STAEDTLER® No. 937 811E Engineer's Computation Pad

•••58 In Fig. 9-64, block 2 (mass 1.0 kg) is at rest on a frictionless surface and touching the end of an unstretched spring of spring constant 200 N/m. The other end of the spring is fixed to a wall. Block 1 (mass 2.0 kg), traveling at speed $v_1 = 4.0$ m/s, collides with block 2, and the two blocks stick together. When the blocks momentarily stop, by what distance is the spring compressed?



FIG. 9-64 Problem 58.

THE FACT THAT THE TWO BLOCKS STICK TOGETHER ⇒ TOTALLY INELASTIC COLLISION IN WHICH KINETIC ENERGY IS NOT CONSERVED

THERE FOR WE CAN NOT APPLY MECHANICAL ENERGY CONSERVATION WITH THE TOTAL ENERGY BEING EQUAL TO THE INITIAL KINETIC OF BLOCK #1

MOMENTUM CONSERVATION @ MOMENT OF COLLISION — BEFORE THE EATERNAL SPRING FORCE HAS TIME TO CHANGE THE TOTAL MOMENTUM.

$$\vec{P}^{\text{total}}_{\text{INITIAL}} = \vec{P}^{\text{total}}_{\text{FINAL}} \;:\; m_1 \vec{v}_{1i} = (m_1+m_2)\vec{v}_{f \text{ of combo}}$$

$$\Rightarrow v_f = \frac{m_1}{m_1+m_2} v_{1i}$$

NOW APPLY CONSERVATION OF MECHANKAL ENERGY

$$\Delta(E^{\text{tot}}_{\text{mec}}) = \Delta(K^{\text{tot}} + U^{\text{tot}}_{\text{spring}}) = 0 \Rightarrow E^{\text{tot}}_i = E^{\text{tot}}_f$$

$$\Rightarrow K^{\text{tot}}_i + U^{\text{spring}}_i = K^{\text{tot}}_f + U^{\text{spring}}_f$$

$$\frac{1}{2}(m_1+m_2)v_f^2 + 0 = 0 + \frac{1}{2}kx_f^2$$

$$x_f^2 = \frac{m_1+m_2}{k}\left(v_f = \frac{m_1}{m_1+m_2} v_{1i}\right)^2$$

$$= \frac{m_1^2}{k(m_1+m_2)} v_{1i}^2 = \frac{2^2}{200(1+2)} 4^2$$

$$= \frac{2^5}{3(100)} = \frac{2^3}{3(5^2)}$$

$$x_f = \frac{2}{5}\sqrt{\frac{2}{3}} = 0.327\ \text{m}$$