Answer on Question 82388, Physics, Other

Question:

A $75\ kg$ ice skater moving at $10.8\ m/s$ crashes into a stationary skater of equal mass. After the collision, the two skaters move as a unit at $5.40\ m/s$. Suppose the average force a skater can experience without breaking a bone is $3038\ N$. If the impact time is $0.120\ s$, does a bone break?

Solution:

Let's use the impulse-momentum theorem, we get:

$$\Delta p = F_{avg}\Delta t,$$

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

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

From this formula we can find the average force acting on a skater:

$$F_{avg} = \frac{m(v_f - v_i)}{\Delta t} = \frac{75\ kg \cdot \left(5.40\ \frac{m}{s} - 10.8\ \frac{m}{s}\right)}{0.120\ s} = -3375\ N.$$

The sign minus indicates that the average force on the skater is directed opposite to the motion of the skater, thus the magnitude of the average force is $3375\ N$. Since, $F_{avg} > 3038\ N$, the bone is break.

Answer:

$F_{avg} > 3038\ N$, the bone is break.