Momentum + Impulse

momentum $\vec{p} = m\vec{v}$

impulse $\vec{J} = \vec{F}\Delta t$

impulse momentum theorem: $\vec{J} = \Delta\vec{p}$ (concept)

$\vec{F}\Delta t = m\Delta\vec{v}$ (more practical)

Problems involving kinematics + dynamics could be solved using $\vec{F}_{net} = m\vec{a}$ or imp-mom. theorem

$$\left(\vec{F}_{net} = \frac{\Delta\vec{p}}{\Delta t}\right)$$

another form of Newton's Second Law

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34. $M = 0.35\,kg$

$\vec{v}_1 = 46\,m/s$ [towards] (+)

$\vec{v}_2 = 62\,m/s$ [away] (−)

$\vec{J} = ?$

$\vec{J} = \Delta\vec{p}$

$\vec{J} = m\Delta\vec{v}$

$\vec{J} = m(\vec{v}_2 - \vec{v}_1)$

$\vec{J} = (0.35\,kg)(-62\,m/s - (+46\,m/s))$

$\vec{J} = -38\,kg\cdot m/s$

$\vec{J} = 38\,kg\cdot m/s$ [away]

(impulse of the bat on the ball)

The impulse of the ball on the bat is $38\,kg\cdot m/s$ [towards the bat]

(Newton's 3rd Law)

Recall Newton's 3rd Law:

$\vec{F}_{A\,on\,B} = -\vec{F}_{B\,on\,A}$ (equal + opp forces)

$\vec{F}_{A\,on\,B}\Delta t = -\vec{F}_{B\,on\,A}\Delta t$ (equal + opp impulses)

$\Delta\vec{p}_B = -\Delta\vec{p}_A$ (equal + opp changes in momenta)