a ball rolls off the top of a step ladder with a horizontal velocity of 10m/s if the steps are 1m high and 1m wide the ball will just hit a)03rd step b)20th step c)12th step d) 10th step

Solution

$V = 10\frac{m}{s}$ –horizontal velocity of the ball;

$h = 1m$ –high of one step;

$d - 1m$ –width of one step;

The equation of motion for the ball along the X-axis (N-number of steps that the ball flew, t – time of the flight):

$x: N \cdot d = Vt$

$t = \frac{Nd}{V}$ (1)

The equation of motion for the ball along the Y-axis

$y: N \cdot h = \frac{gt^2}{2}$ (2)

$(1)in(2)$:

$Nh = \frac{g}{2} \cdot \frac{N^2 d^2}{V^2}$

$2hV^2 = gNd^2$

$N = \frac{2hV^2}{gd^2} = \frac{2 \cdot 1m \cdot (10\frac{m}{s})^2}{9.8\frac{m}{s^2} \cdot (1m)^2} = 20.4 \approx 20 \text{ steps}$

Answer: b) 20th step.