Answer on Question 81843, Physics, Mechanics, Relativity

Question:

A $1000\ kg$ car strikes a tree at $30\ km/h$ and comes to a stop in $0.15\ s$. Find the initial momentum and average force on the car while it is being stopped?

Solution:

Let's first convert km/h to m/s:

$$v_i = 30\ \frac{km}{h} \cdot \frac{1000\ m}{1\ km} \cdot \frac{1\ h}{3600\ s} = 8.33\ \frac{m}{s}.$$

We can find the initial momentum from the formula:

$$p_i = mv_i = 1000\ kg \cdot 8.33\ \frac{m}{s} = 8330\ kg \cdot \frac{m}{s}.$$

Finally, we can find the average force on the car while it is being stopped from the definition of the impulse:

$$J = m\Delta v = F_{avg}\Delta t,$$

$$m(v_f - v_i) = F_{avg}\Delta t,$$

$$F_{avg} = \frac{m(v_f - v_i)}{\Delta t} = \frac{1000\ kg \cdot \left(0\ \frac{m}{s} - 8.33\ \frac{m}{s}\right)}{0.15\ s} = -55533\ N.$$

The sign minus indicates that the average force on the car is directed opposite to the motion of the car.

Answer:

$p_i = 8330\ kg \cdot \frac{m}{s}$.

$F_{avg} = 55533\ N$, in opposite direction to the motion of the car.