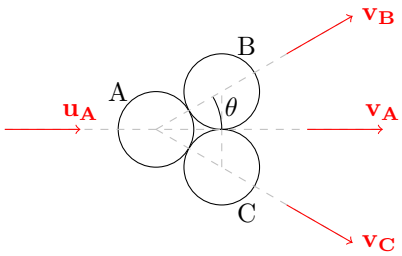
Problem

Two billiard balls are resting on a smooth table, and just touching. A third identical ball moving along the table with velocity v perpendicular to their line of centres strikes both balls simultaneously. Find the velocities of the three balls immediately after impact, assuming the collision is elastic.

Solution

$|\mathbf{u_A}| = v \qquad \theta = 30°$
$|\mathbf{v_A}| = v_1 \qquad |\mathbf{v_B}| = |\mathbf{v_C}| = v_2$



Conservation Laws

$$v^2 = v_1^2 + 2v_2^2 \qquad (1)$$
$$v = v_1 + 2v_2\, cos\theta$$
$$v = v_1 + \sqrt{3}\, v_2 \qquad (2)$$
$$v^2 = (v - \sqrt{3}\, v_2)^2 + 2v_2^2 \quad \text{subs for } v_1 \text{ in (1)}$$
$$v_2 = \frac{2}{5} v\sqrt{3}$$
$$v_1 = -\frac{v}{5} \qquad \text{subs for } v_2 \text{ in (2)}$$

In vector format

$$\mathbf{v_A} = \begin{pmatrix} -1 \\ 0 \end{pmatrix} v/5$$
$$\mathbf{v_B} = \begin{pmatrix} v_2\, cos\theta \\ v_2\, sin\theta \end{pmatrix} = \begin{pmatrix} 3 \\ \sqrt{3} \end{pmatrix} v/5$$
$$\mathbf{v_C} = \begin{pmatrix} v_2\, cos\theta \\ -v_2\, sin\theta \end{pmatrix} = \begin{pmatrix} 3 \\ -\sqrt{3} \end{pmatrix} v/5$$