

### Answer on Question #80104 Physics / Classical Mechanics

At  $t = 0$ , one toy car is set rolling on a straight track with initial position 14.5 cm, initial velocity -4.5 cm/s, and constant acceleration 3.00 cm/s<sup>2</sup>. At the same moment, another toy car is set rolling on an adjacent track with initial position 11.0 cm, initial velocity 5.70 cm/s, and constant zero acceleration. What are their locations at that time? (If there is only one position, enter NA in the second blank. If there are two positions, enter the smaller position first. If they never pass, enter NA in both blanks.).

#### Solution:

The equations of motion for cars

$$x_1(t) = x_{01} + v_{01}t + \frac{a_1 t^2}{2}$$

$$= 14.5 - 4.5t + 1.5t^2$$

$$x_2(t) = x_{02} + v_{02}t + \frac{a_2 t^2}{2}$$

$$= 11.0 + 5.7t$$

When cars pass each other

$$x_1(t) = x_2(t)$$

So

$$14.5 - 4.5t + 1.5t^2 = 11.0 + 5.7t$$

Or

$$1.5t^2 - 10.2t + 3.5 = 0$$

Roots

$$t_1 = 0.36 \text{ s}$$

$$t_2 = 6.44 \text{ s}$$

First position

$$x(t_1) = 11.0 + 5.7 \times 0.36 = 13.1 \text{ cm}$$

Second position

$$x(t_2) = 11.0 + 5.7 \times 6.44 = 47.7 \text{ cm}$$

**Answers:** 13.1 cm, 47.7 cm