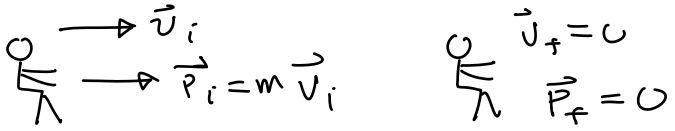
Ex. A 60kg person driving a car at 65mph has a collision that suddenly brings the car to a stop. Calculate the magnitude of the force and acceleration on the person if:

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

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



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

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

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

$$F = 87 \times 10^3 N$$

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

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

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

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

a) The force required to bring an object to a stop in a given time is directly proportional to its momentum.

b) 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.

c) Momentum is a measure of the force required to bring a moving object to a stop.