GCSE MATHEMATICS · HIGHER

Targeting Grade 9

Paper 3 · 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	Odd numbers $2n+1$ and $2n+3$		M1	
	$(2n+1)^2+(2n+3)^2 =$ $8n^2+16n+10$		M1	
	$=8(n^2+2n+1)+2$		C1	Correct conclusion: 2 more than a multiple of 8

Q	Working	Answer	Mark	Notes
2	$3(x+1)-2(x-2)=(x-2)(x+1)$		M1	Multiplies through by $(x-2)(x+1)$
	$x+7=x^2-x-2$		M1	
	$x^2-2x-9=0 \Rightarrow x=\dfrac{2\pm\sqrt{40}}{2}$		M1	Correct use of formula or completing the square
		$1\pm\sqrt{10}$	A1	

Q	Working	Answer	Mark	Notes
3(a)	$\tan x^\circ = \dfrac{\sqrt{3}-1}{\sqrt{3}+1}$ $\dfrac{(\sqrt{3}-1)(\sqrt{3}-1)}{(\sqrt{3}+1)(\sqrt{3}-1)} =$ $\dfrac{3-2\sqrt{3}+1}{2}$ $= \dfrac{4-2\sqrt{3}}{2} = 2-\sqrt{3}$		M1 M1 A1	 Rationalises the denominator Shown with no errors
3(b)	$AB^2 = (\sqrt{3}+1)^2 + (\sqrt{3}-1)^2 =$ $(4+2\sqrt{3}) + (4-2\sqrt{3}) = 8$	 $2\sqrt{2}+2\sqrt{3}$	M1 A1	

Q	Working	Answer	Mark	Notes
4(a)	$4a+2b=2$ and $25a+5b=35$ $2a+b=1,\ 5a+b=7 \Rightarrow 3a=6$	 $a=2,\ b=-3$	M1 M1 A1	
4(b)	$2n^2-3n=230 \Rightarrow$ $2n^2-3n-230=0$ $n = \dfrac{3\pm\sqrt{9+1840}}{4} = \dfrac{3\pm 43}{4}$ $n=11.5$ (or -10), not a positive integer	 No	M1 M1 C1	ft their (a) Correct conclusion from correct working

Q	Working	Answer	Mark	Notes
5	$\overrightarrow{ON} = 2\mathbf{a} + \frac{1}{3}(2\mathbf{b} - 2\mathbf{a}) = \frac{4}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$		P1	
	$\overrightarrow{AM} = -2\mathbf{a} + \mathbf{b}$		P1	
	$\overrightarrow{OX} = 2\mathbf{a} + \mu(\mathbf{b} - 2\mathbf{a}) = (2 - 2\mu)\mathbf{a} + \mu\mathbf{b}$		P1	Point on AM
	$\frac{4}{3}k = 2 - 2\mu$, $\frac{2}{3}k = \mu \Rightarrow \frac{4}{3}k = 2 - \frac{4}{3}k$		P1	Equates coefficients
		$k = \frac{3}{4}$	A1	

Q	Working	Answer	Mark	Notes
6	$P(\text{3 red}) = \dfrac{x(x-1)(x-2)}{720}$		P1	
	$P(\text{3 blue}) = \dfrac{(10-x)(9-x)(8-x)}{720}$		P1	
	$x(x-1)(x-2) + (10-x)(9-x)(8-x) = 144$		P1	
	$24x^2 - 240x + 720 = 144$ (the x^3 terms cancel)		P1	
	$x^2 - 10x + 24 = 0 \Rightarrow x = 4$ or $x = 6$		P1	
		4	A1	Fewer red than blue, so $x = 4$

Q	Working	Answer	Mark	Notes
7	$AB = BC$ (sides of a square), $BE = CF$ (given), angle $ABE =$ angle $BCF = 90°$		M1	
	Triangles ABE and BCF are congruent (SAS), so $AE = BF$		M1	
	Angle $BAE =$ angle CBF (corresponding angles of congruent triangles)		M1	
	In triangle ABX: angle $ABX = 90° -$ angle $CBF = 90° -$ angle BAE		M1	
	So angle $AXB = 180° -$ angle $BAE - (90° -$ angle $BAE) = 90°$		C1	Complete proof with reasons

Q	Working	Answer	Mark	Notes
8	$C = (t, t)$		P1	
	Gradients $\frac{t-6}{t}$ and $\frac{t-2}{t-8}$ with product -1		P1	Or Pythagoras: $AC^2 + BC^2 = AB^2$
	$(t-6)(t-2) = -t(t-8)$		P1	
	$2t^2 - 16t + 12 = 0 \Rightarrow$ $t^2 - 8t + 6 = 0$		P1	
	$t = 4 \pm \sqrt{10}$		P1	
	$(4+\sqrt{10},\ 4+\sqrt{10})$ and $(4-\sqrt{10},\ 4-\sqrt{10})$	Both points	A1	
		Total	**40**	