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.

Question Number	Scheme	Marks
4 (a)	$\mathrm{ff}(6)=\mathrm{f}(13)=-1$	M1 A1 **(2)**
(b)	Attempts $21+2(2-x)=5x\Rightarrow x=...$ or $21-2(x-2)=5x\Rightarrow x=...$ $x=\frac{25}{7}$ only	M1 A1 **(2)**
(c)	Either $k<21$ or $k\geqslant 17$ $17\leqslant k<21$	M1 A1 **(2)**
(d)	$a=\frac{1}{7}$ $b=4$	B1 B1 **(2)** **(8 marks)**

(a)

M1 For attempting f "twice". Award for sight of $\mathrm{f}(13)$ or $21-2\left|2-\left(21-2\left|2-x\right|\right)\right|$ followed by a value.

A1 For -1

(b)

M1 Attempts $21+2(2-x)=5x\Rightarrow x=...$

A1 For $x=\frac{25}{7}$ only. Do not isw if students go on to find additional solutions unless they identify this as the only answer by rejecting others.

(c)

M1 For either $k<21$ or $k\geqslant 17$ Condone for this mark $k\leqslant 21$ or $k>17$

Alt: Allow for **both** $k = 17$ and $k = 21$ identified as critical values even if no inequalities are given.

A1 $17\leqslant k<21$ May be written as separate inequalities. Accept alternative notations for the range such as $\left[17,21\right)$

Do not accept $17\leqslant \mathrm{f}(x)<21$

(d)

B1 Either $a=\frac{1}{7}$ **or** $b=4$

B1 Both $a=\frac{1}{7}$ **and** $b=4$ Allow both marks if $y=\frac{1}{7}\mathrm{f}(x-4)$ is given.