Explosions and Conservation of Momentum in Two Dimensions

17/04/24 11:43 am

23. A 4.00-kg model rocket is launched, expelling burned fuel with a mass of 50.0 g at a speed of 625 m/s. What is the velocity of the rocket after the fuel has burned? *Hint: Ignore the external forces of gravity and air resistance.*

$1g = 10^{-3} Kg$

zero

$\vec{P}_0 = \vec{P}$

$m_1 V_{10} + m_2 V_{20} = m_1 V_1 + m_2 V_2$

$0 = 4 \times V_1 + \underbrace{50 \times 10^{-3} \times 625}$

$0 = 4V_1 + 31.25$

(-)

%

$-31.25 = 4 \cdot V_1$

$\frac{-31.25}{4} = V_1 = -7.81 \frac{m}{s}$

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Example 3: A 1.20 kg red ball moving to the right at 17.1m/s strikes a stationary 2.31 kg blue ball. If the final velocity of the red ball is 13.5m/s at 23.0° above the horizontal, **determine** the final velocity of the blue ball.

Ex3. Given

A sketch is always a good idea, even if you're not asked for one...

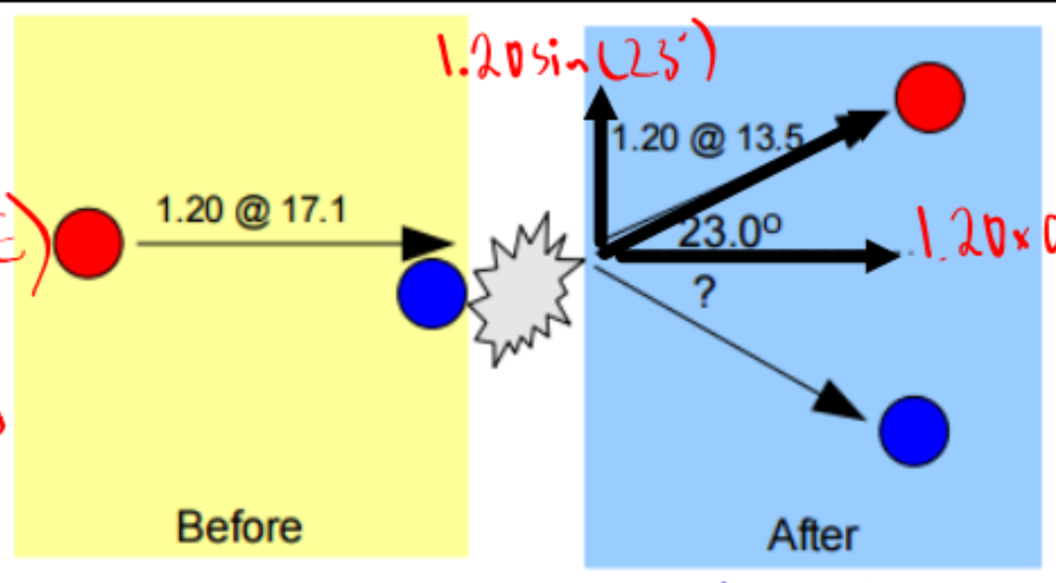
$m_1 = 1.20$ kg

$V_{10x} = 17.1 \frac{m}{s} (E)$

$m_2 = 2.31$ Kg

$V_{20} = 0$

$V_1 = 13.5 \frac{m}{s}$ at $\theta = 23°$ N of E



$1.20 \sin(25°)$

$1.20 \times \cos(25°)$

$\vec{P}_0 = \vec{P}$

$\begin{cases} \vec{P}_{0x} = \vec{P}_x \\ \vec{P}_{0y} = \vec{P}_y \end{cases}$

zero

$\vec{P}_{0x} = \vec{P}$

$m_1 V_{10x} + m_2 V_{20x} = m_1 V_{1x} + m_2 V_{2x}$

$20.52 = 1.20 \times 13.5 \cos(25°) + 2.31 V_{2x}$

$20.52 = 14.9 + 2.31 V_{2x}$

(-) and (%)

$\frac{20.52 - 14.9}{2.31} = V_{2x} = 2.43 \frac{m}{s}$ (East)

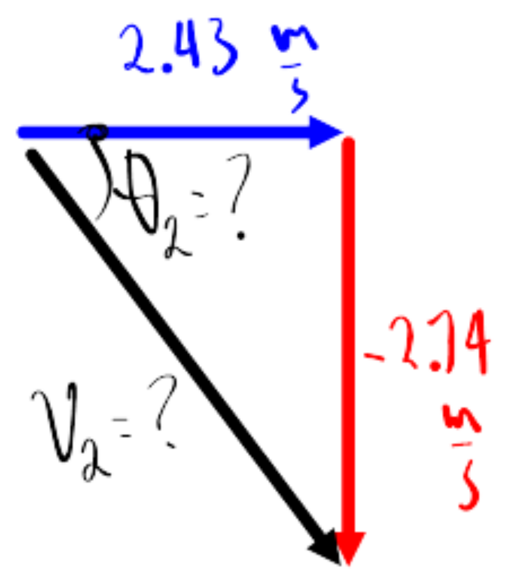
only moving horizontally

zero

$P_{0y} = P_y$

$m_1 V_{10y} + m_2 V_{20y} = m_1 V_{1y} + m_2 V_{2y}$

$0 = 1.2 \times 13.5 \times \sin(23°) + 2.31 \cdot V_{2y}$



$0 = 6.33 + 2.31 \cdot V_{2y}$

$\frac{-6.33}{2.31} = V_{2y} = -2.74 \frac{m}{s}$ (South)

$V_2^2 = V_{2x}^2 + V_{2y}^2$

$V_2 = \sqrt{2.43^2 + 2.74^2} = 3.66 \frac{m}{s}$

$\tan\theta = \frac{V_y}{V_x}$

$\theta_2 = \tan^{-1}\left(\frac{V_y}{V_x}\right) = \tan^{-1}\left(\frac{-2.74}{2.43}\right) = -48.4°$ S of E