Question Number	Scheme	Marks
7(a)	For complete circles there must be speed at the top	B1
	Energy with ke > 0 at top $\frac{1}{2}mv^2 = \frac{1}{2}mu^2 - mg\left(l - l\cos\theta\right) > 0$	M1
	$\frac{1}{2}mu^2 > \frac{mgl}{5}$	A1
	$u > \sqrt{\frac{2gl}{5}}$ *	A1*
		(4)
(b)	Equation of motion at bottom	M1
	$T_{\max} - mg = m\frac{v_{\max}^{\ 2}}{l}$	A1
	Energy equation to bottom	M1
	$\frac{1}{2}mv_{\max}^{\ 2} = \frac{1}{2}mu^2 + mgl\left(1+\cos\alpha\right)$	A1
	$T_{\max} = \frac{mu^2}{l} + \frac{18mg}{5} + mg \quad \left(\text{or} \quad T_{\min} = \frac{mu^2}{l} - \frac{2mg}{5} - mg\right)$	A1
	Equation of motion at top	M1
	$T_{\min} + mg = m\frac{v_{\min}^{\ 2}}{l}$	A1
	Energy equation to top	M1
	$\frac{1}{2}mv_{\min}^{\ 2} = \frac{1}{2}mu^2 - mgl\left(1-\cos\alpha\right)$	A1
	$T_{\max} = 4 \times T_{\min}$	M1
	$u = \sqrt{\frac{51gl}{15}} = \sqrt{\frac{17gl}{5}}$ *	A1*
		(11)
		(15 marks)

Notes	
(a) B1	Or equivalent statement seen or implied by working. Condone $v \geqslant 0$. N.B. this is a rod so $T > 0$ is B0.
M1	Uses energy and $v > 0$ to form an inequality for u^2 If v is not explicitly seen then inequality must be justified by speed at top being positive. Use of equality followed by given answer without clear justification of the inequality is M0.
A1	Correct inequality (allow $\geqslant$ for this mark)
A1*	Deduces given result with no incorrect working seen. Allow consistent omission of m throughout.
(b) M1	Equation of motion at lowest point. Condone sign errors.
A1	Correct equation.
M1	Energy equation to lowest point. Condone sign errors and sin/cos confusion.
A1	Correct equation.
A1	Eliminates v to get expression for tension in terms of m, g, l, u only. Award for correct expression for $T_{\max}$ or $T_{\min}$ seen or implied.
M1	Equation of motion at highest point. Condone sign errors.

A1	Correct equation. A0 if same velocity used for both equations of motion unless recovered later.
M1	Energy equation to highest point. Condone sign errors and sin/cos confusion.
A1	Correct equation. Award if energy equation from (a) is used in (b) A0 if same velocity used for both energy equations unless recovered later.
	N.B. Either energy equation could be replaced by an energy equation for top to bottom: $\frac{1}{2}mv_{\max}{}^2 = \frac{1}{2}mv_{\min}{}^2 + 2mgl$
M1	Compares the two tensions with 4 on the right side. This could be awarded if, e.g. T and $4T$ are used the right way round in the equations of motion.
A1*	Obtains given answer with no incorrect working seen (condone missing brackets and recovery from poor notation (e.g. both velocities as v) but not recovery of incorrect minus signs). Must see some working after the four equations of energy / motion.
	N.B. Some useful values: $T_{\max} = 8mg \quad T_{\min} = 2mg \quad v_{\max} = 7gl \quad v_{\min} = 3gl$

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