Question number	Scheme	Marks
7(a)	$\frac{\lambda(D-l)}{l}=mg$	M1A1
	$\frac{\lambda(2l)^2}{2l}=mg\times 3l$	M1A1A1
	$D=\frac{5l}{3}$ *	A1*
		(6)
7(b)	$mg-T=m\ddot{x}$ or $T-mg=m\ddot{x}$	M1
	$mg-\frac{3mg}{2l}(\frac{2l}{3}+x)=m\ddot{x}$ or $\frac{3mg}{2l}(\frac{2l}{3}-x)-mg=m\ddot{x}$	dM1A1
	$-\frac{3g}{2l}x=\ddot{x}$ hence SHM	A1
	period = $\frac{2\pi}{\omega}=\frac{2\pi}{\sqrt{\frac{3g}{2l}}}$ { $\omega=\sqrt{\frac{3g}{2l}}$ }	M1
	$=2\pi\sqrt{\frac{2l}{3g}}$ *	A1*
		(6)
7(c)	$-\frac{2l}{3}=\frac{4l}{3}\cos\sqrt{\frac{3g}{2l}}t$	M1A1A1
	$t=\frac{2\pi}{3}\sqrt{\frac{2l}{3g}}$	A1
	OR	
	Complete method $t=\frac{1}{4}2\pi\sqrt{\frac{2l}{3g}}+t_1$ where $\frac{2l}{3}=\frac{4l}{3}\sin\sqrt{\frac{3g}{2l}}t_1$	M1A1A1
	$t=\frac{2\pi}{3}\sqrt{\frac{2l}{3g}}$ oe	A1
	OR	
	Complete method $t=\frac{1}{2}2\pi\sqrt{\frac{2l}{3g}}-t_1$ where $\frac{2l}{3}=\frac{4l}{3}\cos\sqrt{\frac{3g}{2l}}t_1$	M1A1A1
	$t=\frac{2\pi}{3}\sqrt{\frac{2l}{3g}}$ or equivalent exact form.	A1
		(4)
		(16)
	Notes	
7(a)		
M1	Use Hooke's law in *D* and equate to *mg*	
A1	Correct equation	

M1	Energy equation with correct no. of terms. EPE of the form $\frac{\lambda x^2}{kl}, k \neq 1$
A1	Equation with at most one error
A1	Correct equation
A1*	Given answer correctly obtained
7(b)	
M1	Equation of motion in a *general* position, allow *a* for acceleration, correct no. of terms, condone sign errors
dM1	Use Hooke's Law to sub for the tension with extension measured from the equilibrium position and allow *a* for acceleration
A1	Correct unsimplified equation, allow *a* for acceleration
A1	Correct SHM equation and conclusion. Must use $\ddot{x}$ for acceleration **and** conclude SHM.
M1	Use of $\frac{2\pi}{\omega}$ where ω has come from an attempt at using N2L at a general point.
A1*	Obtain the given answer for the period. Must follow from fully correct working, including N2L. At least one line of working must be seen between $\ddot{x} = -\omega^2 x$ and reaching the given answer. Eg • period = $\frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{3g}{2l}}} = 2\pi\sqrt{\frac{2l}{3g}}$ • $\omega = \sqrt{\frac{3g}{2l}}$, period = $\frac{2\pi}{\omega} = 2\pi\sqrt{\frac{2l}{3g}}$
(c)	
M1	Complete method to find the required time. Do not ISW. For example, If the sine approach is used, it must include $\frac{1}{4}T$ + their *t* value for M1. If the cos approach is used with $+\frac{2l}{3}$, it must include $\frac{1}{2}T$ – their *t* value for M1. The correct ω must be used. For the method, condone any multiple of *l* for the amplitude.
A1	Equation with at most one error
A1	Correct equation
A1	Cao

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