Answer on Question #53587, Physics Mechanics Kinematics Dynamics

A ball is thrown with a speed of 20 m s–1 in a direction 30° above the horizontal. Calculate

(i) the maximum height attained by the ball and

(iii) the time taken by the ball to return to the same level

(Take g = 10 m s–2).

Solution

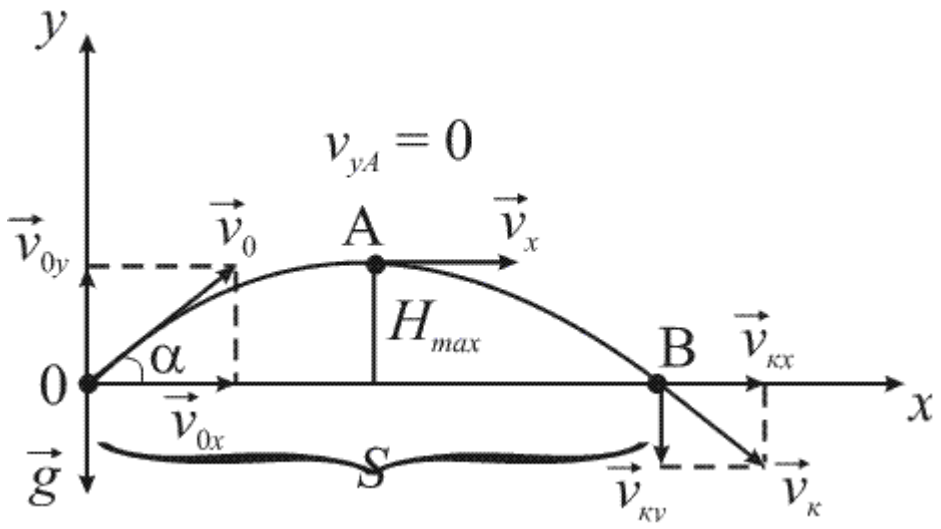

Fig.1

Maximum lift height is found from the law of conservation of energy. The law of conservation of energy transfer from the position O in A is given by Eq(1).

$$\frac{Mv_0^2}{2}=MgH_{\max}+\frac{Mv_{0x}^2}{2} \tag{1}$$

where $v_{0x}=v_0\cos\alpha$; M is the mass of the ball.

Then

$$H_{\max}=\frac{v_0^2-v_{0x}^2}{2g}=\frac{v_0^2-v_0^2\cos^2\alpha}{2g}=\frac{v_0^2\sin^2\alpha}{2g}=\frac{20^2\sin^2 30^0}{2\cdot 10}=5\,m$$

Time of the ball motion from point O to point A is the same as from point A to point B (the symmetry of the trajectory).

Time of the ball motion from point O to point A (see Fig.1):

$$v_{0y}-gt_0=0\Rightarrow t_0=v_{0y}/g=v_0\sin\alpha/g \tag{2}$$

The time taken by the ball to return to the same level is given by Eq.(3)

$$t = 2t_0 = \frac{2v_0 \sin\alpha}{g} = \frac{2 \cdot 20 \cdot \sin 30^0}{10} = 2\,s$$

Answer: $H_{\max} = \frac{v_0^2 \sin^2\alpha}{2g} = 5\,m\,; t = \frac{2v_0 \sin\alpha}{g} = 2\,s\,.$

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