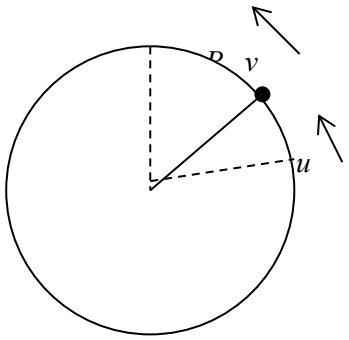
| Question Number | Scheme | Marks |
|---|---|---|
| **7** |  | |
| **(a)** | $mgl(\cos\theta - \cos\alpha) = \frac{1}{2}mu^2 - \frac{1}{2}mv^2$ | M1A1A1 |
| | $v^2 = u^2 - 2gl(\cos\theta - \cos\alpha)$ * | A1* (4) |
| **(b)** | $\cos\alpha = \frac{2}{5}$ $v^2 = 3gl - 2gl\left(\cos\theta - \frac{2}{5}\right)$ | M1 A1 |
| | At top $\theta = 0°$ $v^2 = 3gl - 2gl \times \frac{3}{5}$ | M1 |
| | $v^2 = \frac{9gl}{5}$ | |
| | $v^2 > 0 \Rightarrow$ complete circle * | A1* (4) |
| **(c)** | Equation of motion along radius at lowest point: $kT - mg = \frac{mw^2}{l}$ | M1A1 |
| | $\theta = 180$ $w^2 = 3gl - 2gl\left(-1 - \frac{2}{5}\right) = \frac{29gl}{5}$ | M1 |
| | $kT = \frac{m}{l} \times \frac{29gl}{5} + mg = \frac{34mg}{5}$ | M1A1 |
| | At highest point: $T_2 + mg = \frac{mv^2}{l}$ | M1 |
| | $\theta = 0$ $T = \frac{9mg}{5} - mg = \frac{4mg}{5}$ | M1 A1 |
| | $k\frac{4mg}{5} = \frac{34mg}{5} \Rightarrow k = \frac{17}{2}$ | A1 |
| | | **[17]** |

| Question Number | Scheme | Marks |
|---|---|---|

| | |
|---|---|
| **(a)** | |
| **M1** | Attempt energy equation from $A$ to general position. Must have a difference of 2 PE terms and a difference of 2 KE terms. |
| **A1** | Correct gain in PE or loss of KE |
| **A1** | Fully correct equation |
| **A1*** | Reach the **given** result from fully correct working |
| **(b)** | |
| **M1** | Sub $u = \sqrt{3gl}$ and $cos\alpha = \frac{2}{5}$ in the result in (a) |
| **A1** | Correct equation |
| **M1** | Put $\theta = 0$ to find an expression for $v^2$ at the top (maybe finding KE) |
| **A1*** | Fully correct working and conclusion with reason eg reference to $v^2,\ v,\ KE$ |
| **(c)** | |
| **M1** | Form an equation of motion along the radius at the lowest point. Acceleration in either form. |
| **A1** | Correct equation with acceleration in $v^2/r$ form |
| **M1** | Use $\theta = 180$ in result from (a) to obtain an expression for $w^2$ |
| **M1** | Eliminate $w^2$ and obtain an expression for $kT$ |
| **A1** | Correct expression for $kT$ |
| **M1** | Form an equation of motion along the radius at the highest point. Acceleration in either form. |
| **M1** | Sub $\theta = 0$ and obtain an expression for $T$ |
| **A1** | Correct expression for $T$ |
| **A1** | Correct value of $k$. Must be exact. |
| **NB** | The equation of motion at the top may be seen first. Award M1A1 for either equation correct and M1 for the second. |

| Question Number | Scheme | Marks |
|---|---|---|
| **ALT1 7(c)** | Better equation of motion at top **or** bottom:<br>$T - mg = \frac{mv^2}{l}$<br>$T + mg = \frac{mv^2}{l}$ | M1 A1 |
| | Other equation of motion – see above | M1 |
| | Finding speed at the bottom:<br>$\theta = 180 \qquad w^2 = 3gl - 2gl\left(-1 - \frac{2}{5}\right) = \frac{29gl}{5}$ | M1 |
| | Finding maximum Tension (lowest point)<br>$\theta = 180,\ T = \frac{m}{l} \times \frac{29gl}{5} + mg = \frac{34mg}{5}$ | M1 A1 |
| | Finding minimum Tension (highest point)<br>$\theta = 0 \qquad T = \frac{9mg}{5} - mg = \frac{4mg}{5}$ | M1 A1 |
| | Dividing Tensions to reach the correct answer<br>$k\frac{4mg}{5} = \frac{34mg}{5} \Rightarrow k = \frac{17}{2}$ | A1 |

| Question Number | Scheme | Marks |
|---|---|---|
| **ALT 2 7 (c)** | General equation of motion:<br>$$T + mg\cos\theta = \frac{mv^2}{l}$$ | M1 A1 |
| | Use of $u = \sqrt{3gl}$ and $\cos\alpha = \frac{2}{5}$ to replace $v^2$ in their equation of motion | M1 |
| | Finding speed at the lowest point:<br>$\theta = 180 \qquad w^2 = 3gl - 2gl\left(-1 - \frac{2}{5}\right) = \frac{29gl}{5}$ | M1 |
| | Finding maximum Tension (lowest point)<br>$\theta = 180,\ T = \frac{m}{l} \times \frac{29gl}{5} + mg = \frac{34mg}{5}$ | M1 A1 |
| | Finding minimum Tension (highest point)<br>$\theta = 0,\ T = \frac{9mg}{5} - mg = \frac{4mg}{5}$ | M1 A1 |
| | Dividing Tensions to reach the correct answer<br>$k\frac{4mg}{5} = \frac{34mg}{5} \Rightarrow k = \frac{17}{2}$ | A1 |

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