A car and a truck start from rest at the same instant, with the car initially at some distance behind the truck. The truck has a constant acceleration of 2.10m/s2 , and the car an acceleration of 3.31m/s2 . The car overtakes the truck after the truck has moved a distance 49.0m .

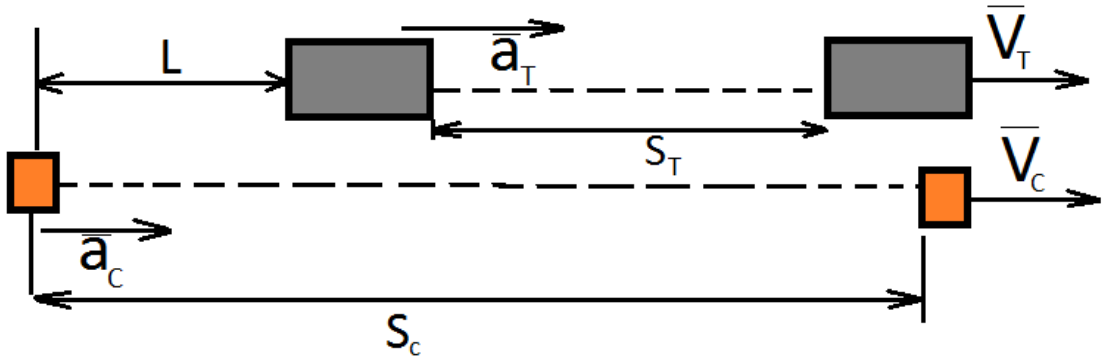
a.How much time does it take the car to overtake the truck?

b.How far was the car behind the truck initially?

c.What is the speed of the truck when they are abreast?

d.What is the speed of the car when they are abreast?

Solution:



a_c – car's acceleration; a_t – truck's acceleration

a) Car require as much time to overtake the truck as needed a truck that would cover a distance S = 49m. Equation of motion for the truck:

$$S_T = \frac{a_T t^2}{2}$$

$$t = \sqrt{\frac{2S_T}{a_T}} = \sqrt{\frac{2 * 49m}{2.1\frac{m}{s^2}}} = 6.83s$$

b) To find the distance L we need to find the difference in distance that the car and truck drove. The equations of motion for the car:

$$S_C = \frac{a_c t^2}{2} = \frac{3.31\frac{m}{s^2} * (6.83s)^2}{2} = 77.2\ m$$

$$L = S_C - S_T = 77.2m - 49.0m = 28.2\ m$$

c) Rate equation for a truck (in the beginning velocity equal to zero)

$$V_T = a_T t = 2.1\frac{m}{s^2} * 6.83s = 14.43\ \frac{m}{s}$$

d) Rate equation for a car (in the beginning velocity equal to zero)

$$V_C = a_C t = 3.31\frac{m}{s^2} * 6.83s = 22.6\ \frac{m}{s}$$

Answer: a) $6.83s$

b) $28.2\ m$

c) $14.43\ \frac{m}{s}$

d) $22.6\ \frac{m}{s}$