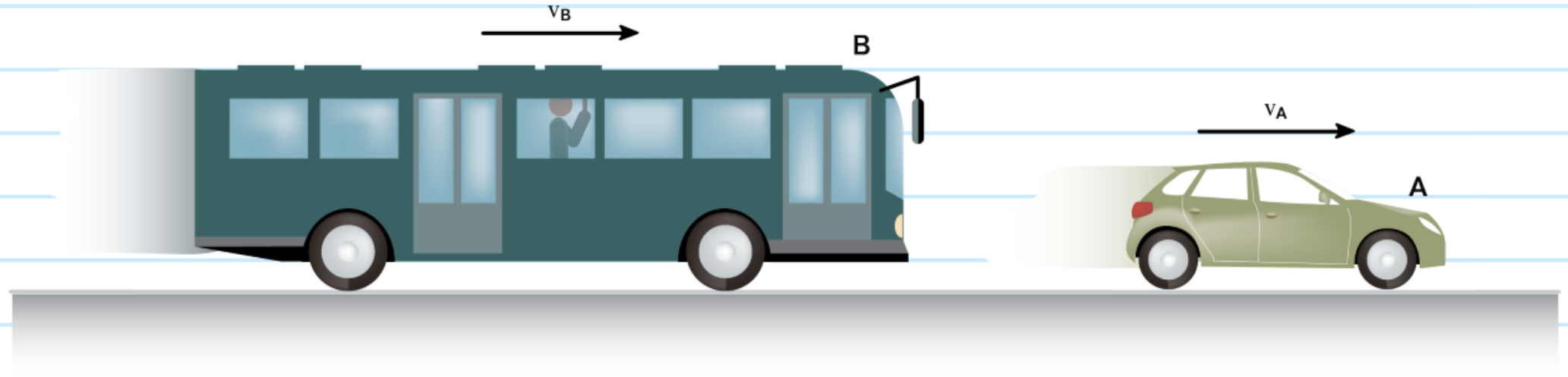


21-P-MOM-GD-008



A m_B kg bus (B) and a m_A kg car (A) are moving to the right at v_B m/s and v_A m/s respectively. After the two vehicles collide, A moves to the right at v_{AB} m/s relative to B. What is the coefficient of restitution between the vehicles and how much energy was lost during the collision?

