75. We choose $\hat{\mathrm{i}}$ East and $\hat{\mathrm{j}}$ North, and use SI units. The ball initially moving eastward has mass $m_1 = 5.0$ kg and initial velocity $\vec{v}_{1i} = 4.0\,\hat{\mathrm{i}}$ m/s, and the ball initially moving westward has mass $m_2 = 4.0$ kg and velocity $\vec{v}_{2i} = -3.0\,\hat{\mathrm{i}}$ m/s. The final velocity of m_1 is $\vec{v}_{1f} = -1.2\,\hat{\mathrm{j}}$.

(a) Momentum conservation leads to

$$\begin{aligned} m_1\vec{v}_{1i} + m_2\vec{v}_{2i} &= m_1\vec{v}_1 + m_2\vec{v}_2 \\ 20\,\hat{\mathrm{i}} - 12\,\hat{\mathrm{i}} &= -6\,\hat{\mathrm{j}} + 4\vec{v}_2 \end{aligned}$$

which leads to

$$\vec{v}_2 = 2.0\,\hat{\mathrm{i}} + 1.5\,\hat{\mathrm{j}} \implies \vec{v}_2 = (2.5 \angle 37^\circ)$$

where magnitude-angle notation is used. Thus, the speed of the 4.0 kg ball just after the collision is 2.5 m/s.

(b) We compute the decrease in total kinetic energy:

$$K_i - K_f = \frac{1}{2}(5)(4)^2 + \frac{1}{2}(4)(3)^2 - \frac{1}{2}(5)(1.2)^2 - \frac{1}{2}(4)(2.5)^2$$

which gives the result 42 J.