Answer on Question #43723 – Physics - Mechanics | Kinematics | Dynamics

A bus is moving at 10ms^-1 towards a traffic light.when the driver sees the light changes to red,the bus is ay a distance of 20m.the reaction time of the driver is 0.5s and the deceleration is 4.5ms^-2.how far is the bus when it stops?

Solution:

$V_0 = 10\frac{m}{s} - \text{initial velocity of the bus;}$

$d_0 = 20m - \text{distance to the traffic light;}$

$t_0 = 0.5s - \text{reaction time of the driver;}$

$a = 4.5\frac{m}{s^2} - \text{deceleration of the bus;}$

$d_1 - \text{distance from the bus to initial position;}$

$\Delta d - \text{distance to the traffic light when bus stops;}$

Rate equation for the bus:

$$0 = V_0 - at$$

$$t = \frac{V_0}{a} \quad (1)$$

Equation of motion for the bus:

$$d_1 = V_0 t_0 + V_0 t - \frac{at^2}{2} \quad (2)$$

$(1)\text{in}(2)$:

$$d_1 = V_0 t_0 + V_0 t - \frac{a\left(\frac{V_0}{a}\right)^2}{2} = V_0 t_0 + V_0 \cdot \frac{V_0}{a} - \frac{V_0^2}{2a^2} = V_0 t_0 + \frac{V_0^2}{2a}$$

$$\Delta d = d_0 - d_1 = d_0 - V_0 t_0 - \frac{V_0^2}{2a} = 20m - 10\frac{m}{s} \cdot 0.5s - \frac{\left(10\frac{m}{s}\right)^2}{2 \cdot 4.5\frac{m}{s^2}} = 3.9m$$

Answer: distance to the traffic light when bus stops will be $3.9m$.