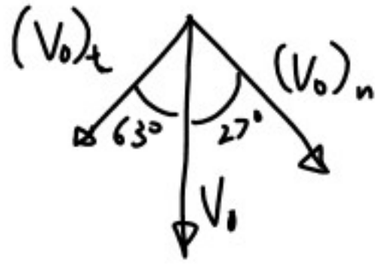
Two identical 40-lb curling stones have diameters of 11 in. and may move freely on a sheet of ice. Stone B is at rest when stone A strikes it with a speed of 0.5 m/s. (*a*) Knowing that $b = 5$ in and $e = 0.7$, determine the velocity of each stone after impact in terms of $\mathbf{v}_0$. (*b*) Show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

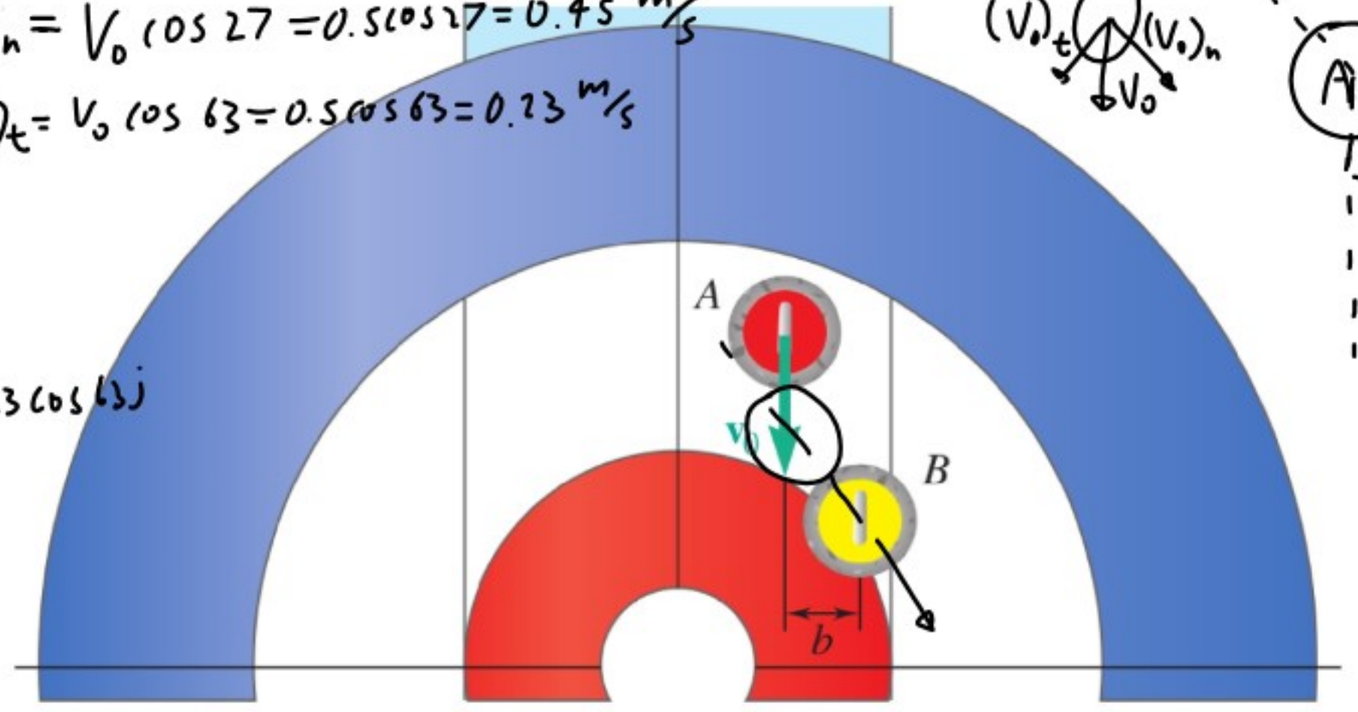
$(V_0)_n = V_0 \cos 27 = 0.5 \cos 27 = 0.45$ m/s

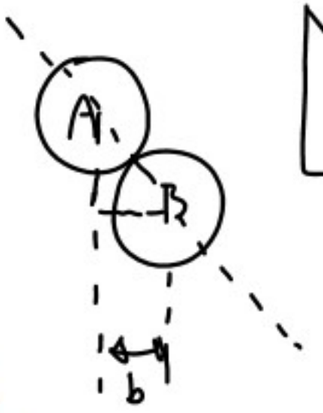
$(V_0)_t = V_0 \cos 63 = 0.5 \cos 63 = 0.23$ m/s



$(\vec{V}_0)_t = -0.23 \sin 63\, i - 0.23 \cos 63\, j$

$= -0.2\, i - 0.1\, j$





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

$\theta = 63°$

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

$v_A + v_B = v_A' + v_B'$

$0.45 = v_A' + v_B' \implies 0.45 = v_A' + 0.31 + v_A'$

$v_B = 0$

$v_A = 0.45\ m/s$

$0.45 - 0.31 = 2v_A'$

$\frac{0.45 - 0.31}{2} = v_A' = 0.069\ m/s$

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

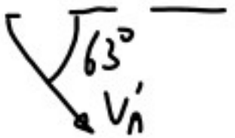
$v_B' - v_A' = 0.7(0.45 - 0)$

$v_B' - v_A' = 0.31\ m/s$

$v_B' = 0.31 + v_A'$

$= 0.31 + 0.069$

$v_B' = 0.38\ m/s$



$\vec{v}_A' = 0.069\cos 63\, i - 0.069 \sin 63 j$

$\vec{v}_A' = 0.031\, i - 0.061 j\ m/s$

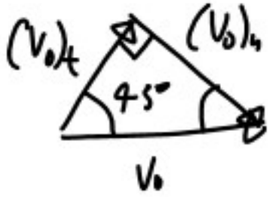
$\vec{v}_B' = 0.38\cos 63\, i - 0.38 \sin 63 j$

