Answer on Question#52865 - Physics - Mechanics - Kinematics - Dynamics

A $m = 4\text{kg}$ ball having velocity $\boldsymbol{v_i} = (7\boldsymbol{i} + 6\boldsymbol{j})\frac{\text{m}}{\text{s}}$ collides and bounces off a wall with a velocity of $\boldsymbol{v_f} = (-3\boldsymbol{i} + 6\boldsymbol{j})\frac{\text{m}}{\text{s}}$. The ball is in contact with the wall for $\Delta t = 0.01\,\text{s}$. In unit-vector notation, what are a) the impulse and b) the average force on the ball from the wall?

Solution:

The change in impulse is given by

$$\Delta\boldsymbol{p} = m(\boldsymbol{v_f} - \boldsymbol{v_i}) = 4\text{kg} \cdot \left(-3\boldsymbol{i} + 6\boldsymbol{j} - (7\boldsymbol{i} + 6\boldsymbol{j})\right)\frac{\text{m}}{\text{s}} = (-40\boldsymbol{i} + 0\boldsymbol{j})\frac{\text{kg} \cdot \text{m}}{\text{s}}$$

The average force on the ball from wall could be found from the following relation

$$\boldsymbol{F_{av}} \cdot \Delta t = \Delta\boldsymbol{p}$$

Therefore,

$$\boldsymbol{F_{av}} = \frac{\Delta\boldsymbol{p}}{\Delta t} = \frac{(-40\boldsymbol{i} + 0\boldsymbol{j})\frac{\text{kg} \cdot \text{m}}{\text{s}}}{0.01\ \text{s}} = (-4\boldsymbol{i} + 0\boldsymbol{j})\ \text{kN}$$

Answer:

a) $(-40\boldsymbol{i} + 0\boldsymbol{j})\frac{\text{kg}\cdot\text{m}}{\text{s}}$

b) $(-4\boldsymbol{i} + 0\boldsymbol{j})\ \text{kN}$