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 $(2m-1-4)^2 \geqslant 2(2m-1)-9$

……

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 $(x-5)^2 \geqslant 0$

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

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

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

Question Number	Scheme	Marks
M1	States $(x-5)^2 \geqslant 0$ and attempts to expand. There is no explanation required here	
A1	Rearranges to reach $x^2-8x-16 \geqslant 2x-9$	
A1*	Reaches the given answer $(x-4)^2 \geqslant 2x-9$ with no errors	
.....		
(ii)		
B1	Shows that it is not true for a value of *n* This requires a calculation (and value found) with a minimal statement that it is not true Eg. '$2^6+1=65$ which is not prime' or '$2^5+1=33$ ×' Condone sloppily expressed proofs. Eg. '$2^7+1=\frac{\mathbf{129}}{3}=43$ which is not prime' Condone implied proofs where candidates write $2^5+1=33$ which has a factor of 11 If there are lots of calculations mark positively. Only one value is required to be found (with the relevant statement) to score the B1 The calculation cannot be incorrect. Eg. $2^3+1=10$ which is not prime	

Question Number	Scheme	Marks
4.(a)	$\left(2-\frac{1}{4}x\right)^6 = 2^6, +{}^6C_1 2^5\left(-\frac{1}{4}x\right)^1 + {}^6C_2 2^4\left(-\frac{1}{4}x\right)^2 + {}^6C_3 2^3\left(-\frac{1}{4}x\right)^3 + \ldots$	B1, M1
	$= 64 - 48x + 15x^2 - 2.5x^3$	A1 A1 **(4)**
(b)	$\left(2-\frac{1}{4}x\right)^6 + \left(2+\frac{1}{4}x\right)^6 = \left(64-48x+15x^2-2.5x^3\right)+\left(64+48x+15x^2+2.5x^3\right)$	M1
	$\approx 128 + 30x^2$	B1ft A1 **(3)** **(7 marks)**

Notes

(a)

B1 For either 2^6 or 64. Award for an unsimplified ${}^6C_0 2^6\left(-\frac{1}{4}x\right)^0$

M1 For an attempt at the binomial expansion. Score for a correct attempt at term 2, 3 or 4.

Accept sight of ${}^6C_1 2^5\left(\pm\frac{1}{4}x\right)^1$ ${}^6C_2 2^4\left(\pm\frac{1}{4}x\right)^2$ ${}^6C_3 2^3\left(\pm\frac{1}{4}x\right)^3$ condoning omission of brackets.

Accept any coefficient appearing from Pascal's triangle. FYI 6, 15, 20

A1 For any two simplified terms of $-48x + 15x^2 - 2.5x^3$

A1 For $64 - 48x + 15x^2 - 2.5x^3$ ignoring terms with greater powers. This may be awarded in (b) if it is not fully simplified in (a). Allow the terms to be listed $64, -48x, 15x^2, -2.5x^3$. Isw after sight of correct values. The expression written out without any method can be awarded all 4 marks.

(b) **Note that this is now marked M1 B1 A1**

M1 For adding two sequences that must be of the correct form with the correct signs.

Look for $\left(A - Bx + Cx^2 - Dx^3\right)+\left(A + Bx + Cx^2 + Dx^3\right)$ but condone

$\left(A - Bx + Cx^2\right)+\left(A + Bx + Cx^2\right)$

For this to be scored there must be some negative terms in (a)

B1ft For one correct term (follow through). Usually a = 128 but accept either $a = 2\times$'their'+ve 64

or $b = 2\times$'their' $+ ve$ 15

A1 For $128 + 30x^2$. CSO so must be from $\left(64-48x+15x^2-2.5x^3\right)+\left(64+48x+15x^2+2.5x^3\right)$

Allow $a = 128, b = 30$ following correct work.

This is a show that question so M1 must be awarded. It must be their final answer so do not isw here.

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Alternative method in (a):

$$\left(2-\frac{1}{4}x\right)^6 = 2^6\left(1-\frac{1}{8}x\right)^6 = 2^6\left(1+6\left(-\frac{1}{8}x\right)+\frac{6\times5}{2}\left(-\frac{1}{8}x\right)^2+\frac{6\times5\times4}{3!}\left(-\frac{1}{8}x\right)^3+\ldots\right)$$

B1 For sight of factor of either 2^6 or 64

M1 For an attempt at the binomial expansion seen in at least one term within the brackets.
Score for a correct attempt at term 2, 3 or 4.