GCSE MATHEMATICS · HIGHER

Targeting Grade 9

Paper 9 · Mark scheme · Non-calculator · 40 marks

M method mark **P** process mark **A** accuracy mark (depends on the M or P marks before it)
B independent mark **C** communication mark **ft** follow through **oe** or equivalent

Q	Working	Answer	Mark	Notes
1	$2^{\frac{x}{2}} = 2^{5(x-3)}$		M1	Writes both sides as powers of 2
	$\frac{x}{2} = 5x - 15$		M1	
		$\frac{10}{3}$	A1	oe

Q	Working	Answer	Mark	Notes
2	Consecutive even numbers $2n$ and $2n+2$		M1	
	$2n(2n+2) = 4n^2 + 4n$		M1	
			C1	$= (2n+1)^2 - 1$, and $2n+1$ is odd

Q	Working	Answer	Mark	Notes
3	$r = \frac{3+\sqrt{3}}{1+\sqrt{3}}$		M1	
	$= \frac{(3+\sqrt{3})(\sqrt{3}-1)}{(\sqrt{3}+1)(\sqrt{3}-1)} = \frac{2\sqrt{3}}{2} = \sqrt{3}$		M1	Rationalises the denominator
	5th term $= (1+\sqrt{3}) \times (\sqrt{3})^4$		M1	
		$9 + 9\sqrt{3}$	A1	

Q	Working	Answer	Mark	Notes
4	$OA = OC$ and $OB = OC$ (radii), so triangles AOC and BOC are isosceles		M1	
	Angle OAC = angle $OCA = x$ and angle OBC = angle $OCB = y$ (base angles of isosceles triangles)		M1	
	In triangle ABC: $x + (x + y) + y = 180°$ (angles in a triangle)		M1	
			C1	$2x + 2y = 180°$ so angle $ACB = x + y = 90°$; complete proof with reasons

Q	Working	Answer	Mark	Notes
5	Centres form an equilateral triangle with side 4 cm		P1	
	Area of triangle $= \frac{1}{2} \times 4 \times 4 \times \sin 60° = 4\sqrt{3}$		P1	
	Three $60°$ sectors $= 3 \times \frac{1}{6} \times \pi \times 2^2 = 2\pi$		P1	
		$4\sqrt{3} - 2\pi$	A1	

Q	Working	Answer	Mark	Notes
6	$\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$; $\overrightarrow{OP} = \mathbf{a} + \frac{1}{4}(\mathbf{b} - \mathbf{a}) = \frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{b}$		M1	
	$\overrightarrow{MP} = \overrightarrow{OP} - \frac{1}{2}\mathbf{a} = \frac{1}{4}\mathbf{a} + \frac{1}{4}\mathbf{b} = \frac{1}{4}(\mathbf{a} + \mathbf{b})$		M1	
	$\overrightarrow{MQ} = -\frac{1}{2}\mathbf{a} - \frac{1}{2}\mathbf{b} = -\frac{1}{2}(\mathbf{a} + \mathbf{b})$		M1	
	$\overrightarrow{MQ} = -2\overrightarrow{MP}$		M1	
			C1	So MP and MQ are parallel and share the point M, so M, P, Q are collinear

Q	Working	Answer	Mark	Notes
7(a)	$2x^2 + 1 = (2x + 1)^2$		M1	
	$2x^2 + 1 = 4x^2 + 4x + 1 \Rightarrow$ $2x^2 + 4x = 0$		M1	
		$x = 0,\ x = -2$	A1	
7(b)	$2x^2 + 4x < 0 \Rightarrow 2x(x + 2) < 0$		M1	
		$-2 < x < 0$	A1	

Q	Working	Answer	Mark	Notes
8	$y = 4 - x$		M1	
	$2x^2 + (4 - x)^2 = 19$		M1	
	$3x^2 - 8x - 3 = 0$		A1	
	$(3x + 1)(x - 3) = 0$		M1	
		$x = 3,\ y = 1$	A1	
		$x = -\frac{1}{3},\ y = \frac{13}{3}$	A1	

Q	Working	Answer	Mark	Notes
9(a)	$\frac{3}{n+3} \times \frac{n}{n+2} + \frac{n}{n+3} \times \frac{3}{n+2}$ $\frac{6n}{(n+3)(n+2)} = \frac{1}{2}$ $12n = n^2 + 5n + 6 \Rightarrow$ $n^2 - 7n + 6 = 0$		M1 M1 A1	Shown
9(b)	$(n-1)(n-6) = 0 \Rightarrow n = 1$ or $n = 6$ $n = 1$: $\frac{3}{4} \times \frac{2}{3}$ $n = 6$: $\frac{3}{9} \times \frac{2}{8}$	 $\frac{1}{2}$ $\frac{1}{12}$	M1 A1 A1	
		Total	**40**	