| Q | Scheme | Mark | Notes |
|---|---|---|---|
| 8a | Use symmetry to find time taken: $-7 = 7 - gt$ | M1 | 0r equivalent complete method using *suvat* to find the time taken e.g. find the time for vertical distance = 0 |
| | $t = \frac{14}{g} \left(= 1.428...\right)$ | A1 | Correct value seen or implied |
| | Horizontal distance $= 4t$ | DM1 | Complete method using *suvat* to find the distance. Dependent on the preceding M1 |
| | $= 5.71\left(\text{m}\right)$ or $5.7\left(\text{m}\right)$ | A1 | 3 sf or 2 sf only $\frac{40}{7}$ scores A0<br>$\frac{56}{g}$ scores A0 (incorrect units) |
| | | **[4]** | |
| 8a alt | Find speed and angle of projection | M1 | Correct use of Pythagoras and trig. |
| | Speed $= \sqrt{16+49} = \sqrt{65}\left(\text{m s}^{-1}\right)$<br>Direction $= \tan^{-1}\frac{7}{4} \quad \left(= 60.3°\right)$ | A1 | Both values seen or implied. |
| | Use of $R = \frac{u^2 \sin 2\alpha}{g}$ | DM1 | Or equivalent. Dependent on the preceding M1 |
| | $= 5.71\left(\text{m}\right)$ *or* $5.7\left(\text{m}\right)$ | A1 | 3 sf or 2 sf only |
| | | **[4]** | |
| 8b | $\left\|\mathbf{v}\right\| = 5 \Rightarrow \mathbf{v} = 4\mathbf{i} + 3\mathbf{j}$ or $\mathbf{v} = 4\mathbf{i} - 3\mathbf{j}$ | B1 | Correct vertical component seen or implied |
| | $-3 = 3 - gT$ | M1 | Complete method to find $T$<br>e.g. $T = \frac{14}{g} - 2 \times \frac{4}{g}$ |
| | $T = 0.612$ or $T = 0.61$ | A1 | 3 sf or 2 sf only $\frac{30}{49}$ scores A0<br>$\frac{6}{g}$ scores A0 (incorrect units) |
| | | **[3]** | |
| 8c | $\begin{pmatrix}4\\7\end{pmatrix} \cdot \begin{pmatrix}4\\p\end{pmatrix} = 0$ | M1 | Or equivalent method to find perpendicular velocity |
| | $\Rightarrow p = -\frac{16}{7}, \quad \mathbf{v} = 4\mathbf{i} - \frac{16}{7}\mathbf{j}$ | A1 | Correct vertical component<br>Allow -2.28…. |
| | $\left(\left(-\right)\frac{16}{7}\right)^2 = 7^2 - 2gh$ | DM1 | Complete method using *suvat* or energy to form an equation in $h$ only.<br>Dependent on the preceding M1 |
| | $h = 2.23$ or $h = 2.2$ | A1 | 3 sf or 2 sf only cso (negative vertical component seen at some point) |
| | | **[4]** | |
| 8c alt | $\begin{pmatrix}4\\7\end{pmatrix} \cdot \begin{pmatrix}4\\7-gt\end{pmatrix} = 0$ | M1 | Or equivalent method to find time when velocity perpendicular |
| | $t = \frac{65}{7g}\left(= 0.947...\right)$ | A1 | Correct time |
| | $h = 7t - \frac{1}{2}gt^2$ | DM1 | Complete method using *suvat* to form an equation in $h$ only. |
| | $h = 2.23$ or $h = 2.2$ | A1 | 3 sf or 2 sf only cso |
| | | **[4]** | |
| | | **(11)** | |

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