Elastic Collision – Collision where total momentum and total kinetic energy are Conserved.

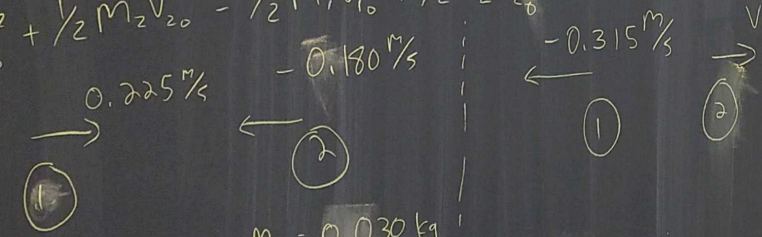
$p_o = p_f$

$m_1 v_{1_o} + m_2 v_{2_o} = m_1 v_{1_f} + m_2 v_{2_f}$

$KE_o = KE_f$

$\frac{1}{2} m_1 v_{1_o}^2 + \frac{1}{2} m_2 v_{2_o}^2 = \frac{1}{2} m_1 v_{1_o}^2 + \frac{1}{2} m_2 v_{2_o}^2$

ex)



$m_1 = 0.015$ kg

$m_2 = 0.030$ kg

What is the final velocity of the 2nd marble?

$p_o = p_f$

$m_1 v_{1_o} + m_2 v_{2_o} = m_1 v_{1_f} + m_2 v_{2_f}$

$(0.015\text{kg})(0.225\text{m/s}) + (0.030\text{kg})(-0.180\text{m/s}) = (0.015\text{kg})(-0.315\text{m/s}) + (0.030\text{kg})(v_{f_2})$

$0.003375\ \text{kg m/s} + (-0.0054\ \text{kg m/s}) = (-0.004725\ \text{kg m/s}) + (0.030\text{kg})(v_{f_2})$

$0.0027\ \text{kg m/s} = (0.030\text{kg})(v_{f_2})$

$v_{f_2} = \frac{0.0027\ \text{kg m/s}}{0.030\text{kg}} = \boxed{0.09\ \text{m/s to the right}}$

b) Confirm that this is an elastic collision.

KE is conserved

$KE_o = KE_f$

$KE_o = \frac{1}{2} m_1 v_{1o}^2 + \frac{1}{2} m_2 v_{2o}^2$

$KE_o = \frac{1}{2}(0.015\,kg)(0.225\,m/s)^2 + \frac{1}{2}(0.030\,kg)(-0.180\,m/s)^2$

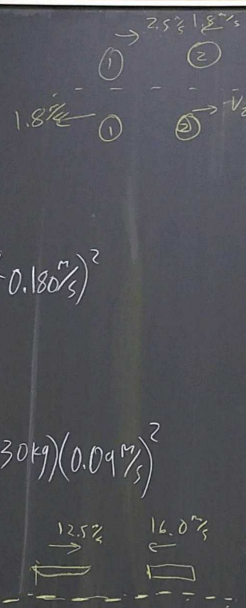
$KE_o = 8.7 \times 10^{-4}\,J$

$KE_f = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$

$KE_f = \frac{1}{2}(0.015\,kg)(-0.315\,m/s)^2 + \frac{1}{2}(0.030\,kg)(0.09\,m/s)^2$

$KE_f = 8.7 \times 10^{-4}\,J$

$KE_o = KE_f$ so it is an elastic collision



Classwork

1. A 1.0 kg pool ball moving to the right at 2.5 m/s collides with another 1.0 kg ball moving to the left at 1.8 m/s. After the collision, the first ball moves to the left at 1.8 m/s.
   a) What is the final velocity of 2nd ball?
   b) Verify that the collision is elastic. $KE_o = KE_f$

2. A 16.0 kg canoe moving to the right at 12.5 m/s makes an elastic head on collision with a 14.0 kg raft moving to the left at 16.0 m/s. After the collision, the raft moves to the right at 14.4 m/s
   a) Find velocity of canoe after the collision
   b) Compare KE_o to KE_f to verify that the collision is elastic.