A1: $m = \frac{49}{128}$ oe Condone sight of $\frac{49}{128}x^2$ as evidence for a correct value for m.

Question Number	Scheme	Marks
3	Calculates the upper limit as $2\ln 2$ or $\ln 4$	B1
	$\int \left(e^{0.5x} - 2\right)^2 dx = \int \left(e^x - 4e^{0.5x} + 4\right) dx = e^x - 8e^{0.5x} + 4x$	M1 A1 A1
	Volume $= \pi\left[\text{"}e^x - 8e^{0.5x} + 4x\text{"}\right]_0^{\text{"}2\ln 2\text{"}} = \ldots$	dM1
	Volume $= 8\pi\ln 2 - 5\pi$	A1 **(6 marks)**

B1: Calculates the upper limit as $2\ln 2$ or $\ln 4$ only. Do not accept 1.386, $\frac{\ln 2}{0.5}$ or anything else.

Recovery from $\frac{\ln 2}{0.5}$ is allowed so if the candidate progresses to $8\pi\ln 2 - 5\pi$ do not withhold this mark.

M1: Attempts to square $\left(e^{0.5x} - 2\right)$ **with** $\int e^{kx}dx \to e^{kx}$ seen at least once. Ignore any factor of π

This may be awarded when candidates fails to square $e^{0.5x}$ correctly

So for example $\int \left(e^{0.5x}\right)^2 - 4e^{0.5x} + 4\, dx \to \ldots. \pm \ldots e^{0.5x}$ is sufficient

A1: Two terms correct $e^x - 8e^{0.5x} + 4x$ Ignore any factor of π

A1: All three terms correct $e^x - 8e^{0.5x} + 4x$ Ignore any factor of π

dM1: A full and complete method of finding the volume of the solid generated.

Look for an attempt to find $\pi\int_0^{\text{"}a\text{"}} \left(e^{0.5x} - 2\right)^2 dx$ with a being $2\ln 2$, $\ln 4$, 1.38.. or $\frac{\ln 2}{2}$

It is dependent upon the previous M so some correct integration must be seen as well as use of both limits. There must be some evidence for the 0. Those terms cannot just "disappear" or be set to 0.

A1: cao $8\pi\ln 2 - 5\pi$ or $-5\pi + 8\pi\ln 2$ Condone $\pi(8\ln 2 - 5)$

(Note that a requirement of the question is to write in the form $a\ln 2 + b$)

Question Number	Scheme	Marks
4(a)	A and B are where $t^3-4t=0 \Rightarrow t(t^2-4)=0 \Rightarrow t=2$ or -2	M1
	Substitutes $t=2, x=2\times4-6\times2=-4$ Hence $A=(-4,0)$	A1
	When $t=-2, x=2\times4-6\times-2=20, (y=0)$ Hence $B=(20,0)$ *	B1*
		(3)
(b)	$\dfrac{dy}{dx}=\dfrac{dy/dt}{dx/dt}=\dfrac{3t^2-4}{4t-6}$	M1A1
	Sub $t=-2$ into $\dfrac{dy}{dx}=\dfrac{3t^2-4}{4t-6} \Rightarrow$ gradient $=\left(-\dfrac{4}{7}\right)$	M1
	Uses their $\left(-\dfrac{4}{7}\right)$ and $(20,0)$ to produce eqn of tangent $\Rightarrow 7y+4x-80=0$ *	M1 A1*
		(5)
(c)	Substitutes $x=2t^2-6t,\ y=t^3-4t,$ into $7y+4x-80=0$	
	$\Rightarrow 7\left(t^3-4t\right)+4\left(2t^2-6t\right)-80=0$	M1
	$\Rightarrow 7t^3+8t^2-52t-80=0$	A1
	$\Rightarrow (t+2)^2(7t-20)=0$	
	$t="\dfrac{20}{7}" \Rightarrow x=....$	dM1
	$x=-\dfrac{40}{49}$	A1
		(4)
		(12 marks)

(a)

M1: Sets $t^3-4t=0 \Rightarrow t=\ldots$ to reach $t=2$ or -2

A1: Substitutes $t=2 \Rightarrow x=2\times4-6\times2=-4$ and states coordinates of $A=(-4,0)$

Accept $t=2 \Rightarrow A=(-4,0)$ provided the M1 has been awarded

B1*: Show that the coordinates of $B=(20,0)$

Possible ways of this are

1) Solves $t^3-4t=0 \Rightarrow t=-2$ and substitutes into $2t^2-6t \Rightarrow x=20 \Rightarrow B=(20,0)$.

This is a show that and there must be some evidence for the "20", not just sight of $t=-2$

Look for $2\times(-2)^2-6\times(-2) \Rightarrow x=20$ or $8+12 \Rightarrow x=20$