

ex. A 60 kg person driving a car at 65 mph has a collision that suddenly brings the car to a stop. Calculate the magnitude of the force and acceleration on the person if:

a) the car's airbags failed to deploy and the driver comes to a stop in 20 ms.

b) the car's airbag deployed properly and the driver comes to a stop in 200 ms.

$$\begin{array}{cc} \text{O} \rightarrow \vec{v}_i & \text{O} \rightarrow \vec{v}_f = 0 \\ \text{O} \rightarrow \vec{p}_i = m \vec{v}_i & \text{O} \rightarrow \vec{p}_f = 0 \end{array}$$

$$\vec{F} = \frac{\Delta \vec{p}}{\Delta t} = \frac{\vec{p}_f - \vec{p}_i}{t_f - t_i} = -\frac{\vec{p}_i}{t}$$

$$(1) \quad F = \frac{p_i}{t} = \frac{mv_i}{t}$$

$$a) \quad F = \frac{(60 \text{ kg})(29 \frac{\text{m}}{\text{s}})}{20 \times 10^{-3} \text{ s}}$$

$$F = 87 \times 10^3 \text{ N}$$

$$a = \frac{F}{m} = \frac{87 \times 10^3 \text{ N}}{60 \text{ kg}}$$

$$a = 1450 \frac{\text{m}}{\text{s}^2} = 148g$$

$$b) \quad F = \frac{(60)(29)}{200 \times 10^{-3} \text{ s}} = 8.7 \times 10^3 \text{ N}$$

$$a = \frac{F}{m} = 144 \frac{\text{m}}{\text{s}^2} = 14.8g$$

- The force required to bring an object to a stop in a given time is directly proportional to its momentum.
- It takes a larger force to stop a heavy moving object than it does a lighter moving object moving with the same velocity because its momentum is larger.
- Momentum is a measure of the force required to bring a moving object to a stop.