## Answer on Question \#53640, Physics / Other

A ball is thrown with a speed of $20 \mathrm{~m} \mathrm{~s}^{-1}$ in a direction $30^{\circ}$ 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 $\mathrm{g}=10 \mathrm{~m} \mathrm{~s}-2$ )

## Solution:



Projectile motion is a form of motion in which an object or particle (called a projectile) is thrown near the earth's surface, and it moves along a curved path under the action of gravity only.

In projectile motion, the horizontal motion and the vertical motion are independent of each other; that is, neither motion affects the other.

The horizontal component of the velocity of the object remains unchanged throughout the motion. The vertical component of the velocity increases linearly, because the acceleration due to gravity is constant ( $g=10 \mathrm{~m} / \mathrm{s}^{2}$ ).

$$
\begin{aligned}
& v_{0 x}=v_{0} \cos \alpha \\
& v_{0 y}=v_{0} \sin \alpha
\end{aligned}
$$

Equations related to trajectory motion are given by

$$
\begin{aligned}
\text { Maximum height reached, } \quad H & =\frac{v_{0}^{2} \sin ^{2} \theta}{2 g} \\
\text { Horizontal distance, } \quad x_{\max } & =v_{0 x} t
\end{aligned}
$$

(i) the maximum height attained by the ball is

$$
H=\frac{v_{0}^{2} \sin ^{2} \theta}{2 g}=\frac{20^{2} * \sin ^{2} 30^{\circ}}{2 * 10}=5 \mathrm{~m}
$$

(iii) the time taken by the ball to return to the same level we find from equation

$$
v_{y}=v_{0 y}-g t
$$

At maximum height $v_{y}=0$, thus time to reach maximum height is

$$
t_{1}=\frac{v_{0 y}}{g}=\frac{20 * \sin 30^{\circ}}{10}=1 \mathrm{~s}
$$

The full time of flight is

$$
t=2 t_{1}=2 \mathrm{~s}
$$

Answer: $H=5 \mathrm{~m} ; t=2 \mathrm{~s}$