$\vec{v}_B' = 0.17\, i - 0.34 j\ m/s$

$\vec{v}_A' + (\vec{v}_0)_t = (0.031 - 0.2) i + (-0.061 - 0.1) j$

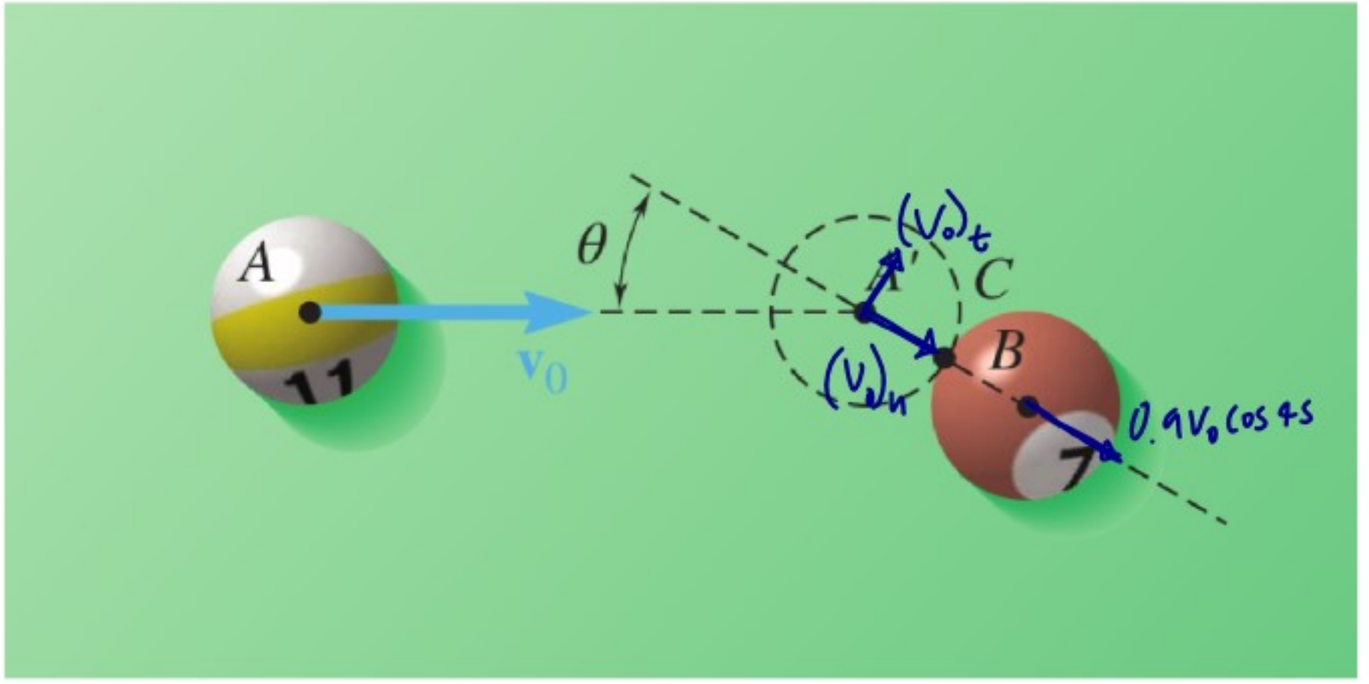
$= -0.169\, i - 0.161 j\ m/s$

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.



$(V_0)_t = V_0 \cos 45°$

$(V_0)_n = V_0 \cos 45°$



$$m_A V_A + m_B V_B = m_A V_A' + m_B V_B'$$

$$V_A + V_B = V_A' + V_B'$$

$$V_0 \cos 45 = V_A' + V_B'$$

$$V_A = (V_0)_n = V_0 \cos 45°$$

$$V_B = 0$$

$$V_B' - V_A' = e(V_A - V_B)$$

$$V_B' - V_A' = 0.8(V_0 \cos 45)$$

$$V_B' = 0.8 V_0 \cos 45 + V_A'$$

$$V_0 \cos 45 = V_A' + 0.8 V_0 \cos 45 + V_A'$$

$$V_0 \cos 45 - 0.8 V_0 \cos 45 = 2V_A'$$

$$0.2 V_0 \cos 45 = 2V_A'$$

$$\frac{0.2 V_0 \cos 45}{2} = V_A' = 0.1 V_0 \cos 45$$

$$(V_0)_n' = V_A' = 0.1 V_0 \cos 45$$

$$V_B' = 0.8 V_0 \cos 45 + 0.1 V_0 \cos 45$$

$$= 0.9 V_0 \cos 45$$