Question #55091, Physics / Mechanics | Kinematics | Dynamics |

A truck starts from rest and accelerates at 0.7m/s2. 5 s later, a car accelerates from rest at the same starting point with an acceleration of 2.2m/s2.

a) Where and when does the car catch the truck?
_56.47__ m from the starting point
at __12.7__ seconds from the moment the truck started to accelerate.

b) What are their velocities when they meet?
The truck : 8.89 m/s
The car : 16.94 m/s

Answer:

a) Let's make an assumption that they meet at the distance d from the starting point in t seconds:

Then, $d = 0.5a_1t^2$, where a_1 – the acceleration of the truck, (for the truck) and

$d = 0.5a_2(t - \Delta t)^2 - 0.5a_1\Delta t^2$, where a_2 – the acceleration of the car and Δt – the difference in starting time (for the car).

Thus,

$0.5a_1t^2 = 0.5a_2(t - \Delta t)^2 - 0.5a_1\Delta t^2$,

$0.5\times0.7t^2 = 0.5\times2.2(t-5)^2 - 0.5\times0.7\times25$

$0.35t^2 = 1.1(t-5)^2 - 8.75$

$0.35\ t^2 - 1.1(t^2 - 10t + 25) = -8.75$

$-0.75\ t^2 + 11t - 27.5 + 8.75 = 0$

$t^2 - 14.67t + 25 = 0$

$D = 215.21 - 100 = 115.21$

$t = [14.67 + 10.73]/2 = 12.7$ s

The distance is: $d = 0.5a_1t^2 = 0.5\times0.7\times12.7^2$ m = 56.47 m.

b) The velocities are calculated by the equations:

For the truck: $v = a_1t = 0.7\times12.7$ m/s = 8.89 m/s

For the car: $v = a_2(t-\Delta t) = 2.2\times(12.7-5)$ m/s = 16.94 m/s