Answer on Question#40638, Physics, Mechanics

Question:

Derive an expression relating impulse and linear movementum.in a safety test a car of mass 1000kg is driven into a brick wall. Its bumper behaves like a spring (k=5×10^6Nm) and is compressed by a distance of 3cm as the car comes to rest. Determine the initial speed of car.

Answer:

Impulse can be defined mathematically, and is denoted by J :

$$J = \int F\, dt$$

We first substitute $F = ma$ into our equation:

$$J = \int ma\, dt = m\Delta v = \Delta p$$

where p is linear momentum.

The law of conservation of energy:

$$\frac{mv^2}{2} + \frac{kx^2}{2} = const$$

where $\frac{mv^2}{2}$ is kinetic energy, $\frac{kx^2}{2}$ – energy of spring deformation, x – spring deformation.

Therefore:

$$\frac{mv^2}{2} + 0 = 0 + \frac{kx^2}{2}$$

$$v = \sqrt{\frac{k}{m}x^2} = 2.12\frac{m}{s}$$

Answer: $2.12\frac{m}{s}$