| Question Number | Scheme | Marks |
|---|---|---|
| **5(a)** | $3amg = \frac{1}{2}m \times 7ag - \frac{1}{2}mv^2$ | M1A2 |
| | $v^2 = ag \quad v = \sqrt{ag}$ | A1 (4) |
| **(b)** | $amg = \frac{1}{2}mw^2 - \frac{1}{2}m \times 7ag$ | M1 |
| | $w^2 = 9ag$ | |
| | $T_1 - mg = \frac{mw^2}{4a}$ | M1 |
| | $T_1 = \frac{13mg}{4}$ | A1 |
| | Speed immediately after impact $= \frac{1}{2}\sqrt{ag}$ | |
| | $4amg = \frac{1}{2}mV^2 - \frac{1}{2}m \times \frac{1}{4}ag$ | M1 |
| | $V^2 = \frac{33}{4}ag$ | |
| | $T_2 - mg = \frac{mV^2}{4a}$ | M1 |
| | $T_2 = \frac{49}{16}mg$ | A1 |
| | $T_1 : T_2 = \frac{13}{4} : \frac{49}{16} = 52 : 49$ | A1 (7) |
| | | [11] |

| | |
|---|---|
| **(a)** | |
| **M1** | Energy equation from projection to reaching the ceiling. Must have at least one GPE term and 2 KE terms |
| **A2** | Correct equation. -1 for each error. |
| **A1cso** | Correct expression for $v$ from fully correct work |
| **(b)** | |
| **M1** | Energy equation from the point of projection to $B$. Must have all required terms |
| **M1** | Form equation of motion at $B$ and eliminate $w^2$ to obtain an expression for $T_1$ Must have attempted a velocity at $B$. Condone $r = a$. |
| **A1** | Correct expression for $T_1$ |
| **M1** | Form energy equation from leaving the ceiling to reaching $B$. Must have attempted to use the coeff of restitution to find the initial speed for this equation. Condone $r = a$. |
| **M1** | Attempt an equation of motion at $B$ and eliminate $V^2$ to obtain an expression for $T_2$. Must have attempted a velocity at $B$. |
| **A1** | Correct expression for $T_2$ |
| **A1cao** | Correct ratio. Question asks for simplest form, so must be 52:49 (Condone $\frac{52}{49}$) |