3> A tennis ball is struck with a racket firing it straight upward at 22 m/s

1) A ball is thrown upward with an initial velocity of 10 m/s from top of 50m bridge

a) With what velocity will the ball strike the ground?

b) How long does it take the ball to strike the ground?

2) A stone is dropped freely in a river from the bridge. It takes 5 s to touch the water surface. Calculate

i) the height of the bridge from water level.

ii) the distance covered by stone in the last second?

3> A tennis ball is struck with a racket, firing it straight upward at 22 m/s. After how much time will it be falling at 15 m/s?

1) i) Initial velocity of ball = 50 m/s

Final velocity of ball when it reached the top = 0 m/s.

By (iii) eqn of motion

$= v^2 - u^2 = 2as$

$= v^2 - u^2 = -2 \times g \times h$

$= (0)^2 - (10)^2 = -2 \times 10 \times h$

$= \frac{-100}{-20} = h = 5m.$

So it will cover 5 m within attaining its max height when thrown upward.

Distance covered by ball when it comes down

$= 50 + 5 = 55m.$

Inital velocity when it starts falling down

$= 0$

Let, Final velocity with which it his ground

$= v$

By (ii) equation of motion,

$= v^2 - u^2 = 2as$

$= v^2 - u^2 = 2gh$

$= v^2 - 0^2 = 2 \times 10 \times 55$

$= v = \sqrt{2 \times 10 \times 55} = 10\sqrt{11}$ m/s.

Therefore the ball hits ground with $10\sqrt{11}$ m/s.

ii) Initial velocity of ball when thrown upwards $= 10$ m/s

Final velocity at attaining maximum height $= 0$

By ① eqⁿ of motion

$= v = u + at$

$= v = u - gt$

$= 0 = 10 - 10t$

$= t = 1$ s.

∴ time taken to reach maximum height is 1s.

Initial velocity when the ball started falling $= 0$ m/s

Final velocity with which the ball hits ground $= 10\sqrt{11}$ m/s.

By ① eqⁿ of motion

$= v = u + at$

$= v = u + g \times t$

$= 10\sqrt{11} = 0 + 10 \times t$

$= t = \sqrt{11}$ s

∴ the ball reached ground in $\sqrt{11}$ s.

Hence, the body takes $(1+\sqrt{11})$ s to reach the ground from starting.

2) i) Initial velocity of the stone = 0m/s

Time taken to touch river = 5s

By (II) eqn of motion,

$= S_1 = ut + \frac{1}{2}at^2$

$= S_1 = ut + \frac{1}{2}gt^2 \Rightarrow S = 0 \times t + \frac{1}{2} \times 10 \times (5)^2$

$= S_1 = 0 + \frac{1}{2} \times 10 \times 25$

$= 5 \times 25 = 125 m.$

ii) Distance covered by stone in last second = distance covered by body/stone in 4th sec

So, distance covered by body in 4th sec

$= S_2 = u + \frac{a}{2}(2n-1)$

$= u + \frac{g}{2}(2(4)-1)$

$= 0 + \frac{10}{2}(8-1)$

$= 5 \times 7 = 35 m.$

Hence the body covered 35m in 4th last sec

3) Initial velocity of ball = 22 m/s
Final velocity of ball = 0 m/s
From ① equation of motion
= $v = u + at$
= $v = u - gt$
= $0 = 22 - 10t$
= $-22 = -10$
= $t = 2.2\,s$.

Now, the initial velocity when it started coming down = 0 m/s
Given final velocity = 15 m/s.
By ① equation of motion
= $v = u + at$
= $v = u + gt$
= $15 = 0 + 10t$
= $t = 1.5\,s$.

Therefore the time after which it will be falling at 15 m/s is
= $1.5 + 2.2 = 3.7\,s$

Hence, the ball will be falling at 15 m/s after 3.7 s.