

Mark Scheme

Q1.

Question	Answer	Mark	Mark scheme	Additional guidance
	Result shown	M1	(indep) for writing $\sqrt{12}$ as $2\sqrt{3}$	This mark can be awarded whenever this is seen, which might be later in the process.
		M1	for method to rationalise the denominator eg $\frac{8+\sqrt{12}}{5+\sqrt{3}} \times \frac{5-\sqrt{3}}{5-\sqrt{3}}$ or $\frac{8+2\sqrt{3}}{5+\sqrt{3}} \times \frac{5-\sqrt{3}}{5-\sqrt{3}}$ oe	
		M1	(dep on previous M1) for expanding terms, condone one error in numerator or denominator eg $\frac{40-8\sqrt{3}+5\sqrt{12}-\sqrt{12}\sqrt{3}}{25-5\sqrt{3}+5\sqrt{3}-\sqrt{3}\sqrt{3}}$ or $\frac{40-8\sqrt{3}+10\sqrt{3}-2\sqrt{3}\sqrt{3}}{25-5\sqrt{3}+5\sqrt{3}-\sqrt{3}\sqrt{3}}$ or $\frac{34+2\sqrt{3}}{22}$ oe	
		A1	for a complete chain of reasoning leading to $\frac{17+\sqrt{3}}{11}$	

(Q19 1MA1/1H, Nov 2021)

Q2.

Question	Working	Answer	Notes
	$(\sqrt{a} + 2\sqrt{b})(\sqrt{a} - 2\sqrt{b})$	$a - 4b$	M1 for expansion of brackets or $\sqrt{4b} = 2\sqrt{b}$
	$\sqrt{a} \times \sqrt{a} - 2\sqrt{a}\sqrt{b} + 2\sqrt{b}\sqrt{a} - 2\sqrt{b} \times 2\sqrt{b}$		M1 for a or $(-4b)$
			A1 cao

(Q18 1MA1/2H/S2, Specimen papers)

Q3.

Question	Working	Answer	Mark	Notes
(a)		2	M1	for start to express the common ratio algebraically, eg $1/(\sqrt{x} - 1)$ or $(\sqrt{x} + 1)/1$ or $\sqrt{x} + 1 = k \times 1$ or $1 = k \times (\sqrt{x} - 1)$
			M1	for setting up an appropriate equation in x, eg $1/(\sqrt{x} - 1) = (\sqrt{x} + 1)/1$
			C1	for convincing argument to show $x = 2$
(b)		Shown	M1	for expressing the relationship between the common ratio, one of the first three terms of the sequence and the fifth term, eg $5^{\text{th}} \text{ term} = 3^{\text{rd}} \text{ term} \times (\text{common ratio})^2$
			C1	for a complete explanation to include eg, $(\sqrt{2} + 1)(\sqrt{2} + 1)^2 = 7 + 5\sqrt{2}$

(Q23 1MA1/2H, Nov 2017)

Q4.

Question	Answer	Mark	Mark scheme	Additional guidance
	5	M1	for $\sqrt{40}$ or $\sqrt{90}$	
			OR $2\sqrt{2}$ or $3\sqrt{2}$	
		M1	for $2\sqrt{10}$ or $3\sqrt{10}$ or $\sqrt{4} \times \sqrt{10}$ or $\sqrt{9} \times \sqrt{10}$ or $\sqrt{4} \times 10$ or $\sqrt{9} \times 10$	
			OR $2\sqrt{2} + 3\sqrt{2}$	
		A1	cao	Answer of $5\sqrt{10}$ from correct working gets M2 A0

(Q13 1MA1/1H, June 2018)

Q5.

Question	Working	Answer	Mark	Notes
		$c = a^2 + 8$	P1	process to expand $(a + \sqrt{8})^2$ given at least 3 terms correct
		$d = 4a$	A1	$c = a^2 + 8$
			A1	$d = 4a$

(Q22 1MA1/2H/M2, Specimen papers)

Q6.

Question	Answer	Mark	Mark scheme	Additional guidance
	$3 + \sqrt{2}$	P1	for start of process to find the common ratio, eg writes $\frac{13+9\sqrt{2}}{3+2\sqrt{2}}$	Award P1 for process to rationalise the denominator of $\frac{3+2\sqrt{2}}{13+9\sqrt{2}}$
		P1	for process to rationalise the denominator, eg $\frac{13+9\sqrt{2}}{3+2\sqrt{2}} \times \frac{3-2\sqrt{2}}{3-2\sqrt{2}}$	
		P1	(dep P2) for expanding terms, condone one error in expansion of numerator or denominator, eg $\frac{39+27\sqrt{2}-18\sqrt{2}\sqrt{2}-26\sqrt{2}}{9+6\sqrt{2}-6\sqrt{2}-4\sqrt{2}\sqrt{2}}$ or $\frac{39+27\sqrt{2}-26\sqrt{2}-36}{9-8}$ oe	
		A1	cao	A correct answer with no supportive working gets 0 marks.

