83. (a) The impulse on the ball is

$$\vec{J} = \Delta\vec{p} = m\vec{v} - 0 = (46 \times 10^{-3}\,\text{kg})(50\,\text{m/s})\hat{\text{i}} = (2.3\,\text{N}\cdot\text{s})\hat{\text{i}}$$

where we choose $\hat{\text{i}}$ to be in the direction of the velocity $\vec{v}$ of the ball as it leaves the club (at 30° above horizontal – so it is like the x axis of an inclined plane problem).

(b) The impulse on the club is, by Newton's third law, $\vec{J}' = -\vec{J} = -(2.3\,\text{N}\cdot\text{s})\hat{\text{i}}$. We note that it is directed opposite to the direction of motion.

(c) Using Eq. 10-8, the average force on the ball is

$$\vec{F}_{\text{avg}} = \frac{\vec{J}}{\Delta t} = \frac{(2.3)\hat{\text{i}}}{1.7 \times 10^{-3}} = 1400\,\hat{\text{i}}\ \text{N} .$$

(d) The work done on the ball is

$$W = \Delta K = \frac{1}{2}mv^2 = \frac{1}{2}(46 \times 10^{-3})(50)^2 = 58\ \text{J} .$$