

Task. A body travel 200cm in the first 2sec and 220cm in the next 5sec. Calculate the velocity at the end of the seventh second from the start.

Solution. Assume that the body is moved with constant acceleration a . Let v_0 be the initial velocity of the body. Then the distance $d(t)$ passed by the body and the velocity $v(t)$ of the body at time t are given by the following formula:

$$v(t) = v_0 + at, \quad d(t) = v_0t + \frac{at^2}{2}.$$

By assumption

$$d(2) = 200 \text{ cm} = 0.2 \text{ m},$$

and

$$d(2 + 5) = d(7) = 200 \text{ cm} + 220 \text{ cm} = 420 \text{ cm} = 0.42 \text{ m}.$$

We should find the velocity $v(7)$.

Substituting $t = 2$ and $t = 7$ into the formulas for d we obtain:

$$d(2) = 0.2 = v_0 * 2 + \frac{a * 2^2}{2} = 2v_0 + 2a,$$

$$d(7) = 0.42 = v_0 * 7 + \frac{a * 7^2}{2} = 7v_0 + 24.5a,$$

so we get the following system of linear equations:

$$\begin{cases} 2v_0 + 2a = 0.2 \\ 7v_0 + 24.5a = 0.42 \end{cases}$$

From the first equation we obtain

$$v_0 + a = 0.1 \quad \Rightarrow \quad v_0 = 0.1 - a.$$

Substituting into the second equation we get

$$7(0.1 - a) + 24.5a = 0.42,$$

Dividing by 7 we obtain

$$\begin{aligned} 0.1 - a + 3.5a &= 0.06, & \Rightarrow & \quad 2.5a = 0.06 - 0.1 & \Rightarrow & \quad 2.5a = -0.04 \\ a &= -\frac{0.04}{2.5} = -0.016 \text{ m/s}^2. \end{aligned}$$

Hence

$$v_0 = 0.1 - a = 0.1 + 0.016 = 0.116 \text{ m/s}.$$

Therefore

$$v(7) = 0.116 - 0.016 * 7 = 0.004 \text{ m/s}.$$

Answer. $v(7) = 0.004 \text{ m/s}$.