Question	Answer	Marks	Guidance
8(a)	$x^2 + 2\sqrt{5}x - 20 = 3\sqrt{5}x + 10$ $x^2 - \sqrt{5}x - 30 = 0$	**M1**	For equating x terms and simplifying to a 3-term quadratic equation equated to zero.
	$x = \dfrac{\sqrt{5} \pm \sqrt{5 - (4 \times -30)}}{2}$ oe	**M1**	**Dep** on previous M mark for attempt to solve to obtain $x =$, sufficient detail must be shown
	$x = 3\sqrt{5} \quad x = -2\sqrt{5}$	**A1**	For both
	$y = 55, y = -20$	**A1**	For both
8(b)	Use of $\text{cosec}^2\,\theta = 1 + \cot^2\,\theta$	**B1**	May be implied by later work
	$\text{cosec}^2\theta = 1 + \dfrac{\left(2+\sqrt{3}\right)^2}{\left(\sqrt{3}-1\right)^2}$	**M1**	For attempting to deal with tan correctly, forming a single fraction and simplifying, with sufficient detail – at least 4 terms in the numerator
	$\text{cosec}^2\theta = \dfrac{11+2\sqrt{3}}{4-2\sqrt{3}}$	**A1**	
	$\text{cosec}^2\theta = \dfrac{11+2\sqrt{3}}{4-2\sqrt{3}} \times \dfrac{4+2\sqrt{3}}{4+2\sqrt{3}}$	**M1**	For attempt to rationalise *their* expression, with sufficient detail in the simplification of the numerator – at least 3 terms
	$14 + \dfrac{15\sqrt{3}}{2}$	**A1**	
	Alternative 1 Use of $\text{cosec}^2\,\theta = 1 + \cot^2\,\theta$	**(B1)**	May be implied by later work
	$\cot\theta = \dfrac{2+\sqrt{3}}{\sqrt{3}-1}$ $= \dfrac{3\sqrt{3}+5}{2}$	**(2)**	**M1** for attempting to rationalise cot θ or tan with sufficient detail in the simplification of the numerator – at least 3 terms
	$\text{cosec}^2\theta = 1 + \left(\dfrac{3\sqrt{3}+5}{2}\right)^2$ $= 14 + \dfrac{15\sqrt{3}}{2}$	**(2)**	**M1** for expressing as a single fraction and attempt to simplify to required form.

Question	Answer	Marks	Guidance
8(b)	**Alternative 2** Use of $\text{cosec}^2\theta = 1 + \cot^2\theta$ **and** $\cot^2\theta = \frac{1}{\tan^2\theta}$	**(B1)**	May be implied by later work
	$\tan^2\theta = \frac{4-\sqrt{3}}{7+4\sqrt{3}}$ $= 52 - 30\sqrt{3}$	**(2)**	**M1** for attempting to rationalise $\tan^2\theta$ with sufficient detail in the simplification of the numerator – at least 3 terms
	$\text{cosec}^2\theta = 1 + \left(\frac{1}{52-30\sqrt{3}}\right)^2$ $= 14 + \frac{15\sqrt{3}}{2}$	**(2)**	**M1** for attempting to rationalise $\cot^2\theta$ with sufficient detail in the simplification of the numerator – at least 3 terms **and** expressing as a single fraction and attempt to simplify to required form.
	Alternative 3 Use of right-angled triangle $\text{Hyp}^2 = 11 + 2\sqrt{3}$	**(2)**	**M1** For attempt to calculate the square of hypotenuse
	$\text{cosec}^2\theta = \frac{11+2\sqrt{3}}{4-2\sqrt{3}}$	**(B1)**	for correct use of $\text{cosec}^2\theta$ with *their* squared hypotenuse
	$\text{cosec}^2\theta = \frac{11+2\sqrt{3}}{4-2\sqrt{3}} \times \frac{4+2\sqrt{3}}{4+2\sqrt{3}}$	**(M1)**	For attempt to rationalise *their* expression, with sufficient detail in the simplification of the numerator – at least 3 terms
	$14 + \frac{15\sqrt{3}}{2}$	**A1**	
9(a)	$\frac{1}{2}r^2\theta = 10,\ \theta = \frac{20}{r^2}$	**B1**	
	$[P =]\ 2r + r\theta$	**M1**	For substituting *their* θ in P
	$[P =]\ 2r + \frac{20}{r^2}$	**A1**	
9(b)	$\frac{dP}{dr} = 2 - \frac{20}{r^2}$	**M1**	For attempt to differentiate *their* answer to part **(a)** to obtain the form of $\left[\frac{dP}{dr} =\right] 2 + \frac{a}{r^2}$
	When $\frac{dP}{dr} = 0,\ r = \sqrt{10}$	**2**	**Dep M1** for equating *their* $\frac{dP}{dr}$ to zero and attempt to solve **A1** cao