5.

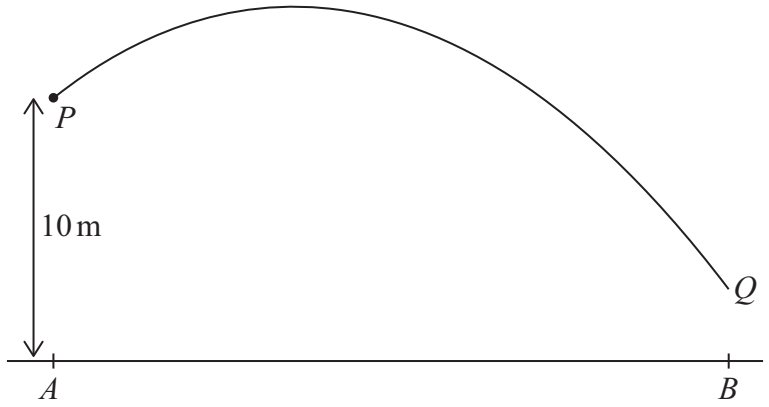


Figure 2

Figure 2 shows the points A and B on horizontal ground.

The point P is 10 m vertically above A.

The point Q is vertically above B.

A ball is projected from P with speed $10.5\,\text{m s}^{-1}$ and passes through the point Q with speed $14\,\text{m s}^{-1}$

The ball is modelled as a particle moving freely under gravity.

(a) Use the principle of conservation of mechanical energy to find the distance BQ.

(3)

Given that

- the ball is projected from P at an angle α above the horizontal
- the direction of motion of the ball at Q is perpendicular to the direction of motion of the ball at P

(b) show that $\tan\alpha = \frac{3}{4}$

(3)

A remote control car, modelled as a particle, is at rest at A.

At the instant when the ball is projected from P, the remote control car leaves A.

The remote control car accelerates uniformly as it moves in a straight line directly from A to B.

At the instant when the ball is at Q, the car is at B.

(c) Find the acceleration of the car.

(5)

(Total for Question 5 is 11 marks)