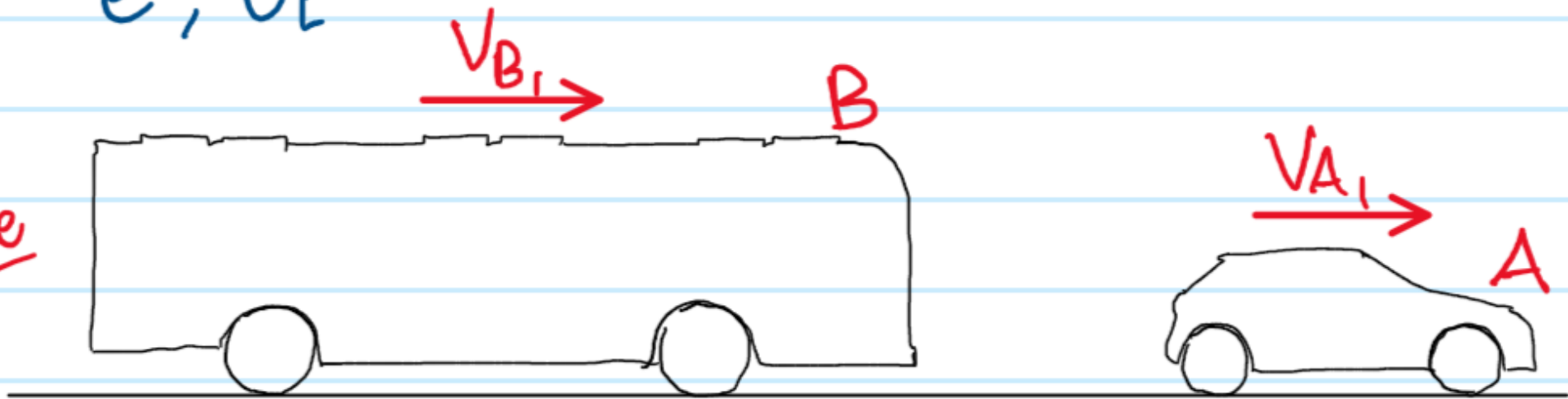
given

$m_B, V_{B1}, m_A, V_{A1}, V_{AB}$

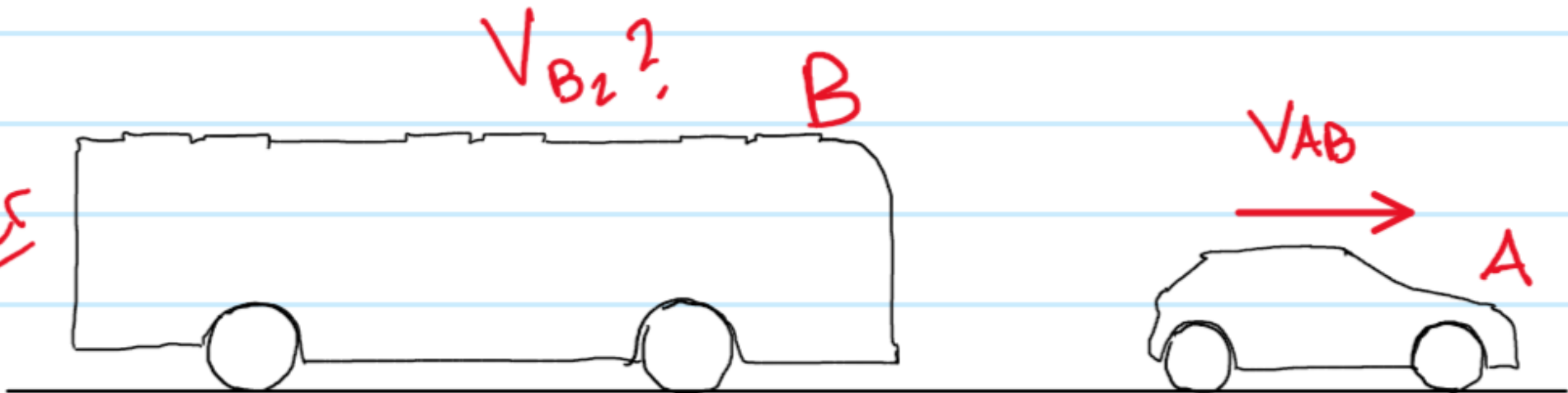
find

e, U_L

Before



After



Conservation of Momentum

$$m_A v_{A1} + m_B v_{B1} = m_A v_{A2} + m_B v_{B2}$$

? ?

$$\textcircled{1} \quad v_{A2} = \frac{m_A v_{A1} + m_B v_{B1} - m_B v_{B2}}{m_A}$$

$$\textcircled{2} \quad v_{A2} = v_{AB} + v_{B2}$$

? ?

2 eqns 2 unknowns

$$\textcircled{1} \rightarrow \textcircled{2} \quad \frac{m_A v_{A1} + m_B v_{B1} - m_B v_{B2}}{m_A} = v_{AB} + v_{B2}$$

$$m_A v_{A1} + m_B v_{B1} - m_B v_{B2} = m_A v_{AB} + m_A v_{B2}$$

$$v_{B2} = \frac{m_A v_{A1} + m_B v_{B1} - m_A v_{AB}}{m_A + m_B}$$

Find v_{A2}

$$v_{A2} = v_{AB} + v_{B2}$$

Coefficient of Restitution

$$e = \frac{V_{B2} - V_{A2}}{V_{A1} - V_{B1}}$$

Energy Lost

before :

$$\frac{1}{2} m_A V_{A1}^2 + \frac{1}{2} m_B V_{B1}^2 = U_1$$

after :

$$\frac{1}{2} m_A V_{A2}^2 + \frac{1}{2} m_B V_{B2}^2 = U_2$$

$$\underline{U_L = U_1 - U_2}$$