Question Number	Scheme	Marks
2.(a)	Attempts $(x\pm 2)^2+(y\pm 5)^2 .....=0$	M1
	(i) Centre $(-2,5)$	A1
	(ii) Radius $\sqrt{50}$ or $5\sqrt{2}$	B1 **(3)**
(b)	Gradient of radius = $\frac{(5)-4}{(-2)-5}=-\frac{1}{7}$ which needs to be in simplest form	B1ft
	Uses $m_2=-\frac{1}{m_1}$ to find gradient of tangent	M1
	Equation of tangent $y-4="7"(x-5)\Rightarrow y=7x-31$	M1 A1 **(4)** **(7 marks)**

Notes

(a) **Note that the epen set up here is M1 M1 B1**

M1 Attempts to complete the square on both terms or states the centre as $(\pm 2,\pm 5)$

For completing the square look for $(x\pm 2)^2+(y\pm 5)^2 .....=...$

A1 Centre $(-2,5)$ Allow $x=-2, y=5$ This alone can score both marks even following incorrect lines eg $(x+2)^2..(y-5)^2=...$where … could be , for example a minus sign or blank

A1 Radius $\sqrt{50}$ or $5\sqrt{2}$ You may isw after a correct answer.

If a candidate attempts to use $x^2+y^2+2fx+2gy+c=0$ then M1 may be awarded for a centre of $(\pm 2,\pm 5)$

(b) **Note that the epen set up here is M1 M1 M1 A1**

B1ft Correct answer for the gradient of the line joining $P(5,4)$to their centre.

You may ft on their centre but the value must be fully simplified.

M1 Awarded for using $m_2=-\frac{1}{m_1}$ to find gradient of tangent.

Do be aware that some good candidates may do the first two marks at once so you may need to look at what value they are using for the gradient of the tangent.

M1 For an attempt to find the equation of the tangent using $P(5,4)$and a changed gradient. Condone bracketing slips only.

If the candidate uses the form $y=mx+c$ they must use *x* and *y* the correct way around and proceed as far as $c=...$

A1 $y=7x-31$ stated. It must be written in this form.

(It cannot be awarded from $y=mx+c$ by just stating $c=-31$)

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Attempts at (b) using differentiation.

B1 $x^2+y^2+4x-10y-21=0\rightarrow 2x+2y\frac{dy}{dx}+4-10\frac{dy}{dx}=0$.

M1 Substitutes $P(5,4)$into an expression of the form $ax+by\frac{dy}{dx}+c+d\frac{dy}{dx}=0$ AND finds the value of $\frac{dy}{dx}=(7)$. The values of *a, b , c* and *d* must be non-zero.

M1 Uses $m = \left.\frac{\mathrm{d}y}{\mathrm{d}x}\right|_{x=5}$ with $P(5,4)$ to find equation of tangent

A1 $y = 7x - 31$

Question Number	Scheme	Marks
3. (i)	$(x-4)^2 \geqslant 2x-9 \Rightarrow x^2-10x+25 \ldots 0$	M1
	$\Rightarrow (x-5)^2 \ldots 0$	A1
	Explains that "square numbers are greater than or equal to zero" hence (as $x \in \mathbb{R}$), $\Rightarrow (x-4)^2 \geqslant 2x-9$ *	A1*
		(3)
(ii)	Shows that it is not true for a value of n Eg. When $n=3$, $2^n+1=8+1=9$ × Not prime	B1
		(1)
		(4 marks)

Notes

(i) A proof starting with the given statement

M1 Attempts to expand $(x-4)^2$ and work from form $(x-4)^2 \ldots 2x-9$ to form a 3TQ on one side of an equation or an inequality

A1 Achieves both $x^2-10x+25$ and $(x-5)^2$. Allow $(x-5)^2$ written as $(x-5)(x-5)$

A1* For a correct proof. Eg

"square numbers are **greater than or equal** to zero", hence (as $x \in \mathbb{R}$), $(x-5)^2 \geqslant 0$

$\Rightarrow (x-4)^2 \geqslant 2x-9$

This requires (1) Correct algebra throughout, (2) a correct explanation concerning square numbers and (3) a reference back to the original statement

Answers via b^2-4ac are unlikely to be correct. Whilst it is true that there is only one root and therefore it touches the x-axis, it does not show that it is always positive. The explanation could involve a sketch of $y=(x-5)^2$ but it must be accurate with a minimum on the +ve x axis with some statement alluding to why this shows $(x-5)^2 \geqslant 0$

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Approaches via odd and even numbers will usually not score anything. They would need to proceed using the main scheme via $(2m-4)^2 \geqslant 4m-9$ and $(2m-1-4)^2 \geqslant 2(2m-1)-9$

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Alt to (i) via contradiction

Proof by contradiction is acceptable and marks in a similar way

M1 For setting up the contradiction

'Assume that there is an x such that $(x-4)^2 < 2x-9 \Rightarrow x^2-10x+25 \ldots 0$

A1 $\Rightarrow (x-5)^2 \ldots 0$ or $(x-5)(x-5) \ldots 0$

A1* This is not true as square numbers are always greater than or equal to 0,

hence $(x-4)^2 \geqslant 2x-9$

……

Alt to part (i) States $(x-5)^2 \geqslant 0$

$\Rightarrow x^2-10x+25 \geqslant 0$

$\Rightarrow x^2-8x-16 \geqslant 2x-9$

$\Rightarrow (x-4)^2 \geqslant 2x-9$