Answer on Question #63210, Physics / Other

A 75.0 kg ice skater moving at 9.50 m/s crashes into a stationary skater of equal mass. After the collision, the two skaters move as a unit at 4.75 m/s. If the impact time is 0.120 s, what are the magnitudes of the average forces experienced by each skater during the collision?

Force experienced by moving skater

Solution:

Find the momentum of one of the skaters before and after the collision, then find the change in momentum. Recall that the change in momentum is just the impulse, or average force applied during some time interval. If you divide the impulse by the contact time, then we would get the average force experienced by each skater. Remember, due to action and reaction, the force experienced by each skater has equal magnitude but opposite directions.

For each skater, the impulse-momentum theorem gives

$$\bar{F} = \frac{\Delta p}{\Delta t} = \frac{m(\Delta v)}{\Delta t}$$

where

$$\Delta v = v_f - v_i$$

For the first skater:

$$\Delta v = v_f - v_i = 4.75 - 9.50 = -4.75 \frac{m}{s}$$

For the second skater:

$$\Delta v = v_f - v_i = 4.75 - 0 = 4.75 \frac{m}{s}$$

Thus, the average forces experienced by each skater

$$\bar{F} = \frac{(75.0\ kg)(4.75\ m/s)}{0.120\ s} = 2968.75\ N$$

Force experienced by moving skater is $- 2968.75$ N

Force experienced by stationary skater 2968.75 N

Answer: 2968.75 N