Answer on Question #70728, Physics / Mechanics | Relativity

Question. The driver of a car wishes to bus a truck hat is traveling at a constant speed of $20\ m/s$. Initially the car is also traveling $20\ m/s$ and its front bumper is $24\ m$ behind the truck's rear bumper. The car accelerates at a constant $0.6\ m/s^2$, then bus bock into the truck's lane when the rare of the car is $26\ m$ ahead of the front of the truck. The car is $4.5\ m$ long and the truck is $21\ m$ long.

a) how much time is required for the car to pass the truck?

b) what distance does the car travel during this time?

c) what is the final speed of the car?

Given.

$u = v_0 = 20\ \text{m/s};\ l_1 = 24\ m;\ l_2 = 26\ m;\ l_3 = 21\ m;\ l_4 = 4.5\ m;\ a = 0.6\ m/s^2.$

Find.

$t - ?;\ S - ?;\ v - ?.$

Solution.

a) The car needs to move

$$l = l_1 + l_2 + l_3 + l_4 = 24 + 26 + 21 + 4.5 = 75.5\ m.$$

Since both vehicles, at initially have the same speed they do not move in relation to each other. So

$$l = \frac{at^2}{2} \ \rightarrow\ t = \sqrt{\frac{2 \cdot l}{a}} = \sqrt{\frac{2 \cdot 75.5}{0.6}} \approx \mathbf{15.86\ s}.$$

b) Total distance travelled by car

$$S = l + u \cdot t = 75.5 + 20 \cdot 15.86 \approx \mathbf{393\ m}.$$

c) The final speed of the car

$$v = v_0 + at = 20 + 0.6 \cdot 15.86 = \mathbf{29.5\ \frac{m}{s}}.$$

Answer. $\boldsymbol{t = 15.86\ s;\ S = 393\ m;\ v = 29.5\ \frac{m}{s}}$.