Question Number	Scheme	Marks
2.(a)	Sight of $10^{1.478}$ or $10^{0.0646}$ or $10^{0.0646t+1.478}$	M1
	$(a=)$awrt 30 or $(b=)$awrt 1.16	A1
	$\log_{10} N = 0.0646t + 1.478 \rightarrow N = 10^{0.0646t+1.478} = 10^{0.0646t}10^{1.478}$	dM1
	$= "30" \times "1.16"^t$	
	$N = 30 \times 1.16^t$	A1
		(4)
(b)	Attempts $N = 30 \times 1.16^{30} =$ awrt 2600	M1 A1
		(2)
		(6 marks)

(a) **NB This shows as MMAA on ePEN but is being marked as MAMA.**

M1 Sight of $10^{1.478}$ or $10^{0.0646}$ or $10^{0.0646t+1.478}$ (allowing slips copying the values) anywhere in their solution. This mark is implied by seeing awrt 30 or awrt 1.16

A1 Sight of either awrt 30 or awrt 1.16

dM1 Applies correct index laws and proceeds to find values for *a* and *b*. $N = \left(10^{0.0646}\right)^t \times 10^{1.478} = "1.16"^t \times "30"$

For this mark there must be evidence of correct index work so expect to see at least $10^{0.0464t+1.478}$ before a final answer and no incorrect index work.

A1 $a = awrt\ 30$ and $b = awrt\ 1.16$ as long as there is no contrary work, or states that $N = 30 \times 1.16^t$ (awrt values)

(b)

M1 Attempts $N = 30 \times 1.16^{30}$ with their values of *a* and *b*.

Alternatively $\log_{10} N = 0.0646 \times 30 + 1.478 \Rightarrow N = 10^{3.416}$

A1 awrt 2600, isw after a correct answer.

.....

Alt (a) using $N = ab^t$ as a starting point.

M1 As main scheme.

A1 $a =$ awrt 30 or $b =$ awrt 1.16 (must be correctly assigned)

dM1 Takes $\log_{10}$ of both sides and proceeds to at least $\log_{10} N = \log_{10} a + t \log_{10} b$ and attempts to find a value for both of the constants with no incorrect log work.

A1 $a = awrt\ 30$ and $b = awrt\ 1.16$ as long as there is no contrary work, or states that $N = 30 \times 1.16^t$ (awrt values)

Question Number	Scheme	Marks
3. (a)	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{(4x-1)^{\frac{1}{2}}\times 2-(2x+3)\times 2(4x-1)^{-\frac{1}{2}}}{(4x-1)}$	M1 A1
	$\dfrac{(4x-1)^{\frac{1}{2}}\times 2-(2x+3)\times 2(4x-1)^{-\frac{1}{2}}}{(4x-1)}\times\dfrac{(4x-1)^{\frac{1}{2}}}{(4x-1)^{\frac{1}{2}}}=\dfrac{4x-8}{(4x-1)^{\frac{3}{2}}}$	dM1 A1
		(4)
(b)	Turning point where $\dfrac{\mathrm{d}y}{\mathrm{d}x}=0\Rightarrow x=2$	M1
	Find value of f at $x=2\Rightarrow \mathrm{f}(x)=\sqrt{7}$ Hence range is $\mathrm{f}\geqslant\sqrt{7}$	dM1 A1
		(3)
		(7 marks)

(a)

M1 Attempts the quotient rule and **achieves** $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{p(4x-1)^{\frac{1}{2}}-q(2x+3)(4x-1)^{-\frac{1}{2}}}{(4x-1)}$ condoning slips in coefficients

Allow the denominator to appear as $(4x-1)^{\frac{1}{2}\ 2}$ or even $(4x-1)^{\frac{1}{4}}$

Alternatively attempts the product rule with $(2x+3)$ and $(4x-1)^{-\frac{1}{2}}$ and **achieves**

$\dfrac{\mathrm{d}y}{\mathrm{d}x}=A(4x-1)^{-\frac{1}{2}}\pm B(2x+3)(4x-1)^{-\frac{3}{2}}$

A1 For a correct un-simplified $\dfrac{\mathrm{d}y}{\mathrm{d}x}$. Look for $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{(4x-1)^{\frac{1}{2}}\times 2-(2x+3)\times 2(4x-1)^{-\frac{1}{2}}}{(4x-1)}$ oe via the quotient rule

Look for $\dfrac{\mathrm{d}y}{\mathrm{d}x}=2(4x-1)^{-\frac{1}{2}}-2(2x+3)(4x-1)^{-\frac{3}{2}}$ oe via the product rule

dM1 Multiplies both numerator and denominator by $(4x-1)^{\frac{1}{2}}$ and simplifies to a linear numerator, or correctly takes a common factor of $(4x-1)^{-\frac{1}{2}}$ out of the numerator to leave a linear factor.

If the product rule is used look for a correct attempt to factor out $(4x-1)^{-\frac{3}{2}}$

A1 $\dfrac{4x-8}{(4x-1)^{\frac{3}{2}}}$ or exact simplified equivalent Must have a single term in $(4x-1)$

NB Allow marks for (a) if simplification of f'(x) is seen in (b) (but not having set f'(x) = 0 and rearranging).

(b)

M1 Attempts $\dfrac{\mathrm{d}y}{\mathrm{d}x}=0\Rightarrow x=...$

dM1 Finds the value of $\mathrm{f}(\text{their } 2)$, where their 2 > $\dfrac{1}{4}$

A1 $\mathrm{f}\geqslant\sqrt{7}$ Allow e.g. $y\geqslant\sqrt{7}$, $\mathrm{f}(x)\geqslant\sqrt{7}$ or range is $\left[\sqrt{7},\infty\right)$ Allow with $\dfrac{7}{\sqrt{7}}$ oe or awrt 2.65

Do not allow $x\geqslant\sqrt{7}$ or just $\geqslant\sqrt{7}$

Special Case: If candidates square the function first in (a) they will get $\left(\mathrm{f}(x)^2\right)'=1-\dfrac{49}{(4x-1)^2}=\dfrac{16x^2-8x-48}{(4x-1)^2}$.

They will score no marks in (a) but can achieve full marks in (b) as the stationary point occurs at the same x coordinate.

Special Case: A correct range given following no attempt, or an incorrect answer to (a), can score SC M1M0A0.