Question	Scheme	Marks
3(a)	$f'(x) = 2(x-2)\times e^{3x} + (x-2)^2 \times 3e^{3x}$	**M1 A1**
	$f'(x) = 0 \Rightarrow e^{3x}(x-2)(2+3(x-2)) = 0 \Rightarrow x = ...$	**M1**
	$\Rightarrow x = \frac{4}{3}$	**A1**
	$y = \frac{4}{9}e^4 \quad \left(\text{so } A \text{ is } \left(\frac{4}{3}, \frac{4}{9}e^4\right)\right)$	**A1**
		(5)
(b)	$k > 0$ or k „ their $\frac{4}{9}e^4$ or with … or < respectively.	**M1**
	$0 < k$„ their $\frac{4}{9}e^4$	**A1ft**
		(2)
		(7 marks)

Notes:

(a)

M1: Differentiates using the product rule reaching the form $\alpha(x-2)\times e^{3x} + (x-2)^2 \times \beta e^{3x}$

A1: Correct derivative, need not be simplified.

M1: Sets their derivative equal to zero and attempts to cancel or factorise out the exponential term and the $(x-2)$ term (or multiple thereof) and solve for *x*. Alternatively, they may expand to a 3 term quadratic $(3x^2 - 10x + 8)$ and attempt to solve this via correct method. Allow recovery on slips in the exponent for this mark (and the A's if a correct quadratic expression is solved).

A1: Correct *x* value.

A1: Correct simplified *y* value. Allow if seen in part (b). Isw, after a correct answer, but the follow through in (b) will not apply on an incorrectly simplified answer if this mark has been awarded.

(b)

M1: Identifies one correct boundary for *k* (the direction of inequality must be correct). Accept in terms of *y* or f(*x*) for this mark.

A1ft: Correct range for *k* following their **positive** *y* coordinate in (a). Must have correct inequalities. Accept awrt 24.3 for the upper bound. Allow as separate inequalities, or set or interval notation.

Question	Scheme	Marks
4(a)	$y=\log_{10}(2x+1)\Rightarrow 10^y=2x+1\Rightarrow x=...$	**M1**
	$\Rightarrow x=\dfrac{10^y-1}{2}$	**A1**
		(2)
(b)	$\left(\dfrac{\mathrm{d}x}{\mathrm{d}y}=\right)\dfrac{1}{2}10^y\ln 10$	**M1**
	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=1\Big/\dfrac{\mathrm{d}x}{\mathrm{d}y}=\dfrac{1}{\frac{1}{2}10^y\ln 10}$	**M1**
	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{2}{(2x+1)\ln 10}$	**A1**
		(3)
		(5 marks)

Notes:

(a)

M1: Correctly undoes the logarithm and attempts to rearrange to make *x* the subject.

A1: Correct expression for *x*. Apply isw after a correct answer.

(b)

M1: Attempts to differentiate 10^y. Accept $\alpha 10^y\rightarrow\beta 10^y\ln 10$ (ignore any extra terms). Do not be concerned about the lhs for this mark.

M1: Applies reciprocal $\dfrac{\mathrm{d}y}{\mathrm{d}x}=1\Big/\dfrac{\mathrm{d}x}{\mathrm{d}y}$. Variables must be consistent.

A1: Correct answer. Accept equivalents in terms of *x*, e.g. with $10^{\log(2x+1)}$ isw after a correct answer.

Alt for (b): Allow use of change of base formula.

M1: $y=\dfrac{\ln(2x+1)}{\ln 10}$ (effectively a B mark via this method)

M1: $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\left(\dfrac{1}{\ln 10}\times\right)\dfrac{1}{2x+1}\times...$ Attempts to differentiate using the chain rule.

A1: Correct answer.

Note: Candidates who write $\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{1}{2x+1}\times...\left(\text{ or }\dfrac{\mathrm{d}y}{\mathrm{d}x}=\dfrac{1}{10^y}\times...\right)$ with no ln 10 term can score M0M1A0 under the Alt.

Alt 2: Implicit Differentiation

M1: As main scheme, attempts to differentiate as part of their work, so $\alpha 10^y\rightarrow\beta 10^y\ln 10\dfrac{\mathrm{d}y}{\mathrm{d}x}$

M1: Makes $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ the subject. **A1:** Correct answer.