Answer on Question #49896-Physics-Mechanics-Kinematics-Dynamics

At the instant the traffic light turns green, an automobile starts with a constant acceleration of 2.2m/s2. At the same instant a truck travelling with a constant speed of 9.5m/s overtakes and passes the automobile. How far beyond the same point will the automobile overtake the truck? How fast will the car be travelling at that instance?

Solution

Take the origin to be at the point where the truck overtakes the car. Measuring time from this event, the position of the truck is

$$x_t = v_t t,$$

where the speed of the truck is $v_t = 9.5\frac{m}{s}$.

The position of the car (which starts from rest) is

$$x_c = \frac{1}{2}at^2.$$

The truck and car will be at the same position when , $x_t = x_c$ so that

$$v_t t = \frac{1}{2}at^2.$$

The solution $t = 0$ corresponds to when the truck overtakes the car. The other solution gives the time at which the car overtakes the truck, i.e.

$$t = \frac{2v_t}{a} = \frac{2 \cdot 9.5}{2.2} = 8.6\ s.$$

At this time the truck and car both travelled a distance of $s = v_t t = 9.5 \cdot 8.6 = 82\ m$ from the starting point of the car.

The speed of the car is

$$v_c = at = 2v_t = 19\frac{m}{s}.$$

Answer: $82\ m$; $19\frac{m}{s}$.

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