7. [*In this question, the perpendicular unit vectors* **i** *and* **j** *are in a vertical plane with* **i** *being horizontal and* **j** *being vertically upwards.*]

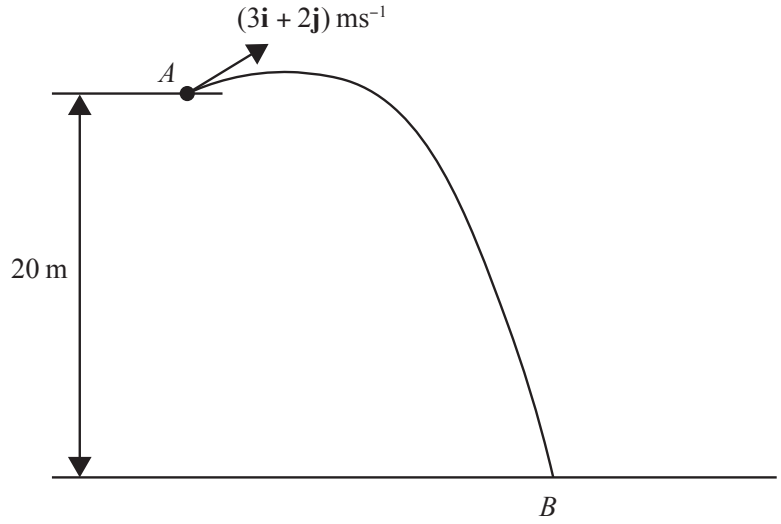


Figure 4

A small ball is projected with velocity $(3\mathbf{i} + 2\mathbf{j})\,\text{m s}^{-1}$ from the fixed point A.

The point A is 20 m above horizontal ground.

The ball hits the ground at the point B, as shown in Figure 4.

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

(a) By considering energy, find the speed of the ball at the instant immediately before it hits the ground.

(3)

(b) Find the direction of motion of the ball at the instant immediately before it hits the ground.

(3)

(c) Find the time taken for the ball to travel from A to B.

(3)

At the instant when the direction of motion of the ball is perpendicular to $(3\mathbf{i} + 2\mathbf{j})$ the ball is h metres above the ground.

(d) Find the value of h.

(6)

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(Total for Question 7 = 15 marks)

TOTAL FOR PAPER IS 75 MARKS

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