| Question | | n | Answer | Marks | AOs | | Guidance |
|----------|-----|---|---|-----------------|--------------|--|---|
| 13 | (a) | | eg. Neglect air resistance | B 1 | 1.2 | One sensible statement. | Do not accept level ground |
| | | | Constant gravity | | | | |
| | | | Projectile is a particle | [1] | | | |
| 13 | (b) | | $u_x = 35\cos\theta$ giving $x = (35\cos\theta)t$ | B 1 | 3.3 | Award seen in any form | |
| | | | $u_y = 35\sin\theta$ giving $y = (35\sin\theta)t - \frac{1}{2}gt^2$ | B 1 | 3.3 | soi | |
| | | | Substitute for t | M1 | 3.3 | Substituting for t in their equation | |
| | | | $y = (35\sin\theta) \left(\frac{x}{35\cos\theta}\right) - \frac{1}{2}g \left(\frac{x}{35\cos\theta}\right)^2$ | A1 | 1.1 | for <i>y</i> Award in any form ISW | |
| | | | $\left[y = x \tan \theta - \frac{x^2}{250 \cos^2 \theta}\right]$ | [4] | | | |
| 13 | (c) | | EITHER Using $s = 22.5$, $u = 35\sin\theta$, $v = 0$, $a = -9.8$ | M1 | 3.1b | Using any <i>suvat</i> in <i>y</i> -direction with | |
| | | | $v^2 = u^2 + 2as$ | | | $v_y = 0$ | |
| | | | $0 = (35\sin\theta)^2 - 2 \times 9.8 \times 22.5$ | A1 | 1.1 a | Correct equation for θ only | Either $\theta = 37^{\circ}$ or |
| | | | $\sin\theta = 0.6 \text{ [giving } \theta = 36.9^\circ \text{]}$ | A1 | 1.1 | allow 37º | $\cos\theta = \frac{4}{5}$, $\tan\theta = \frac{3}{4}$ may be |
| | | | Use the trajectory with $x = 110$ | M1 | 3.1b | Allow in terms of θ FT their value for θ if used | used. Allow this M mark for |
| | | | $y = 110 \times \tan \theta^{\circ} - 1000000000000000000000000000000000000$ | A1 E1 [6] | 1.1 3.2a | Correct <i>y</i> value Conclusion in context from correct values | $t = \frac{110}{35\cos\theta} = \frac{33}{14}$ used in a suitable equation for y |

| Question | Answer | Marks | AOs | | Guidance |
|----------|---|----------------|-----|---|--|
| | OR Using $s = 22.5$, $u = 35\sin\theta$, $v = 0$, $a = -9.8$ $v^2 = u^2 + 2as$ $0 = (35\sin\theta)^2 - 2 \times 9.8 \times 22.5$ $\sin\theta = 0.6$ giving $\theta = 36.9^\circ$ | M1 A1 A1 | | Using any <i>suvat</i> in <i>y</i> -direction with $v_y = 0$ Correct equation for θ only | Either $\theta = 37^{\circ}$ or |
| | Use the trajectory with $y = 5$ $5 = x \tan \theta^{\circ} - \frac{1}{2450} g \sec^2 \theta^{\circ} x^2$ $\frac{1}{2450} x^2 - \frac{3}{2} x + 5 = 0$ | M1 | | allow 37° Allow in terms of θ FT their value for θ if used | $\cos \theta = \frac{4}{5}$, $\tan \theta = \frac{3}{4}$ may be seen. Allow this M mark for roots of their $y = 5$ used in a suitable equation for x. |
| | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | A1 | | Both correct <i>x</i> -values | |
| | So particle is above the height of the wall between 7 m and 112.9 m away, so when $x = 110$ m so it does not hit the wall | E1 [6] | | Conclusion in context from correct values | |