Question Number	Scheme	Marks
7.(a)	$R=\sqrt{17}$	B1
	$\tan\alpha=4\Rightarrow\alpha=$ awrt 1.326	M1A1
		(3)
(b)	Minimum height $=\dfrac{24}{3+"R"}=3.37$ (metres)	M1 A1
		(2)
(c)	Uses part (a) $10=\dfrac{24}{3+\sqrt{17}\cos\left(\frac{1}{2}t-1.326\right)}\Rightarrow\cos\left(\frac{1}{2}t-1.326\right)=\dfrac{-0.6}{\sqrt{17}}$	M1 A1
	$t=$ awrt 6.09	M1 A1
		(4)
		(9 marks)

(a)

B1 $R=\sqrt{17}$

Condone $R=\pm\sqrt{17}$ (Do not allow decimals for this mark Eg 4.12 but remember to isw after $\sqrt{17}$)

M1 $\tan\alpha=\pm4,\ \tan\alpha=\pm\dfrac{1}{4}\Rightarrow\alpha=...$

If R is used to find α accept $\sin\alpha=\pm\dfrac{4}{R}$ or $\cos\alpha=\pm\dfrac{1}{R}\Rightarrow\alpha=...$

A1 $\alpha=$ awrt 1.326 Note that the degree equivalent $\alpha=$ awrt $75.96°$ is A0

(b)

M1 Attempts minimum height by stating or finding $\dfrac{24}{3+"R"}$

Attempts via differentiation must be complete methods with correct work up to slips in coefficients. They are unlikely to succeed.

FYI $\dfrac{\mathrm{d}H}{\mathrm{d}t}=-\dfrac{24\left(2\cos\left(\frac{t}{2}\right)-\frac{1}{2}\sin\left(\frac{t}{2}\right)\right)}{\left(4\sin\left(\frac{t}{2}\right)+\cos\left(\frac{t}{2}\right)+3\right)^2}=0\Rightarrow\tan\left(\frac{t}{2}\right)=4\Rightarrow H=\dfrac{24}{3+\cos(1.326)+4\sin(1.326)}$

A1 3.37 (metres) Assume metres unless otherwise stated, but 3.37 cm is A0. Accept 337 cm as long as the units are stated, but do not accept $\dfrac{24}{3+\sqrt{17}}$ and do not isw if incorrect units are given following 3.37.

(c)

M1 Attempts to use their answer to part (a) (including their R and their α) AND proceeds to

$\cos\left(\beta t\pm"1.326"\right)=k,\quad -1<k<1$ and $\beta=1$ or $\dfrac{1}{2}$

A1 $\cos\left(\beta t\pm"1.326"\right)=\dfrac{-0.6}{\sqrt{17}}$ or awrt -0.146 where $\beta=1$ or $\dfrac{1}{2}$

M1 Full method to make t the subject from an equation of the form $\cos\left(\frac{1}{2}t\pm"1.326"\right)=k,\quad -1<k<1$

Look for $2\times\left(\text{their }\arccos\left(k\right)\pm\text{their }\alpha\right)$

A1 awrt $t=6.09$ (Ignore any extra solutions outside the domain, but A0 if extras inside are given.)

Question Number	Scheme	Marks
8(i)(a)	$g'(x) = 3e^{3x}\sec 2x + 2e^{3x}\sec 2x\tan 2x$	M1 A1 **(2)**
(b)	$g'(x) = 0 \Rightarrow e^{3x}\sec 2x(3 + 2\tan 2x) = 0$	M1
	$\tan 2x = -1.5 \Rightarrow x = -0.491$	dM1 A1 **(3)**
(ii)	$x = \ln(\sin y) \Rightarrow \frac{dx}{dy} = \frac{1}{\sin y} \times \cos y$	B1
	Attempts $\cos y = \sqrt{1-\sin^2 y} = \sqrt{1-e^{2x}}$ or $\frac{dy}{dx} = \frac{\sin y}{\cos y}$	M1
	Hence $\frac{dy}{dx} = \frac{\sin y}{\cos y} = \frac{e^x}{\sqrt{1-e^{2x}}}$	dM1 A1 **(4)**
		(9 marks)

(i)(a)

M1 Correct attempt at the product rule $g'(x) = Ae^{3x}\sec 2x + Be^{3x}\sec 2x\tan 2x$

For use of the quotient rule look for $\frac{A\cos 2x\, e^{3x} - Be^{3x}\sin 2x}{\cos^2 2x}$

A1 $g'(x) = 3e^{3x}\sec 2x + 2e^{3x}\sec 2x\tan 2x$ Allow in any form and then isw

For use of the quotient rule look for $\frac{3\cos 2x\, e^{3x} + 2e^{3x}\sin 2x}{\cos^2 2x}$

(i)(b)

M1 Sets $g'(x) = 0 \Rightarrow$ and takes out / factorises out $e^{3x}\sec 2x$ to identify a linear factor in tan2x

For the quotient rule they should be factorising out $\frac{e^{3x}}{\cos^2 2x}$ to leave a linear factor in $\cos 2x$ and $\sin 2x$

dM1 Correct order of operations to x = ...

For quotient rule approach they must use $\tan 2x = \frac{\sin 2x}{\cos 2x}$ (oe correct work)

You may need to check their answer if no method is shown. Accept awrt 2.s.f. for their tan 2x = …. in either radians or degrees.

A1 $x = awrt -0.491$ only in the range. If extra solutions arise from trying to solve sec2x = 0 then A0.