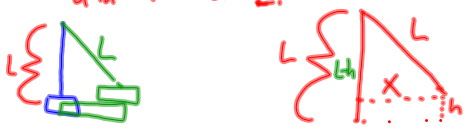
Purpose: To calculate the velocity of the dart using con. of mom. and con. of E.



Data $m_b \cdot V_b + m_d \cdot V_d = m_b \cdot v' + m_d \cdot v'$

$$\frac{\cancel{m_b V_b} + m_d \cdot V_d}{m_d} = \frac{v'(m_b + m_d)}{m_d}$$

$$V_d = \frac{v'(m_b + m_d)}{m_d}$$

$$P.E. = K.E.$$

$$mgh = \frac{1}{2}mv^2$$

$$v = \sqrt{2gh}$$

step 3 $a^2 + b^2 = c^2$

$$(L-h)^2 + x^2 = L^2$$

$$(L^2 - 2Lh + h^2) + x^2 = L^2$$

$$-L^2 \qquad -L^2$$

$$h^2 - 2hL + x^2 = 0$$

$$h = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$a = 1$
$b = -2L$
$c = x^2$

$$\frac{2L \pm \sqrt{(-2L)^2 - 4(1)(x^2)}}{2}$$

$$\frac{2L \pm \sqrt{4L^2 - 4x^2}}{2}$$

$$\frac{2L \pm \sqrt{4(L^2 - x^2)}}{2} \rightarrow \frac{2L \pm 2\sqrt{L^2 - x^2}}{2}$$

$$L - \sqrt{L^2 - x^2} = h$$

$L = 0.772\,m$

$m_b = 104\,g$

$m_d = 2\,g$

$x_i = 2.00\,m$

$x_f = 0.245\,m$

$$h = 0.772\,m - \sqrt{(0.772\,m)^2 - (0.245\,m)^2}$$

$$h = 0.00585\,m$$

$$h = 1.3 \times 10^{-4}\,m$$

$$v = \sqrt{2gh} = \sqrt{2(9.80\,m/s^2)(1.3 \times 10^{-5}\,m)}$$

$$v = 0.16\,m/s$$