

Figure 4

A boy throws a ball at a target. At the instant when the ball leaves the boy's hand at the point A, the ball is 2 m above horizontal ground and is moving with speed U at an angle α above the horizontal.

In the subsequent motion, the highest point reached by the ball is 3 m above the ground. The target is modelled as being the point *T*, as shown in Figure 4. The ball is modelled as a particle moving freely under gravity.

Using the model,

(a) show that
$$U^2 = \frac{2g}{\sin^2}$$
. (2)

The point *T* is at a horizontal distance of 20 m from *A* and is at a height of 0.75 m above the ground. The ball reaches *T* without hitting the ground.

(b) Find the size of the angle α

(c) State one limitation of the model that could affect your answer to part (b).

(d) Find the time taken for the ball to travel from A to T.

(3)

(9)

(1)