

5. [In this question, $\mathbf{i}$ is a horizontal unit vector and $\mathbf{j}$ is a unit vector directed vertically upwards.]

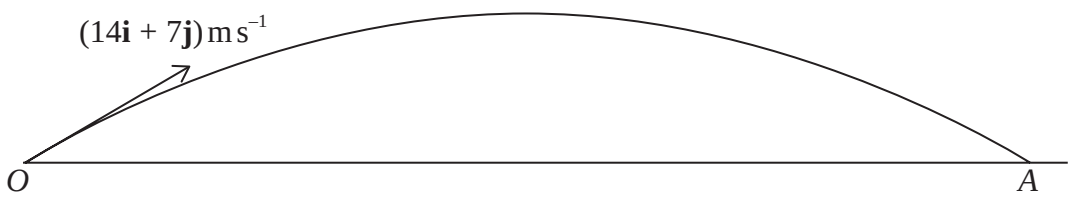


Figure 3

At time $t = 0$ seconds, a small stone is projected with velocity $(14\mathbf{i} + 7\mathbf{j}) \text{ m s}^{-1}$ from a point O on horizontal ground.

The stone hits the ground at the point A, as shown in Figure 3.

In an initial model, the stone is modelled as a particle moving freely under gravity.

Using this model, find

- (a) the distance OA (4)
- (b) the speed, $V \text{ m s}^{-1}$, of the stone at $t = 0.5$ seconds. (3)

The model is refined to include air resistance.

Using this refined model, the speed of the stone at $t = 0.5$ seconds is found to be $W \text{ m s}^{-1}$

Given that in both models the stone is still moving upwards at $t = 0.5$ seconds,

- (c) state which is greater, V or W , giving a reason for your answer. (2)
- (d) State a limitation of the refined model. (1)