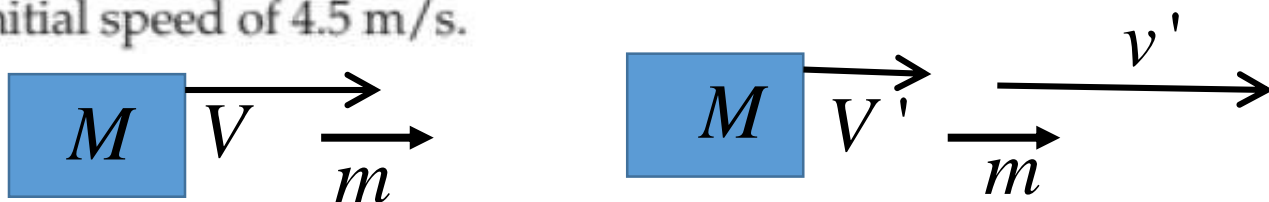


- The collision between a hammer and a nail can be considered to be approximately elastic. Calculate the kinetic energy acquired by a 12-g nail when it is struck by a 550-g hammer moving with an initial speed of 4.5 m/s.



## Momentum Conservation

$$MV = mv' + MV' \quad \Rightarrow \quad V' = \frac{MV - mv'}{M}$$

## Elastic= Energy Conservation

$$\frac{M}{2}V^2 = \frac{m}{2}v'^2 + \frac{M}{2}V'^2$$

$$\frac{M}{2}V^2 = \frac{m}{2}v'^2 + \frac{M}{2}\left[\frac{MV - mv'}{M}\right]^2$$

$$\frac{M}{2}V^2 = \frac{m}{2}v'^2 + \frac{M}{2M^2}[MV - mv']^2$$

$$\frac{M}{2}V^2 = \frac{m}{2}v'^2 + \frac{[MV - mv']^2}{2M}$$

$$\frac{M}{2}V^2 = \frac{m}{2}v'^2 + \frac{[M^2V^2 - 2MVmv' + mv'^2]}{2M}$$

$$\frac{M}{2}V^2 = \frac{m}{2}v'^2 + \frac{MV^2}{2} - Vmv' + \frac{m^2v'^2}{2M}$$

$$0 = \frac{m}{2} v'^2 - Vmv' + \frac{m^2 v'^2}{2M}$$

$$0 = \left[ \frac{m}{2} + \frac{m^2}{2M} \right] v'^2 - Vmv'$$

$$0 = \left[ \frac{m}{2} + \frac{m^2}{2M} \right] v' - Vm$$

$$v' = \frac{Vm}{\left[ \frac{m}{2} + \frac{m^2}{2M} \right]}$$

$$v' = \frac{2V}{\left[ 1 + \frac{m}{M} \right]}$$

$$\frac{m}{2} v'^2 = \frac{m}{2} \left[ \frac{2V}{\left[ 1 + \frac{m}{M} \right]} \right]^2$$

$$\frac{m}{2} v'^2 = m \left[ \frac{2V^2}{\left[ 1 + \frac{m}{M} \right]^2} \right]$$

$$\frac{m}{2} v'^2 = .012 \left[ \frac{2(4.5)^2}{\left[ 1 + \frac{.012}{.55} \right]^2} \right] = .012 \left[ \frac{40.5}{1.044} \right] = .4655 \text{ J}$$