

Answer on Question #62281, Physics / Other |

An automobile and a truck start from rest at the same instant, with the automobile initially at some distance behind the truck. The truck has a constant acceleration of 2 m/s^2 and the automobile an acceleration of 3 m/s^2 . The automobile overtakes the truck after the truck has moved 75 cm.

How long does it take the auto to overtake the truck?

How far was the automobile behind the truck initially?

What is the velocity of each when they are abreast?

Solution:

a) How long does it take the auto to overtake the truck?

Let the initial distance between the truck and automobile be d . Then the distance covered by the automobile before overtaking the truck is $75+d$ m. Let the time needed be t .

Using equation of motion

$$s = \frac{1}{2}at^2$$

(since initial velocity = 0), for automobile

$$0.75 + d = 0.5 \cdot 3 \cdot t^2$$

and for truck

$$0.75 = 0.5 \cdot 2 \cdot t^2$$

Hence,

$$t^2 = 0.75$$

$$t = 0.866 \text{ s}$$

b) How far was the automobile behind the truck initially?

$$d = 0.5 \cdot 3 \cdot 0.75 - 0.75 = 0.375 \text{ m}$$

c) What is the velocity of each when they are abreast?

Using the equation:

$$v^2 - v_0^2 = 2as$$

The velocity of the truck is

$$v_1 = \sqrt{2as_1} = \sqrt{2 \cdot 2 \cdot 0.75} = 1.732 \text{ m/s}$$

The velocity of the automobile is

$$v_2 = \sqrt{2as_2} = \sqrt{2 \cdot 3 \cdot 1.125} = 2.598 \text{ m/s}$$

Answer: $t = 0.866 \text{ s};$

$$d = 37.5 \text{ cm};$$

$$v_1 = 1.732 \text{ m/s};$$

$$v_2 = 2.598 \text{ m/s}.$$