SNS COLLEGE OF ENGINEERING<br>Kurumbapalayam (Po), Coimbatore - 641107<br>Accredited by NAAC-UGC with 'A' Grade<br>Approved by AICTE \& Affiliated to Anna University, Chennai

Problem 2: A ball is tossed with a velocity of $20 \mathrm{~m} / \mathrm{sec}$ directed vertically from a window located at 50 m above the ground. Determine

1. Elevation $y$ of the ball above the ground
2. Time and velocity when the ball hits the ground

## Solution:

a) Elevation of the ball above the ground

Initial velocity, $u=20 \mathrm{~m} / \mathrm{sec}$
Acceleration due to gravity, $\mathrm{g}=-9.81 \mathrm{~m} / \mathrm{sec}^{2}$
Final velocity, $\mathrm{v}=0$
We know $\mathrm{v}^{2}=\mathrm{u}^{2}-2 \mathrm{gs}$

$$
\begin{gathered}
0=20^{2}-2 \times 9.81 \times \mathrm{s} \\
\mathrm{~s}=20.387 \mathrm{~m} \\
\mathrm{y}=50+\mathrm{s} \\
=50+20.387 \\
=70.387 \mathrm{~m}
\end{gathered}
$$

b) Time and velocity when of the ball to hit the ground Initial velocity $u=0$

Final velocity $\mathrm{v}=\mathrm{v}_{2}$
Distance $\mathrm{s}=70.387 \mathrm{~m}$
Acceleration due to gravity $\mathrm{g}=9.81 \mathrm{~m} / \mathrm{s}^{2}$

$$
\begin{gathered}
\mathrm{v}^{2}-\mathrm{u}^{2}=2 \mathrm{gs} \\
\mathrm{v}^{2}-0=2 \times 9.81 \times 70.387
\end{gathered}
$$

Final velocity $\mathrm{v}^{2}=37.16 \mathrm{~m} / \mathrm{sec}$

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Time taken to reach maximum height

$$
\begin{gathered}
v=u+a t \\
0=20-9.81 \mathrm{t} \\
\frac{20}{9.81}=\mathrm{t}_{1} \\
\mathrm{t}_{1}=2.038 \mathrm{sec}
\end{gathered}
$$

Time required to reach the ground from maximum height

$$
\begin{gathered}
\mathrm{v}=\mathrm{u}+\mathrm{at}_{2} \\
37.16=0+9.81 \mathrm{t}_{2} \\
\mathrm{t}_{2}=3.788 \mathrm{sec}
\end{gathered}
$$

Total time of travel $=\mathrm{t}_{1}+\mathrm{t}_{2}$

$$
\begin{aligned}
& =2.038+3.788 \\
& =5.826 \mathrm{sec}
\end{aligned}
$$

