(c)	$x = 8\cos t + 2 \Rightarrow \cos t = \frac{x-2}{8} \quad y = 6\sin t - 3 \Rightarrow \sin t = \frac{y+3}{6}$	M1
	$\frac{(x-2)^2}{64} + \frac{(y+3)^2}{36} = 1$	A1
		(2)
		(11 marks)

(c)

M1: Attempts to rearrange either of the parametric equations to obtain $\cos t$ or $\cos^2 t$ in terms of x or $\sin t$ or $\sin^2 t$ in terms of y which may be implied by their working.
You can condone slips as long as the intention is clear e.g.

$$x = 8\cos t + 2 \Rightarrow x^2 = 8\cos^2 t + 4 \Rightarrow \cos^2 t = \frac{x^2 - 4}{8}$$

Also condone an attempt to obtain $\cos t$ or $\cos^2 t$ in terms of x or $\sin t$ or $\sin^2 t$ in terms of y if they have errors in trig identities but the intention is clear e.g. $\sin^2 t = 1 - \frac{x-2}{8}$

A1: $\frac{(x-2)^2}{64} + \frac{(y+3)^2}{36} = 1$ o.e. e.g. $y = 6\sqrt{1 - \left(\frac{x-2}{8}\right)^2} - 3$ or e.g. $y = \pm 6\sqrt{1 - \left(\frac{x-2}{8}\right)^2} - 3$

There will be many different alternatives. Once a correct equation is seen, award the A mark and apply isw.

Question Number	Scheme	Marks
7(a)	$\dfrac{\mathrm{d}u}{\mathrm{d}x}=\mathrm{e}^x$	B1
	$\displaystyle\int\frac{24\mathrm{e}^x-2}{\left(2\mathrm{e}^x-1\right)^2}\,\mathrm{d}x=\int\frac{24\left(u+\frac{1}{2}\right)-2}{(2u)^2}\times\frac{\mathrm{d}u}{\left(u+\frac{1}{2}\right)}$	M1
	$\displaystyle=\int\frac{24u+12-2}{(2u)^2}\times\frac{2}{2u+1}\mathrm{d}u=\int\frac{48u+20}{4u^2(2u+1)}\,\mathrm{d}u=\int\frac{12u+5}{u^2(2u+1)}\,\mathrm{d}u$	A1
	$x=\ln 3\to a=\dfrac{5}{2},\quad x=\ln 8\to b=\dfrac{15}{2}$	B1
		(4)

(a) **Note that apart from the limits, this is a given answer so check the work carefully.**

B1: Any correct equation connecting dx and du e.g.

$$\frac{\mathrm{d}u}{\mathrm{d}x}=\mathrm{e}^x,\ \frac{\mathrm{d}x}{\mathrm{d}u}=\frac{1}{\mathrm{e}^x},\ \mathrm{d}u=\mathrm{e}^x\mathrm{d}x,\ 1=\mathrm{e}^x\frac{\mathrm{d}x}{\mathrm{d}u},\ \mathrm{d}x=\frac{\mathrm{d}u}{\mathrm{e}^x},\ \mathrm{d}x=\frac{\mathrm{d}u}{u+\frac{1}{2}}\ \text{etc.}$$

M1: A full attempt to substitute $u=\mathrm{e}^x-\dfrac{1}{2}$ proceeding to an expression in terms of u only (which is not the given answer). Condone slips such as a poor rearrangement of $\dfrac{\mathrm{d}u}{\mathrm{d}x}=\mathrm{e}^x$ but it must include an attempt to replace dx with a function of u.

A1: Achieves the given integral with sufficient and no incorrect working seen including invisible brackets. You can ignore any limits for this mark.
There must be at least one intermediate line of working following the stage at which they obtain their integral totally in terms of u. This may be seen in "side-working".
You can condone e.g. a missing "du" in the working as long as it is present in the final answer.

