1    (a) A tennis ball is thrown vertically **downwards** and bounces on the ground. The ball leaves the hand with an initial speed of 1.5 m s⁻¹ and at a  height  of 0.65 m  above the ground. The  ball      rebounds  and  is caught when it is travelling upwards with a speed of 1.0 m s⁻¹.

Assume that air resistance is negligible.

(i)    Calculate the speed of the ball just before it strikes the ground.

Speed = …........................ m s⁻¹  [2]

(ii)   The ball is released at $t = 0$. It hits the ground at $t_1$ and is caught at time $t_2$.

On Fig 1.1, sketch the velocity-time graph for the vertical motion of the tennis ball from the time it leaves the hand to when it returns. Take the upward direction as positive.

Assume that the contact time between the ball and the ground is negligible. The initial velocity **X** and final velocity **Y** are marked on Fig 1.1.                    [3]
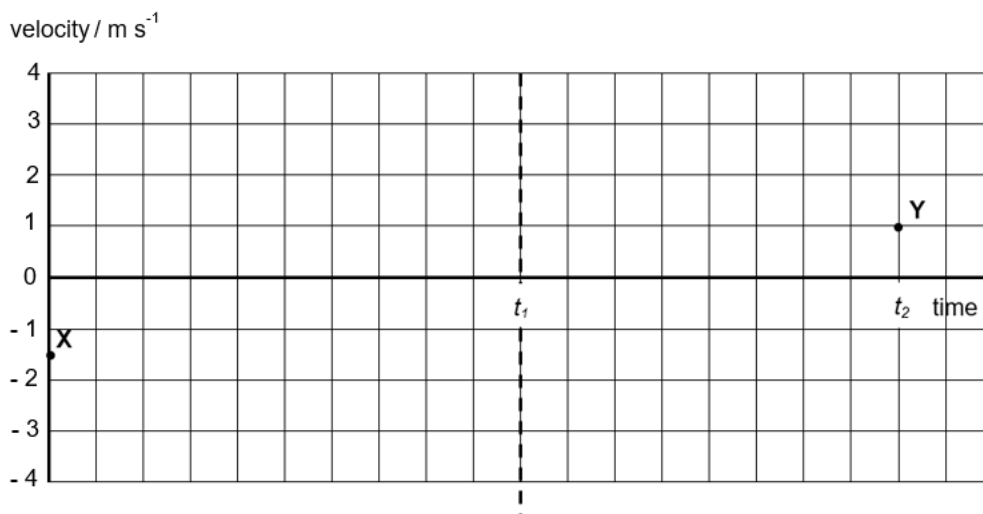
velocity / m s⁻¹



**Fig. 1.1**

(iii)   Explain whether the bounce is elastic.

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**(b)** Sketch on Fig 1.1, the velocity-time graph of the tennis ball if air resistance is not negligible, up to the instant when it reaches the highest point after bouncing off the ground. Label this graph as **P**.                                         [3]

**[Total: 10]**