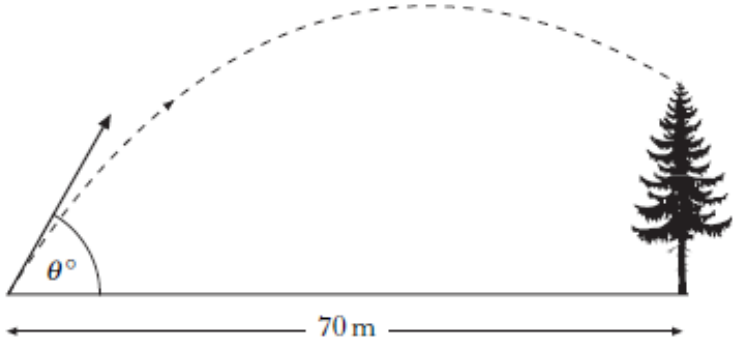
Homework 4

1) . A golfer strikes a golf ball on a horizontal range, projecting the ball with speed 30 $m\,s^{-1}$ at an angle $\theta°$ to the horizontal. After 3 seconds, the ball hits the top of a tree, which is situated at a horizontal distance of 70 metres from the point of projection.



Calculate the height of the tree. **4**

2) On a horizontal cricket field, a batsman strikes a cricket ball towards a fielder standing 40 metres away. The ball is projected from ground level at an angle $\theta°$ to the horizontal, where $\tan\theta° = \frac{3}{4}$, and is caught by the fielder when it is 2 metres above the ground, without having hit the ground first.

Calculate the speed with which the ball leaves the bat. **5**

3) The greatest height reached by a projectile is one tenth of its range on horizontal ground. Calculate the angle of projection. **5**

4) A golfer strikes a golf ball from O across a horizontal section of ground, giving the ball an initial speed of $V\ \text{m s}^{-1}$ at an angle α to the horizontal.

(a) Show that the range, R metres, of the golf ball is given by

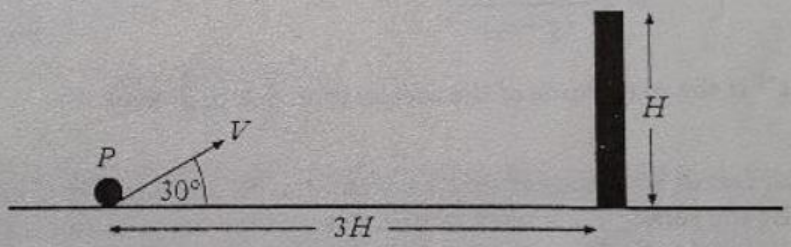
$$R = \frac{V^2}{g}\sin 2\alpha.$$ **4**

(b) The golfer intends the ball to land between two points A and B on the horizontal section such that $OA = L$ metres, $OB = 2L$ metres and OAB is a straight line.

Given that the angle of projection of the ball is 15°, show that the initial speed must satisfy

$$\sqrt{2} < \frac{V}{\sqrt{gL}} < 2.$$ **3**

5) A football is kicked towards a wall from a point P on a horizontal playing field. The initial speed given to the ball is $V\ \text{m s}^{-1}$ at an angle of 30° to the horizontal, as shown below. The wall is a horizontal distance $3H$ metres from the point P, where H is the height of the wall in metres.



Treating the ball as a particle, show that the ball goes **over** the wall if

$$V > \sqrt{\frac{6gH}{\sqrt{3}-1}},$$

where $g\ \text{m s}^{-2}$ is the magnitude of the acceleration due to gravity.

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