Answer on Question #45039 - Physics - Mechanics | Kinematics | Dynamics

A car is traveling on a level highway at a speed of 15m/s. A braking force of 3000 N brings the car to a stop in 10 seconds. The mass of the car is?

A) 1500kg

B) 2000kg

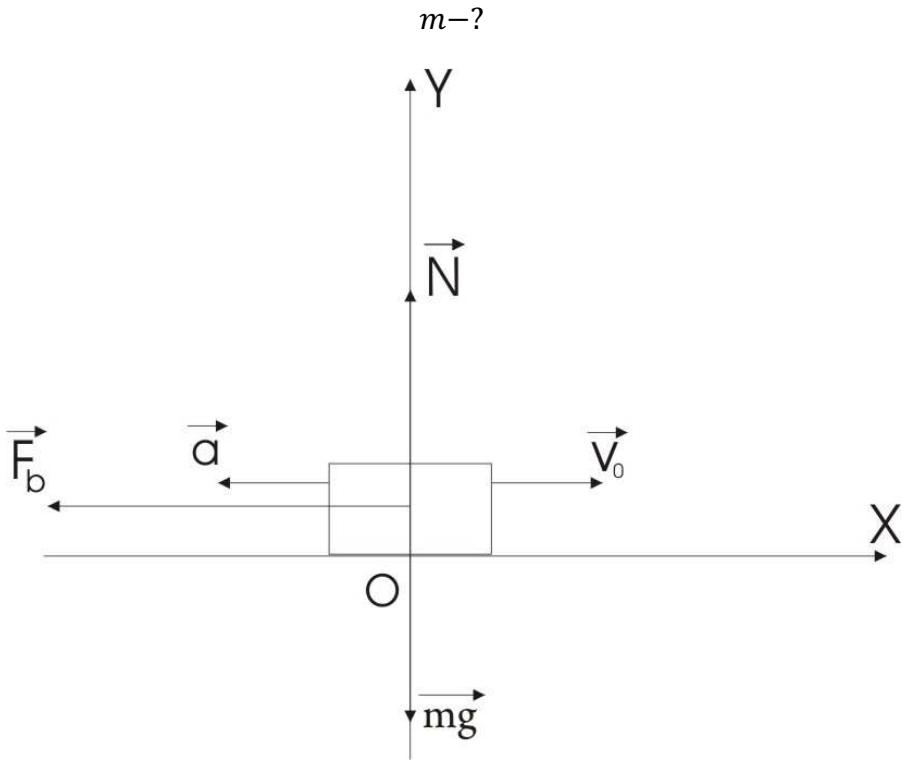
C) 2500kg

D) 3000kg

E) 45,000kg

Solution.

$$\upsilon_0 = 15\frac{m}{s}, F_b = 3000N, t = 10s;$$



F_b – a braking force;

υ_0 – an initial speed of the car;

a – a deceleration of the car;

m – a mass of the car;

mg – a weight of the car;

t – a time to the stop;

N – a normal force of the car;

From the equation for the velocity:

$$\vec{v} = \overrightarrow{v_0} + \vec{a}t;$$

$\vec{v} = 0$, because car stopped.

$$0 = \overrightarrow{v_0} + \vec{a}t;$$

Projection on OX:

$$0 = v_{0x} - a_x t;$$

$$v_{0x} = a_x t;$$

$$v_{0x} = v_0;\ a_x = a;$$

$$v_0 = at; (1)$$

Newton's second law in vector form:

$$m\vec{a} = \overrightarrow{F_b} + \vec{N} + m\vec{g};$$

Projection on OX:

$$-ma_x = -F_{bx} + 0 + 0 = -F_{bx};$$

$N = 0$ and $mg = 0$ – projections on OX are zero.

$$ma_x = F_{bx};$$

$$a_x = \frac{F_{bx}}{m};$$

$$F_{bx} = F_b;\ a_x = a;$$

$$a = \frac{F_b}{m}; (2)$$

From equations (1) and (2) we have:

$$v_0 = \frac{F_b}{m}t;$$

$$m = \frac{F_b}{v_0}t;$$

$$m = \frac{3000N}{15\frac{m}{s}} \cdot 10s = 2000kg.$$

Answer: B) 2000kg.