(Q22 1MA1/1H, Nov 2023)

Q7.

Paper 1MA1: 1H			
Question	Working	Answer	Notes
		Given result	C1 Correct first step towards simplifying expression eg. $\frac{\sqrt{2}}{\sqrt{2}+1}$ C1 Correct step to rationalise denominator C1 Conclusion to given result

(Q23 1MA1/1H/N, Specimen papers)

Q8.

Question	Working	Answer	Mark	Notes
		$\sqrt{3}$	C1	first step shown towards simplifying, e.g. $\frac{4\sqrt{3}}{1+\sqrt{3}\sqrt{3}}$
			C1	simplifies denominator, e.g. $\frac{4\sqrt{3}}{1+3}$
			C1	conclusion to get result

(Q18 1MA1/1H/M2, Specimen papers)

Q9.

Question	Working	Answer	Notes
		Completes reasoning	M1 Expansion of $(4 - \sqrt{3})(4 + \sqrt{3})$ with at least 3 terms out of 4 correct or $4^2 - \sqrt{3} \times \sqrt{3}$ C1 for $\sqrt{13}$ from correct working

(Q14 1MA1/1H/S2, Specimen papers)

Q10.

Question	Working	Answer	Mark	Notes
		$\frac{11-\sqrt{2}}{17}$	3	M1 for intention to multiply numerator and denominator by $(5-\sqrt{8})$ M1 for correct expansion of either $(3+\sqrt{2})(5-\sqrt{8})$ or $(5+\sqrt{8})(5-\sqrt{8})$, at least 3 terms correct or 4 correct terms ignoring signs. A1 for fully correct working leading to $\frac{11-\sqrt{2}}{17}$

(Q21 1MA1/1H/M1, Specimen papers)

Q11.

Question	Working	Answer	Mark	Notes
	$\frac{6-\sqrt{8}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1}$ = $\frac{6\sqrt{2}+6-\sqrt{8}\sqrt{2}}{2-1}$ $=6\sqrt{2}+6-4-2\sqrt{2}$	$2+4\sqrt{2}$	M1 M1 A1	for correct first step eg multiplies numerator and denominator by $\sqrt{2}+1$ condone missing brackets (dep) for expansion of numerator with 4 terms correct with or without signs or 3 out of exactly 4 terms correct for $2+4\sqrt{2}$ oe or for stating $a=2$ and $b=4$

(Q21 1MA1/1H, Nov 2017)

Q12.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	explanation	C1	for a correct explanation, eg $\sqrt{3} \times -\sqrt{3} = -3$, not 3	
(b)	explanation	C1	for correct explanation, eg $\sqrt{12} = 2\sqrt{3}$, not $3\sqrt{2}$	

(Q20 1MA1/2H, June 2018)

Q13.

Paper 1MA1: 1H			
Question	Working	Answer	Notes
		$\sqrt{31}$	M1 expands brackets eg $36 + 6\sqrt{5} - 6\sqrt{5} - \sqrt{25} (=31)$ M1 rationalises the denominator eg using $\sqrt{31}$ with numerator & denominator A1 for $\sqrt{31}$

(Q19 1MA1/1H/S1, Specimen papers)

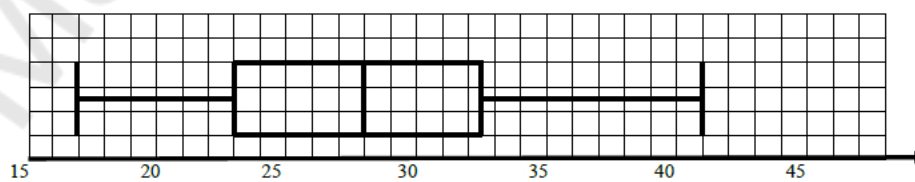
Q14.

Question	Working	Answer	Mark	Notes
		1:3	M1 for a valid first step, e.g. $\sqrt{9 \times 7} + \sqrt{9c}$ M1 for a complete method to show a multiplicative relationship, e.g. $3(\sqrt{7} + \sqrt{c})$ A1 cao	

(Q14 1MA1/3H/M2, Specimen papers)

Q15.

