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25) Question: A basketball is released from the top of a 500 meters tall building. Approximately how much time (in seconds) after being released, will it reach the ground? Use the following formula

$S \quad = ut + \left(\frac{1}{2}\right) gt^2$

where

S = *distance traveled in meters*
u = *initial velocity in meters/second*
t = *time taken in seconds*
g = *acceleration due to gravity* = $9.81 \frac{meters}{second^2}$

A) 2 seconds
B) 3 seconds
C) 5 seconds
D) 10 seconds

cs,cu

For speed, while solving something similar, only THINK the words in blue; WRITE only the words in other COLORS.

Solution:

Given: 1) A basketball is released (NOT pushed / thrown up or down) from the top of a 100 meters tall building.
2) Approximately how much time (in seconds) after being released, will it reach the ground?
3) $S \quad = ut + \left(\frac{1}{2}\right) gt^2$

Solve: Plug in the known (given) values into the equation above to find the value of "t".

Road Map of Solution:

First thing; variable; S = Distance travelled by the basketball = 500 meters
Second thing; variable; u = initial velocity = 0 meters/second;
It is zero, because, it is NOT launched in the direction, in which the "Distance Travelled" is being measured. It is merely released.
Third thing; variable; t = time taken in seconds, to fall 500 meters to reach the ground.
Fourth thing; constant; g = acceleration due to gravity = 9.81 meters/second^2
So, anything falling freely (no air resistance) under gravity will be travelling at

(9.81 meters/second^2)×(t second) = (9.81×t) meters/second after "t" second of free fall.
(9.81 meters/second^2)×(1 second) = 9.81 meters/second after "1" second of free fall.
(9.81 meters/second^2)×(2 second) = 19.62 meters/second after "2" second of free fall.
(9.81 meters/second^2)×(3 second) = 29.43 meters/second after "3" second of free fall.
(9.81 meters/second^2)×(4 second) = 39.24 meters/second after "4" second of free fall.

Given Third Statement:

$$S = ut + \left(\frac{1}{2}\right) gt^2$$
$$S = (u)(t) + \left(\frac{1}{2}\right)(g)(t^2)$$
$$500\ m = (0\ \text{meters/second})(t\ \text{second}) + \left(\frac{1}{2}\right)\left(9.81 \frac{meters}{} second^2\right)(t\ second)^2$$
$$500 = 0 + \left(\frac{1\times 9.81}{2}\right)(t^2)$$
$$500 = \left(\frac{9.81}{2}\right)(t^2)$$

Insert explanation

$$\{\ 500\ \} \times\left(\frac{2}{9.81}\right) = \{\left(\frac{9.81}{2}\right)(t^2)\}\times\left(\frac{2}{9.81}\right)$$
$$\{\ 500\ \} \times\left(\frac{2}{9.81}\right) = \{\left(\frac{\cancel{9.81}}{\cancel{2}}\right)(t^2)\}\times\left(\frac{\cancel{2}}{\cancel{9.81}}\right)$$
$$\left(\frac{500 \times 2}{9.81}\right) = \{\left(\frac{1}{1}\right)(t^2)\}\times\left(\frac{1}{1}\right)$$
$$\left(\frac{100\times 5 \times 2}{9.81}\right) = t^2$$

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$$\left(\frac{100 \quad \times 10}{9.81}\right) = t^2$$

$$\left(\frac{100 \quad \times 10}{9.81}\right) = t^2$$

$$(100) \times \left(\frac{10}{9.81}\right) = t^2$$

$$\sqrt{(100) \times \left(\frac{10}{9.81}\right)} = \sqrt{t^2}$$

$$\sqrt{(100)} \times \sqrt{\left(\frac{10}{9.81}\right)} = t$$

$$10 \times \sqrt{\frac{10}{9.81}} = t$$

$$10 \times \sqrt{1} = t \quad \textit{(Approximately)}$$

$$10 \times 1 = t \quad \textit{(Approximately) Answer(D)}$$