Note an answer of A1 $\frac{5}{24}$ with no supporting working scores no marks as algebraic integration is specified. But alternative methods of integration are permissible. Two alternatives are:

Question Number	Scheme	Marks
5 (b) Alt 1	$\int_0^{\frac{\pi}{3}} \sin^3 x \, dx = \int_0^{\frac{\pi}{3}} \sin x\left(1-\cos^2 x\right) dx = \int_0^{\frac{\pi}{3}} \sin x - \sin x \cos^2 x \, dx$	M1
	$= \left[-\cos x - \left(-\frac{\cos^3 x}{3}\right)\right]_0^{\frac{\pi}{3}}$	dM1A1
	$= \frac{5}{24}$	A1
		(4)
(b) Alt 2	$u = \cos x \Rightarrow \frac{du}{dx} = -\sin x \Rightarrow \int_0^{\frac{\pi}{3}} \sin^3 x \, dx = \int_1^{\frac{1}{2}} u^2 - 1 \, du$	M1
	$= \left[\frac{u^3}{3} - u\right]_1^{\frac{1}{2}}$	dM1 A1
	$= \frac{5}{24}$	A1
		(4)
		(8 marks)

Notes: First three marks as follows (final A is as main scheme).

Alt 1

M1: Splits as $\sin^3 x = \sin x \sin^2 x$ and applies $\sin^2 x = 1 - \cos^2 x$ to get the integrand into and integrable form.

dM1 for $\sin x \to \pm \cos x$ and $\sin x \cos^2 x \to K \cos^3 x$

A1 $-\cos x - \left(-\frac{\cos^3 x}{3}\right)$ oe (not a multiple of this (unless recovered))

Alt 2

M1 Sets $u = \cos x$, finds $\frac{du}{dx} = \pm \sin x$ and makes a full substitution using both of these to get an integral in terms of u only. (Limits not needed for this mark).

dM1 for $au^2 - b \to Au^3 - bu$

A1 For reaching $\left[\frac{u^3}{3} - u\right]_1^{\frac{1}{2}}$ including correct limits or for undoing the substitution and reaching $\frac{\cos^3 x}{3} - \cos x$

Question Number	Scheme	Marks
6 (a)	$5e^{x-1}+3=18 \Rightarrow e^{x-1}=3$	M1
	$\Rightarrow x=\ln 3+1$ or $e^{x}=3e$	A1
	$\Rightarrow x=\ln 3e$	A1
		(3)
(b)	Sets $5e^{x-1}+3=10-x^{2}$ and proceeds to find and use a suitable function. Eg $(f(x)=)7-x^{2}-5e^{x-1}$	B1
	Attempts $f(1.1335)=0.001$ and $f(1.1345)=-0.007$	M1
	Correct values with reason(change of sign and continuous) and conclusion, hence α is 1.134 to 3dp	A1
		(3)
(c)	$x_2=-\sqrt{7-5e^{-3-1}}=-2.628388$	M1 A1
	$\beta=-2.620330$	A1
		(3)
		(9 marks)

(a)

M1 For attempting to proceed from $5e^{x-1}+3=18$ to $e^{x-1}=...$ or $e^{x}=...$

A1 $x=\ln 3+1$ or for $e^{x}=3e$

A1 $x=\ln 3e$ Accept $x=\ln 3e^{1}$

(b)

B1 Sets the equations equal to each other and finds a suitable function which is then used.

Suitable functions are $f(x)=\pm\left(7-x^{2}-5e^{x-1}\right)$, $g(x)=\pm\left(x-\sqrt{7-5e^{x-1}}\right)$ or $h(x)=\pm\left(x-1-\ln\left(\frac{7-x^{2}}{5}\right)\right)$

M1 Substitutes $x=1.1335$ and $x=1.1345$, or suitable values for a tighter interval (either side of 1.133634..), into a suitable function and obtains one correct value to 1sf rounded or truncated.

FYI for the + options above

$f(1.1335)=0.001$ and $f(1.1345)=-0.007$

$g(1.1335)=-0.0005$ and $g(1.1345)=0.003$

$h(1.1335)=-0.0002$ and $g(1.1345)=0.001$

A1 Requires both values to be correct (1sf rounded or truncated), a reason (change of sign and continuous) and a minimal conclusion

(c)

M1 For an attempt at substituting -3 into the iterative equation.

This is implied by the sight of the expression or awrt -2.63

A1 awrt -2.628388

A1 $\beta=$ awrt -2.620330 condone -2.62033

.....

It is possible in part (b) to score B0 M1 A1 by comparing y values for $y=5e^{x-1}+3$ and $y=10-x^{2}$ at $x=1.1335$ and $x=1.1345$ For the A1 apply the similar criteria as for the main scheme with values to 3d.p..

At $x=1.1335$, $y|_{1.1335}=5e^{x-1}+3=8.714$ and $y|_{1.1335}==10-x^{2}=8.715$

At $x=1.1345$, $y|_{1.1345}=5e^{x-1}+3=8.720$ and $y|_{1.1345}=10-x^{2}=8.713$