Answer on Question #42915 – Physics - Mechanics | Kinematics | Dynamics

On a foggy day, two drivers spot each other when they are 80m apart. they are travelling at 72km/h and 60km/h. both of them simultaneously apply brakes which retards both the cars at a rate of 5m/s^2. determine whether they avert collision or not?

Solution:

$v_1 = 72\frac{km}{h} = 20\frac{m}{s} - \text{velocity of the first car;}$

$v_2 = 60\frac{km}{h} = 16.7\frac{m}{s} - \text{velocity of the second car;}$

$a = 5\frac{m}{s^2} - \text{deceleration of the cars;}$

$D = 80m - \text{initial distance between two cars.}$

Drivers can avert collision if the sum of the braking distances will be less then 80m. Lets find the distance travelled by both before they come to a halting stop.

Rate equation for the **first car** (final velocity is zero, $t_1 -$ time of breaking):

$$0 = v_1 - at_1$$

$$t_1 = \frac{v_1}{a} \quad (1)$$

Equation of motion for the first car ($S_1 -$braking distance for the first car):

$$S_1 = v_1 t_1 - \frac{at_1^2}{2} = |\text{using } (1)| = v_1\frac{v_1}{a} - \frac{a}{2}\left(\frac{v_1}{a}\right)^2 = \frac{v_1^2}{2a} \quad (2)$$

Rate equation for the **second car** (final velocity is zero, $t_2 -$ time of breaking):

$$0 = v_2 - at_2$$

$$t_2 = \frac{v_2}{a} \quad (3)$$

Equation of motion for the first car ($S_2 -$braking distance for the second car):

$$S_2 = v_2 t_2 - \frac{at_2^2}{2} = |\text{using } (3)| = v_2\frac{v_2}{a} - \frac{a}{2}\left(\frac{v_2}{a}\right)^2 = \frac{v_2^2}{2a} \quad (4)$$

$$S = S_1 + S_2 \quad (5)$$

$$(2)\text{and}(4)\text{in}(5):$$

$$S = \frac{v_1^2}{2a} + \frac{v_2^2}{2a} = \frac{v_1^2 + v_2^2}{2a} = \frac{\left(16.7\frac{m}{s}\right)^2 + \left(20\frac{m}{s}\right)^2}{2 \cdot 5\frac{m}{s^2}} = 67.9\ m$$

$$S < D \Longrightarrow$$

Since they are 80 m apart and sum of both their distance is less than 80 m, they would stop before time. There would no collision.

Answer: drivers will avert the collision.