

Task. A freely falling covers 0.1 m in 0.1 sec and 0.2 m in next 0.1 sec. Find the value of acceleration due to gravity at the place.

Solution. Assume that the acceleration g due to gravity is constant at the place, so the object moves with constant acceleration. Let v be its initial velocity. Then the distance passed by time t is equal to

$$h(t) = vt + \frac{gt^2}{2}.$$

By assumption,

$$h(0.1 \text{ sec}) = 0.1 \text{ m}.$$

Moreover, in next 0.1 sec., that is at $t = 0.1 + 0.1$ the distace was

$$h(0.1 + 0.1) = h(0.2) = 0.1 + 0.2 = 0.3$$

So we get the following system of equations:

$$\begin{aligned} h(0.1) = 0.1 &= v * 0.1 + \frac{g * 0.1^2}{2}, & h(0.2) = 0.3 &= v * 0.2 + \frac{g * 0.2^2}{2} \\ 0.1v + 0.005g &= 0.1, & 0.2v + 0.02g &= 0.3. \\ 0.2v + 0.01g &= 0.2, & 0.2v + 0.02g &= 0.3. \end{aligned}$$

Subtracting left equation from the right one we get

$$0.2v + 0.02g - 0.2v - 0.01g = 0.3 - 0.2$$

$$0.01g = 0.1$$

$$g = \frac{0.1}{0.01} = 10 \text{ m/s}^2.$$

Answer. $g = 10 \text{ m/s}^2$.