B1: Correct limits seen at any stage and they do not need to be seen attached to the integral but if there is any contradiction, the limits attached to the integral take precedence.

Note that an <u>example</u> of minimum acceptable work for the first 3 marks in (a) could be:

$$\frac{\mathrm{d}u}{\mathrm{d}x}=\mathrm{e}^x,\ \int\frac{24\mathrm{e}^x-2}{\left(2\mathrm{e}^x-1\right)^2}\,\mathrm{d}x=\int\frac{24\left(u+\frac{1}{2}\right)-2}{(2u)^2}\times\frac{\mathrm{d}u}{\left(u+\frac{1}{2}\right)}=\int\frac{24u+10}{(2u)^2}\times\frac{\mathrm{d}u}{u+\frac{1}{2}}=\int\frac{12u+5}{u^2(2u+1)}\,\mathrm{d}u$$

(b)	$12u+5\equiv A(2u+1)+Bu(2u+1)+Cu^2 \Rightarrow A=...\text{or } B=...\text{or } C=...$ or e.g. $12u+5\equiv (2B+C)u^2+(2A+B)u+A\Rightarrow A=...\text{or } B=...\text{or } C=...$	M1
	2 of: $A=5,\ B=2\ ,C=-4$	A1
	$\frac{5}{u^2}+\frac{2}{u}-\frac{4}{(2u+1)}$	A1
		(3)

(b)

M1: Attempts to find at least one of the values for *A*, *B* and *C* by multiplying up and substituting values or by multiplying up and comparing coefficients.
When multiplying up must have at least one of the terms on the rhs correct for their lhs.

A1: Two of $A=5,\ B=2,\ C=-4$

A1: Correct **fractions**: $\frac{5}{u^2}+\frac{2}{u}-\frac{4}{(2u+1)}$ oe. Allow $\frac{5}{u^2}+\frac{2}{u}+-\frac{4}{(2u+1)}$

If the correct fractions are not seen in part (b), allow this mark to score if the correct fractions are seen in part (c).

(c)	$\int \frac{5}{u^2}+\frac{2}{u}-\frac{4}{(2u+1)}\,\mathrm{d}u=-5u^{-1}+2\ln u-2\ln(2u+1)\ \ (+c)$	M1A1ft
	$\left[-5u^{-1}+2\ln u-2\ln(2u+1)\right]_{2.5}^{7.5}$ $=\left(-5\times 7.5^{-1}+2\ln 7.5-2\ln(16)\right)-\left(-5\times 2.5^{-1}+2\ln 2.5-2\ln(6)\right)$ or $\left[-5\left(\mathrm{e}^x-\frac{1}{2}\right)^{-1}+2\ln\left(\mathrm{e}^x-\frac{1}{2}\right)-2\ln(2\left(\mathrm{e}^x-\frac{1}{2}\right)+1)\right]_{\ln 3}^{\ln 8}$ $=\left(-5\times 7.5^{-1}+2\ln 7.5-2\ln(16)\right)-\left(-5\times 2.5^{-1}+2\ln 2.5-2\ln(6)\right)$	**d**M1
	$\frac{4}{3}+\ln\left(\frac{81}{64}\right)$	A1
		(4)
		(11 marks)

(c)

M1: Integrates either $\frac{"2"}{u}\rightarrow ...\ln ku$ **or** $\frac{"4"}{(2u+1)}\rightarrow ...\ln k(2u+1)$

A1ft: $-5u^{-1}+2\ln u-2\ln(2u+1)$ oe following through on their non-zero *A*, *B* and *C* from part (b). Allow unsimplified.

dM1: Substitutes in their changed limits from part (a) or transforms back in terms of *x* i.e. ln3 and ln8 and subtracts either way round.
Depends on the previous method mark.

A1: $\frac{4}{3}+\ln\left(\frac{81}{64}\right)$ or equivalent in the required form i.e. $p+\ln q$