Question Number	Scheme	Marks
4 (a)	$a=3, b=5$	**B1**
	E.g $u=\sqrt{2x+1} \Rightarrow \dfrac{\mathrm{d}x}{\mathrm{d}u}=u$ or $\dfrac{\mathrm{d}u}{\mathrm{d}x}=(2x+1)^{-\frac{1}{2}}$ o.e.	**B1**
	$\int \sqrt{8x+4}\, \mathrm{e}^{\sqrt{2x+1}}\, \mathrm{d}x = \int 2u\, \mathrm{e}^{u}\, u\, \mathrm{d}u$	**M1**
	$= \int_3^5 2u^2\, \mathrm{e}^{u}\, \mathrm{d}u$	**A1**
		(4)
(b)	$\int \sqrt{8x+4}\, \mathrm{e}^{2x+1}\, \mathrm{d}x = \int 2u^2\, \mathrm{e}^{u}\, \mathrm{d}u$	
	$= 2u^2\mathrm{e}^{u} - \int 4u\, \mathrm{e}^{u}\, \mathrm{d}u$	**M1**
	$= = 2u^2\mathrm{e}^{u} - \left(4u\mathrm{e}^{u} - 4\mathrm{e}^{u}\right) = 2u^2\mathrm{e}^{u} - 4u\mathrm{e}^{u} + 4\mathrm{e}^{u}$	**dM1 A1ft**
	$\int_4^{12} \sqrt{8x+4}\, \mathrm{e}^{\sqrt{2x+1}}\, \mathrm{d}x = \left[2u^2\mathrm{e}^{u} - 4u\mathrm{e}^{u} + 4\mathrm{e}^{u}\right]_3^5 = \left(50\mathrm{e}^{5} - 20\mathrm{e}^{5} + 4\mathrm{e}^{5}\right) - \left(18\mathrm{e}^{3} - 12\mathrm{e}^{3} + 4\mathrm{e}^{3}\right)$	**ddM1**
	$= 34\mathrm{e}^{5} - 10\mathrm{e}^{3}$	**A1**
		(5)
		(9 marks)

Notes:

(a)

B1: For both $a=3, b=5$ seen in their solution. Allow if these are recovered in (b).

B1: For a correct expression involving $\dfrac{\mathrm{d}u}{\mathrm{d}x}$ or $\dfrac{\mathrm{d}x}{\mathrm{d}u}$ or du and dx separately. May be unsimplified

M1: Attempts to fully change $\int \sqrt{8x+4}\, \mathrm{e}^{\sqrt{2x+1}}\, \mathrm{d}x$ into an integral with respect to u. Must include an attempt at replacing dx to get du so M0 if there are no d terms present or dx becomes du without an attempt at connecting them first (ie there must have been an attempt at $\dfrac{\mathrm{d}u}{\mathrm{d}x}$ oe).

A1: Complete method to show I = $\int_3^5 2u^2\, \mathrm{e}^{u}\, \mathrm{d}u$. Must include the correct limits and the du.

(b) Note: you may see different ways of presenting the application of parts e.g D/I method.

M1: Use of integration by parts once to obtain $pu^2\mathrm{e}^{u} - \int qu\, \mathrm{e}^{u}\, \mathrm{d}u$, where $p, q > 0$ (if k is positive, otherwise signs will be opposite) and may be in terms of k (as can the dM mark).

dM1: Completely integrates by parts twice to a form $pu^2\mathrm{e}^{u} - qu\mathrm{e}^{u} \pm r\mathrm{e}^{u}$ where $p, q > 0$ (if $k > 0$ as before). Note they may evaluate in stages, but look for the complete integration overall.

A1ft: $\int_a^b ku^2\, \mathrm{e}^{u}\, \mathrm{d}u = ku^2\mathrm{e}^{u} - 2ku\mathrm{e}^{u} + 2k\mathrm{e}^{u}$ (oe) accepted with k or their value for k. May have the last two terms bracketed but must be seen as a complete answer in their work.

ddM1: Substitutes their a and b into a form $pu^2\mathrm{e}^{u} - qu\mathrm{e}^{u} \pm r\mathrm{e}^{u}$ and subtracts (either way), but must be using a value for k at this stage. May be done in stages.

A1: $34e^{5}-10e^{3}$ or exact equivalent in a simplified form such as $2e^{3}\left(17e^{2}-5\right)$

Question Number	Scheme	Marks
5 (a)	$y^2 = 2x^2 + 15x + 10y \Rightarrow 2y\frac{dy}{dx} = 4x + 15 + 10\frac{dy}{dx}$	**M1 A1**
	$(2y - 10)\frac{dy}{dx} = 4x + 15 \Rightarrow \frac{dy}{dx} = \frac{4x+15}{2y-10}$ oe	**M1, A1**
		(4)
(b)	Deduces that $2y - 10 = 0 \Rightarrow y = 5$	**B1ft**
	Substitutes $y = 5$ into $y^2 = 2x^2 + 15x + 10y \Rightarrow 2x^2 + 15x + 25 = 0$ and solves for x	**M1**
	$(p =) -5, (q =) -\frac{5}{2}$	**A1**
		(3)
		(7 marks)

Notes:

(a)

M1: Correct differentiation of one of the y terms, ie $y^2 \to 2y\frac{dy}{dx}$ or $10y \to 10\frac{dy}{dx}$.

A1: Fully correct differentiation $2y\frac{dy}{dx} = 4x + 15 + 10\frac{dy}{dx}$ o.e.

M1: Rearranges to make $\frac{dy}{dx}$ the subject. The differentiated expression must contain exactly two $\frac{dy}{dx}$ terms - one from each y term, not an extra $\frac{dy}{dx} = \ldots$.

A1: $\frac{dy}{dx} = \frac{4x+15}{2y-10}$ oe

(b)

B1ft: Deduces that $2y - 10 = 0 \Rightarrow y = 5$. Follow through on a denominator of form $ay + b$, $a, b \neq 0$. This deduction may arise from use of the symmetry of a hyperbola.

E.g. $x = 0 \Rightarrow y^2 - 10y = 0 \Rightarrow y = 0, 10$ so p, q when $y = 5$

M1: Substitutes their $y = 5$ into $y^2 = 2x^2 + 15x + 10y \left(\Rightarrow 2x^2 + 15x + 25 = 0\right)$ and solves for x (usual rules, if no working shown (by calculator) they must give correct values for their quadratic).

A1: $(p =) -5, (q =) -\frac{5}{2}$ Correct values, do not be concerned about the labels and accept if they give as the end points of the interval (ie accept if they give $\left(-5, -\frac{5}{2}\right)$ as their answer).