Question	Working	Answer	Mark	Notes
		$a = \frac{23}{49}$	M1	for method to expand $(3 - \sqrt{2})^2 (= 11 - 6\sqrt{2})$
		$b = \frac{17}{49}$	M1	for method to rationalise the denominator, e.g. multiplying by $\frac{11+6\sqrt{2}}{11+6\sqrt{2}}$
			M1	(dep M1) for method to expand correctly either the numerator or the denominator, e.g. $23 + 17\sqrt{2}$ or $121 - 72 (= 49)$
			A1	for $a = \frac{23}{49}$
			A1	for $b = \frac{17}{49}$



(Q19 1MA1/1H/M3, Specimen papers)

Q16.

Question	Answer	Mark	Mark scheme	Additional guidance
	fully correct working leading to $16(1+\sqrt{2})$	C1	for expanding the numerator. eg $18 + 2\sqrt{2}\sqrt{18} + 2$ or $\sqrt{324} + \sqrt{36} + \sqrt{36} + \sqrt{4}$ (= 32) or for simplifying $\sqrt{18}$, eg. $\sqrt{18} = 3\sqrt{2}$ or $\sqrt{18} + \sqrt{2} = 4\sqrt{2}$	Expanded terms need not be simplified
		C1	(indep) for method to rationalise the denominator, eg. $\frac{\text{"numerator"}}{\sqrt{8}-2} \times \frac{\sqrt{8}+2}{\sqrt{8}+2}$	
		C1	for fully correct working leading to $16(1+\sqrt{2})$	Accept $a = 16$. $b = 1$

(Q20 1MA1/1H, Nov 2018)

Q17.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	$3\sqrt{3}$	M1	for working unambiguously with $\sqrt{12}$, eg $\sqrt{4 \times 3}$ or $\sqrt{4} \times \sqrt{3}$ or $2\sqrt{3}$	
		A1	cao	
(b)	$\frac{\sqrt{3}}{81}$	M1	for simplifying the power eg $(\sqrt{3})^6 = 27\sqrt{3}$	
		M1	for method to rationalise the denominator eg multiplying by $\frac{\sqrt{3}}{\sqrt{3}}$	May be seen as the first step
		A1	for $\frac{\sqrt{3}}{81}$ or equivalent fraction in form $\frac{\sqrt{b}}{c}$, eg $\frac{\sqrt{2187}}{2187}$	

(Q18 1MA1/1H, June 2019)

Q18.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	$2\sqrt{11}$	M1	for method to multiply numerator and denominator by $\sqrt{11}$ or a multiple of $\sqrt{11}$, eg $\frac{22}{\sqrt{11}} \times \frac{\sqrt{11}}{\sqrt{11}}$	
		A1	for $2\sqrt{11}$	
(b)	$\frac{6+\sqrt{3}}{11}$	M1	for method to multiply numerator and denominator by $2\sqrt{3} + 1$ or a multiple of $2\sqrt{3} + 1$, eg $\frac{\sqrt{3}}{2\sqrt{3}-1} \times \frac{2\sqrt{3}+1}{2\sqrt{3}+1}$	
		M1	(dep) for $\sqrt{3} \times 2\sqrt{3} = 6$ or $2\sqrt{3} \times 2\sqrt{3} = 12$	
		A1	for $\frac{6+\sqrt{3}}{11}$ (accept $a = 6$ and $b = 11$)	

(Q16 1MA1/1H, Nov 2019)

Q19.

Question	Answer	Mark	Mark scheme	Additional guidance
	$1 + \frac{\sqrt{5}}{5}$	P1	for writing $\sqrt{180}$ as $6\sqrt{5}$	This process mark can be awarded whenever this is seen, which might be later in the process.
		P1	for process to rationalising the denominator eg $\frac{\sqrt{180}-2\sqrt{5}}{5\sqrt{5}-5} \times \frac{5\sqrt{5}+5}{5\sqrt{5}+5}$ or $\frac{4\sqrt{5}}{5\sqrt{5}-5} \times \frac{5\sqrt{5}+5}{5\sqrt{5}+5}$ oe	
		P1	(dep on previous P1) for expanding terms eg $\frac{5\sqrt{5}\sqrt{180}+5\sqrt{180}-50-10\sqrt{5}}{125-25}$ or $\frac{100+20\sqrt{5}}{100}$ oe	
		A1	for $1 + \frac{\sqrt{5}}{5}$	Accept written as $a = 1, b = 5$

(Q20 1MA1/1H, Nov 2020)

Q20.

