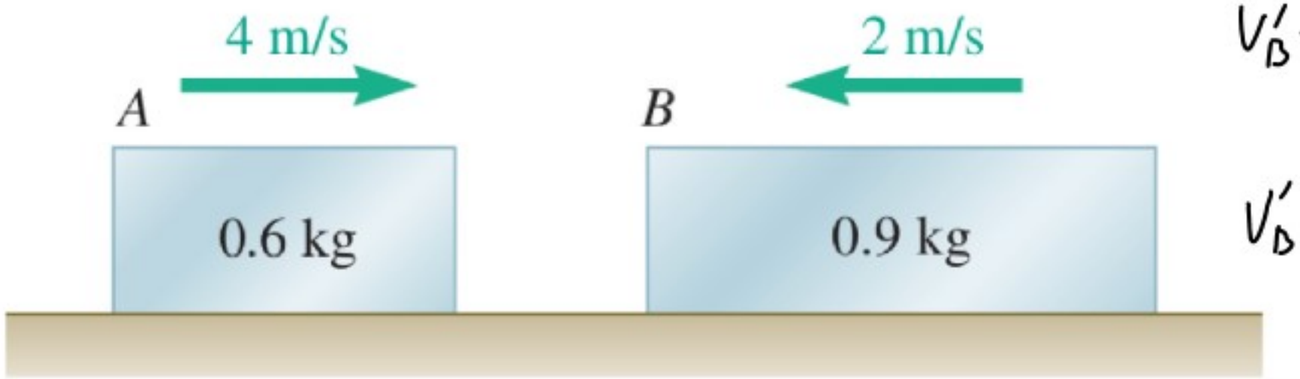
Two steel blocks slide without friction on a horizontal surface; immediately before impact their velocities are as shown. Knowing that $e = 0.75$, determine (a) their velocities after impact, (b) the energy loss during impact.



