Answer on Question #45287 – Physics - Mechanics | Kinematics | Dynamics

a batter hits a ball so that it lifts the bat at speed of 30 m\s at angle 53.1 degree.find the position and velocity of ball at T=2 sec

Solution:

$V_0 = 30\frac{m}{s} -$ initial velocity of the ball;

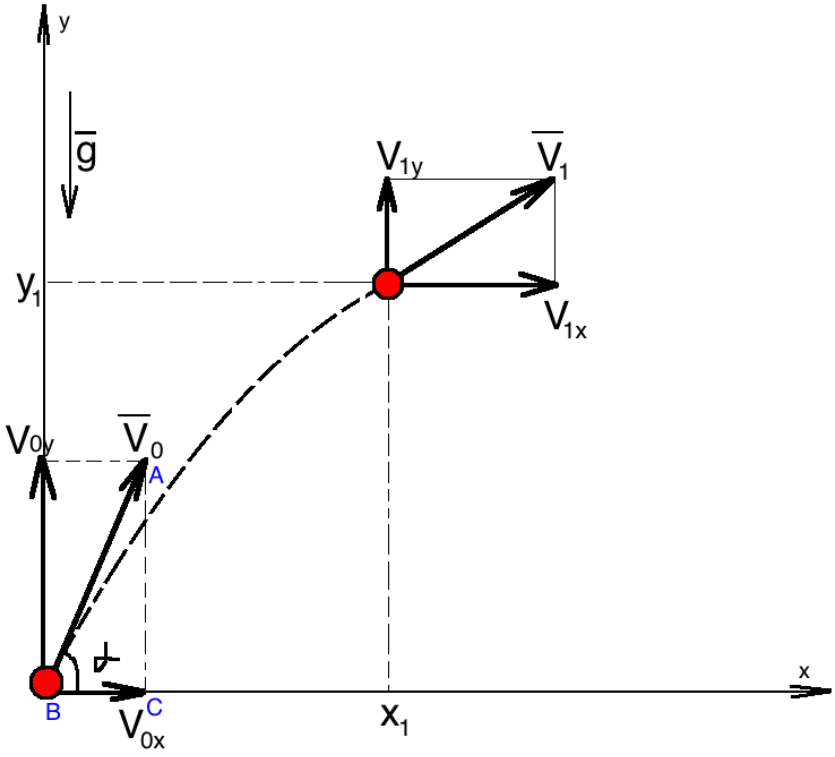
$\alpha = 53.1\,° -$ angle of projection;

$T = 2s -$ travelling time;

$V_1 -$ final velocity of the ball;

$x_1 -$ final horizontal position of the ball;

$y_1 -$ final vertical position of the ball;



From the right triangle ABC:

$$V_{x0} = V_0 \cdot \cos\alpha\,;\ V_{y0} = V_0 \cdot \sin\alpha\,;$$

Equation of motion of the ball along the X-axis:

$$x_1 = V_{x0} T \cos\alpha = 30\frac{m}{s} \cdot 2s \cdot \cos 53.1° = 36\ m$$

Equations of motion along the Y-axis:

$$y_1 = V_{y0} T - \frac{gT^2}{2} = 30\frac{m}{s} \cdot 2s \cdot \sin 53.1° - 9.8\frac{m}{s^2} \cdot \frac{1}{2} \cdot (2s)^2 = 28.4\ m$$

Rate equation for the horizontal component of the final velocity:

$$V_{1y} = V_{0y} - gT = V_0 \cdot \sin\alpha - gT = 30\frac{m}{s} \cdot \sin 53.1° - 9.8\frac{m}{s^2} \cdot 2s = 4.4\frac{m}{s}$$

$V_{1x} = V_{0x}$, because horizontal acceleration is zero.
The final velocity of the ball by the Pythagorean theorem:

$$V_1 = \sqrt{V_{1x}^2 + V_{1y}^2} = \sqrt{\left(4.4\frac{m}{s}\right)^2 + \left(30\frac{m}{s}\cdot\cos 53.1°\right)^2} = 18.5\frac{m}{s}$$

Answer: position of the ball: horizontal: $36\ m$, vertical : $28.4\ m$; final velocity: $18.5\frac{m}{s}$.