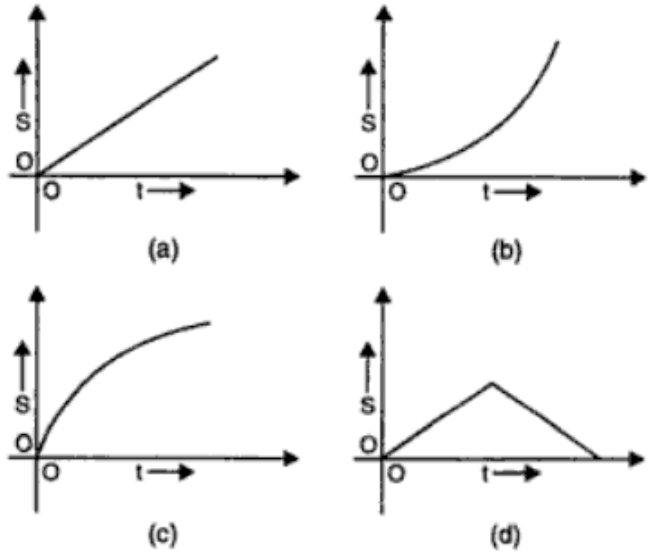
Answer on Question 59348, Physics, Other

Question:

One stone is dropped from a tower from rest (at time $t = 0$) and simultaneously another stone is projected vertically upwards from the same tower with some initial velocity. The graph of the distance *S* between the two stones, before either hits the ground, varies with time as:



Solution:

Let's take the downwards as the positive direction, for convenience. Then, using the kinematic equation, we can find the distance S_1, that the first stone travels until it hits the ground (since the stone dropped from rest, its initial velocity is equal to zero):

$$S_1 = \frac{1}{2} g t^2,$$

here, g is the acceleration due to gravity (because it directed downward, it will be with sign plus), t is the time.

We can find the distance S_2, that the second stone travels until it hits the ground from the same kinematic equation (this time we have some initial velocity v_0 and because it directed upward, it will be with sign minus):

$$S_2 = -v_0 t + \frac{1}{2} g t^2,$$

here, v_0 is the initial velocity of the second stone, t is the time, g is the acceleration due to gravity.

Then, we can find the distance between the two stones:

$$S = S_1 - S_2 = \frac{1}{2}gt^2 - \left(-v_0 t + \frac{1}{2}gt^2\right) = \frac{1}{2}gt^2 + v_0 t - \frac{1}{2}gt^2 = v_0 t \propto t.$$

Therefore, on the distance-time graph we will see the line with constant and positive slope (case (a)).

Answer: a)