Question	Answer	Mark	Mark scheme
	$\frac{10\sqrt{3}+27}{39}$	M1	for method to rationalise one of the fractions, eg $\frac{3\sqrt{3}}{4-\sqrt{3}} \times \frac{4+\sqrt{3}}{4+\sqrt{3}} (= \frac{12\sqrt{3}+9}{16-3})$ or $\frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} (= \frac{2\sqrt{3}}{3})$ oe
		M1	for method to rationalise both of the fractions eg $\frac{3\sqrt{3}}{4-\sqrt{3}} \times \frac{4+\sqrt{3}}{4+\sqrt{3}} (= \frac{12\sqrt{3}+9}{16-3})$ and $\frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} (= \frac{2\sqrt{3}}{3})$ oe
		M1	for method to write correct fractions with a common denominator eg $\frac{3(12\sqrt{3}+9)}{13 \times 3} - \frac{13 \times 2\sqrt{3}}{13 \times 3}$ or $\frac{36\sqrt{3}+27}{39} - \frac{26\sqrt{3}}{39}$ oe
		A1	for $\frac{10\sqrt{3}+27}{39}$ oe

(Q23 1MA1/1H, June 2023)

Q21.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	$\frac{\sqrt{7}}{7}$	B1	for $\frac{\sqrt{7}}{7}$ or $\frac{k\sqrt{7}}{7k}$ or $\frac{\sqrt{7k^2}}{7k}$ where k is an integer not equal to 0	
(b)	$3\sqrt{5}$	M1	for writing $\sqrt{80}$ as $\sqrt{16 \times 5}$ or $\sqrt{16} \times \sqrt{5}$ or $4\sqrt{5}$	
		A1	for $3\sqrt{5}$ or $\sqrt{45}$	

(Q17 1MA1/1H, June 2024)

Q22.

Question	Answer	Mark	Mark scheme	Additional guidance
	$\frac{\sqrt{a}-1}{a-1}$	M1	for a correct method to rationalise the denominator, eg. $\frac{1}{\sqrt{a}+1} \times \frac{\sqrt{a}-1}{\sqrt{a}-1}$ or $\frac{1}{\sqrt{a}+1} \times \frac{1-\sqrt{a}}{1-\sqrt{a}}$	Condone use of a prime number in place of a for the M1
		A1	for $\frac{\sqrt{a}-1}{a-1}$ or $\frac{1-\sqrt{a}}{1-a}$	Do not ISW

(Q15 1MA1/2H, June 2024)

Q23.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	$3\sqrt{5}$	M1	for $\frac{15}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ or $\frac{15}{\sqrt{5}} \times \frac{-\sqrt{5}}{-\sqrt{5}}$	
		A1	for $3\sqrt{5}$ or $\sqrt{45}$	
(b)	$\frac{32-9\sqrt{3}}{11}$	M1	(indep) for writing $\sqrt{75}$ as $5\sqrt{3}$	This mark can be awarded whenever this is seen, which might be later in the process.
		M1	for method to rationalise the denominator, eg $\frac{\sqrt{75}-2}{1+2\sqrt{3}} \times \frac{1-2\sqrt{3}}{1-2\sqrt{3}}$ or $\frac{5\sqrt{3}-2}{1+2\sqrt{3}} \times \frac{1-2\sqrt{3}}{1-2\sqrt{3}}$	
		M1	(dep on previous M1) for expanding terms, condone one error in numerator or denominator eg $\frac{\sqrt{75}-2\sqrt{75}\sqrt{3}-2+4\sqrt{3}}{1-2\sqrt{3}+2\sqrt{3}-4\sqrt{3}\sqrt{3}}$ or $\frac{5\sqrt{3}-10\sqrt{3}\sqrt{3}-2+4\sqrt{3}}{1-2\sqrt{3}+2\sqrt{3}-4\sqrt{3}\sqrt{3}}$	
		A1	for $\frac{32-9\sqrt{3}}{11}$ or eg $\frac{-32+9\sqrt{3}}{-11}$	

(Q16 1MA1/1H, Nov 2024)

Q24.

Question	Answer	Mark	Mark scheme	Additional guidance
(a)	4000	P1	for process to identify the common ratio, eg $400\sqrt{5} \div 200 (= 2\sqrt{5})$ or $200 \div 400\sqrt{5} (= \frac{1}{2\sqrt{5}})$ or for a process to find the next term of the sequence, eg $200 \times (200 \div 10)$	May use any 2 consecutive terms
		A1	cao	
(b)	5	P1	for process to find the ratio of the 4th and 6th terms, eg $\frac{5\sqrt{2}}{8} \div \frac{5\sqrt{2}}{4} (= \frac{1}{2})$ or $\frac{5\sqrt{2}}{4} \div \frac{5\sqrt{2}}{8} (= 2)$ or for finding that the 2nd term is $\frac{5\sqrt{2}}{2}$	
		P1	for complete process to find 1st term, eg $\frac{5\sqrt{2}}{4} \div \left(\frac{1}{\sqrt{2}}\right)^3$	
		A1	cao	Award 0 marks for a correct answer with no supportive working

(Q23 1MA1/1H, Nov 2022)