

### Answer on Question #74040 Physics / Classical Mechanics

A particle  $A$  is dropped from a point  $P$  at  $t = 0$ . At the same time another particle  $B$  is thrown from a point  $O$  which is 2m to the right and 10m below  $P$ , with velocity  $v$  making an angle  $\theta$  with horizontal.  $B$  collides with the particle  $A$ . If the two particles collide 2 sec after they start, find  $v$ . (Acceleration due to gravity is  $10\text{m/s}^2$  in negative  $y$  direction. Point  $O$  is not necessarily on ground.)

#### Solution:

Let the origin is at point  $O$ . The  $y$  axis is directed upward. The  $x$  axis is directed to the left. So, the equations of motion of particles  $A$  and  $B$

$$y_A(t) = 10 - \frac{gt^2}{2}$$

$$x_A(t) = 2$$

$$y_B(t) = v \sin \theta t - \frac{gt^2}{2}$$

$$x_B(t) = v \cos \theta t$$

When particles collide

$$x_A(t) = x_B(t) \text{ and } y_A(t) = y_B(t), t = 2 \text{ s}$$

Thus

$$2 = 2v \cos \theta \Rightarrow v \cos \theta = 1$$

$$10 - \frac{10 \times 2^2}{2} = 2v \sin \theta - \frac{10 \times 2^2}{2} \Rightarrow v \sin \theta = 5$$

Finally

$$v^2 \cos^2 \theta + v^2 \sin^2 \theta = 1^2 + 5^2$$

$$v^2 = 26$$

$$v = \sqrt{26} \text{ m/s}$$

**Answer:**  $v = \sqrt{26} \text{ m/s}$

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