Topic 19: Exercises on Harder 3 Unit Projectile Motion
Level 2, Part 2

1. A particle is projected from a point O with speed $\frac{150}{7} ms^{-1}$ at an angle of elevation α, where $\tan\alpha = \frac{3}{4}$. One second later, another particle is projected from O with speed $\frac{225}{7} ms^{-1}$ at an angle of elevation β, where $\tan\beta = \frac{3}{4}$ and in the same vertical plane through O as the first particle. Show that the two particles collide, and find when this occurs. (Take $g = 10\ ms^{-2}$.)

1 s after projection of second particle

2. Two particles A and B are projected simultaneously under gravity, A from a point O on horizontal ground and B from a point 45 m vertically above O. B is projected horizontally with speed 30 ms^{-1}. The particles hit the ground simultaneously at the same point. Taking $g = 10\ ms^{-2}$, find the magnitude and direction of the velocity with which A is projected.

$15\sqrt{5}\ ms^{-1}$, at angle of elevation $\tan^{-1}\frac{1}{2}$

3. O is a point on horizontal ground. D is a point a distance d vertically above O. A particle is projected from O with speed U at an angle of elevation α. Simultaneously a second particle is projected horizontally from D with speed V on the same side of OD as A and the same vertical plane through O as the first particle. If the two particles are to collide, show that $V = U\cos\alpha$ and find a second condition which must also be satisfied.

$(U\sin\alpha)T = d$, where T is the time to collision

4. A particle P is projected from a point O and inclined at an angle of 45^0 above the horizontal. The particle describes a parabola under gravity. Coordinate axes are taken horizontally and vertically through O. The particle just clears the tops of two vertical poles a distance 40 m apart and each 15 m above the point of projection. Find the horizontal range of the projectile.

80 m

5. A projectile is fired from a point O on level ground with speed 13 ms^{-1} at an angle of elevation α, where $\tan\alpha = \frac{12}{5}$. The projectile just clears the top of a wall in its path and then reaches a maximum height of twice the height of the wall. Find the distance of the base of the wall from O.

$3(2-\sqrt{2})\ m$

6. A particle is projected from a point O on level ground with speed V at an angle of elevation α. The particle just clears a wall of height h at a distance d from O. Show that if the angle of projection is fixed, the particle hits the ground at the distance $\dfrac{dh}{d\tan\alpha - h}$ beyond the wall.