In the figure below, a 5.00-kg stationary block explodes into two pieces $L$ and $R$ that slide across a frictionless floor and then into regions with friction, where they stop. Piece $L$ encounters a coefficient of kinetic friction $\mu_L = 0.500$ and slides to a stop in distance $d_L = 2.00$ m. Piece $R$ encounters a coefficient of kinetic friction $\mu_R = 0.400$ and slides to a stop in distance $d_R = 4.00$ m.

a) What is the velocity of the center of mass of the system after the explosion?

The velocity of the center of mass does not change before and after the explosion. Before the explosion, the velocity of com is zero. Therefore, it is zero after the explosion.

b) What are the masses of the two pieces?

The two pieces slow down and eventually stop due to friction. The work-energy theorem yields the velocity of the two pieces just after the explosion:

$0 - \frac{1}{2}m_Lv_L^2 = -\mu_Lm_Lgd_L \Rightarrow v_L = -\sqrt{2\mu Lgd_L} = -4.43$ m/s

$0 - \frac{1}{2}m_Rv_R^2 = -\mu_Rm_Rgd_R \Rightarrow v_R = +\sqrt{2\mu Rgd_R} = 5.60$ m/s

Note that we choose our +x direction to the right. Piece $L$ moves to the left after the explosion, thus we need to take the negative root for $v_L$. Piece $R$ moves to the right so $v_R$ is positive. Since the total momentum is conserved (or equivalently, the motion of com is conserved), we apply the momentum conservation equation to find the ratio of the two masses.

$0 = m_Lv_L + m_Rv_R \Rightarrow m_L/m_R = -v_R/v_L = 1.264$

Since the total mass is 5 kg, the masses of the two pieces are

$5 = m_L + m_R = 1.264m_R + m_R = 2.264m_R \Rightarrow m_R = 2.21$ kg

$m_L = 5 - m_R = 2.79$ kg.