}n(2a + (n-1)d)$ and $l = a + (n-1)d$ and eliminate d	M1
	$8500 = \frac{n}{2}(300 + 700)$	$8500 = \frac{n}{2}(600 + 400)$	A1
	$\Rightarrow n = 17$		A1
			(3)
			(8 marks)

A level Mathematics Practice Paper – Arithmetic sequences and series – Mark scheme

Question	Scheme	Marks
6(a)	(a) Use n^{th} term $= a + (n-1)d$ with $d = 10$; $a = 150$ and $n = 8$, or $a = 160$ and $n = 7$, or $a = 170$ and $n = 6$: $= 150 + 7 \times 10$ or $160 + 6 \times 10$ or $170 + 5 \times 10$	M1
	$= 220^*$ (Or gives clear list – see note)	A1*
		(2)
Or	If answer 220 is assumed and $150 + (n-1)10 = 220$ or variation is solved for $n =$	M1
	Then $n = 8$, so 2007 is the year (must conclude the year)	A1*
		(2)
6(b)	Use $S_n = \frac{n}{2}\{2a + (n-1)10\}$ or $S_n = \frac{n}{2}\{a + l\}$ and $l = a + (n-1)10$	M1
	$= 7(300 + 13 \times 10)$ or $7(150 + 280)$	A1
	$= 7 \times 430$	
	$= 3010$	A1
		(3)
6(c)	Cost in year $n = 900 + (n-1) \times -20$	M1
	Sales in year $n = 150 + (n-1) \times 10$	
	Cost $= 3 \times$ Sales $\Rightarrow 900 + (n-1) \times -20 = 3 \times (150 + (n-1) \times 10)$	M1
	$900 - 20n + 20 = 450 + 30n - 30$	
	$500 = 50n$	
	$n = 10$	M1
	Year is 2009	A1
	As n is not defined they may work correctly from another base year to get the answer 2009 and their n may not equal 10. If doubtful – send to review.	
		(4)
		(9 marks)

A level Mathematics Practice Paper – Arithmetic sequences and series – Mark scheme

Question	Scheme	Marks
7(a)	$32000 = 17000 + (k-1) \times 1500 \Rightarrow k = \dots$	M1
	$(k =) 11$	A1
		(2)
7(b)	$S = \frac{k}{2}(2 \times 17000 + (k-1) \times 1500)$ or $\frac{k}{2}(17000 + 32000)$ $S = \frac{k-1}{2}(2 \times 17000 + (k-2) \times 1500)$ or $\frac{k-1}{2}(17000 + 30500)$	M1
	$S = \frac{11}{2}(2 \times 17000 + 10 \times 1500)$ or $\frac{11}{2}(17000 + 32000)$ $S = \frac{10}{2}(2 \times 17000 + 9 \times 1500)$ or $\frac{10}{2}(17000 + 30500)$ $(= 269\,500 \text{ or } 237\,500)$	A1
	$32000 \times \alpha$	M1
	$288\,000 + 269\,500 = 557\,500$ or $320\,000 + 237\,500 = 557\,500$	ddM1A1
		(5)
		(7 marks)
8(a)	$S_{10} = \frac{10}{2}[2P + 9 \times 2T] \quad \underline{\text{or}} \quad \frac{10}{2}(P + [P + 18T])$	M1
	e.g. $5[2P + 18T] = (\pounds)(10P + 90T) \quad \underline{\text{or}} \quad (\pounds) 10P + 90T \quad (*)$	A1cso
		(2)
8(b)	Scheme 2: $S_{10} = \frac{10}{2}[2(P + 1800) + 9T] = \{10P + 18000 + 45T\}$	M1A1
	$10P + 90T = 10P + 18000 + 45T$	M1
	$90T = 18000 + 45T$	
	$T = 400 \text{ (only)}$	A1
		(4)
8(c)	Scheme 2, Year 10 salary: $[a + (n-1)d] = (P + 1800) + 9T$	B1ft
	$P + 1800 + \text{“}3600\text{”} = 29850$	M1
	$P = (\pounds) \underline{24450}$	A1
		(3)
		(9 marks)

A level Mathematics Practice Paper – Arithmetic sequences and series – Mark scheme

Question	Scheme		Marks
9(a)	Series has 50 terms		B1
	$S = \frac{1}{2}(50)(2 + 100) = 2550$ or $S = \frac{1}{2}(50)(4 + 49 \times 2) = 2550$		M1 A1
			(3)
9(b)	$\frac{100}{k}$		B1
	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
			(4)
9(c)	$50^{\text{th}} \text{ term} = a + (n-1)d$		
	$= (2k+1) + 49(2k+3)$	Or $2k + 49(2k) + 1 + 49(3)$	M1
	$= 100k + 148$	$= 100k + 148$	A1
			(2)
			(9 marks)
10(a)	Attempts to use $a + (n-1)d$ with $a=A$ and " d "= $d+1$ and $n = 14$		M1
	$A + 13(d+1) = A + 13d + 13$ *		A1*
			(2)
10(b)	Calculates time for Yi on Day 14= $(A-13) + 13(2d-1)$		M1
	Sets times equal $A + 13d + 13 = (A-13) + 13(2d-1) \Rightarrow d = \dots$		M1
	$d = 3$		A1 cso
			(3)
10(c)	Uses $\frac{n}{2}\{2A + (n-1)(D)\}$ with $n=14$, and with $D=d$ or $d+1$		M1
	Attempts to solve $\frac{14}{2}\{2A + 13 \times '(d+1)'\} = 784 \Rightarrow A = \dots$		dM1
	$A = 30$		A1
			(3)
			(8 marks)

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	Source paper	Question number	New spec references	Question description	New AOs
1	C1 2017	4	4.4 and 4.6	Arithmetic sequence	3.1b and 3.4
2	C1 2012	6	4.4 and 4.6	Arithmetic sequences and series	1.1b, 2.1, 2.4, 3.1b and 3.4
3	C1 Jan 2011	6	4.4	Arithmetic sequences and series	1.1b, 3.1a
4	C1 2013	7	4.4	Arithmetic Series	1.1b, 2.1, 2.2a, 3.1b, 3.2, 3.3, 3.4
5	C1 Jan 2013	7	4.4 and 4.6	Arithmetic sequences and series	1.1b, 3.1b, 3.2, 3.4
6	C1 2014	8	4.4	Arithmetic sequences	1.1b, 2.1, 2.2a, 3.1b, 3.2, 3.4
7	C1 2015	9	4.4 and 4.6	Real-life use of sequences	1.1b, 3.4
8	C1 Jan 2012	9	4.4 and 4.6	Arithmetic sequences and series	1.1b, 2.1, 2.2a, 3.1b
9	C1 2011	9	4.4	Arithmetic sequences and series	1.1b, 2.1 and 2.4
10	C1 June 2014R	10	4.4, 4.6	Use of arithmetic sequence	1.1b, 2.4, 3.1b, 3.4