$m_A v_A + m_B v_B = m_A v_A' + m_B v_B'$

$0.6(4) + 0.9(-2) = 0.6 v_A' + 0.9 v_B'$

$0.6 = 0.6 v_A' + 0.9 v_B'$

$0.6 = 0.6 v_A' + 0.9(4.5 + v_A')$

$0.6 = 0.6 v_A' + 4.05 + 0.9 v_A'$

$-3.45 = (0.6 + 0.9) v_A' = 1.5 v_A'$

$v_A' = \frac{-3.45}{1.5} = -2.3 \text{ m/s}$

$v_B' - v_A' = e(v_A - v_B)$

$= 0.75(4 - (-2))$

$v_B' - v_A' = 4.5$

$v_B' = 4.5 + v_A'$

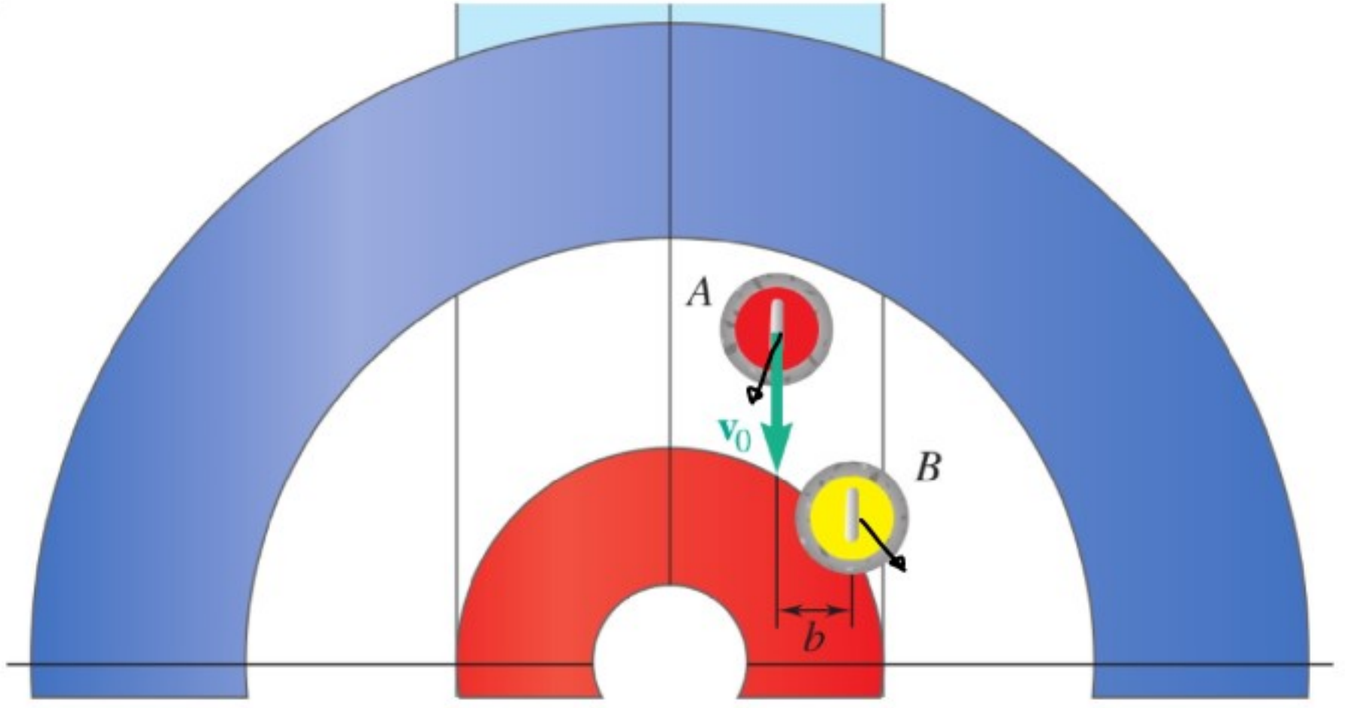
$= 4.5 + (-2.3)$

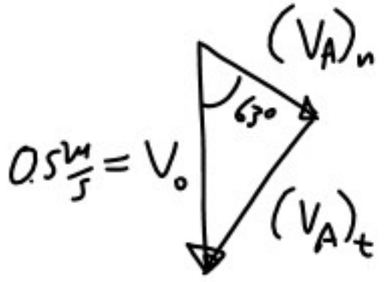
$= 2.2 \text{ m/s}$

Two identical 40-lb curling stones have diameters of 11 in. and may move freely on a sheet of ice. Stone B is at rest when stone A strikes it with a speed of 0.5 m/s. (a) Knowing that $b = 5$ in and $e = 0.7$, determine the velocity of each stone after impact in terms of $\mathbf{v}_0$. (b) Show that if $e = 1$, the final velocities of the stones form a right angle for all values of b.

$\cos\theta = \frac{5}{11}$

$\theta = 63°$





$$(V_A)_n = V_0 \cos 63 = 0.5 \cos 63 = 0.23 \text{ m/s}$$

$$(V_A)_t = V_0 \sin 63 = 0.45 \text{ m/s}$$

$$m_A(V_A)_n + m_B(V_B)_n = m_A(V_A')_n + m_B(V_B')_n$$

($(V_B)_n \to 0$)

$$0.23 = (V_A')_n + (V_B')_n$$

$$(V_B')_n - (V_A')_n = e\left((V_A)_n - (V_B)_n\right)$$

($(V_B)_n \to 0$)

$$= 0.7 \cdot 0.23 = 0.16$$

$$(V_B')_n = 0.16 + (V_A')_n$$

$$0.23 = (V_A')_n + 0.16 + (V_A')_n$$

$$0.071 = 2(V_A')_n$$

$$0.036 \text{ m/s} = (V_A')_n$$

$$= 0.16 + 0.036$$

$$= 0.2 \text{ m/s}$$

$$\vec{V}_A' = (\vec{V}_A')_n + (\vec{V}_A')_t$$

$$= (\vec{V}_A')_n + (\vec{V}_A)_t$$

$$(\vec{V}_A')_n = (V_A')_n \sin 63\, i - (V_A')_n \cos 63\, j$$

$$\approx 0.032\, i - 0.016\, j$$

$$(\vec{V}_A)_t = -(V_A)_t \cos 63\, i - (V_A)_t \sin 63\, j$$

$$= -0.2\, i - 0.4\, j$$

$$= (0.032 - 0.2)\, i + (-0.016 - 0.4)\, j$$

$$= -0.17\, i - 0.42\, j \text{ m/s}$$

Two identical billiard balls can move freely on a horizontal table. Ball A has a velocity $\mathbf{v}_0$ as shown and hits ball B, which is at rest, at a point C defined by $\theta = 45°$. Knowing that the coefficient of restitution between the two balls is $e = 0.8$ and assuming no friction, determine the velocity of each ball after impact.