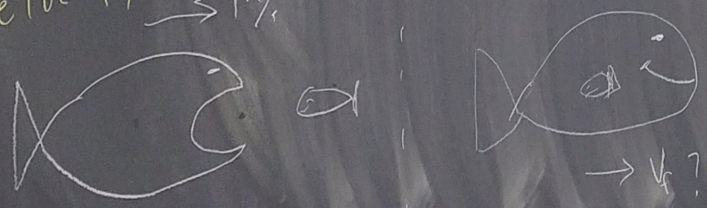
More Inelastic Collisions

Fish eats another fish

A 6 kg fish swims at 1 m/s and shallows a 2 kg fish that is at rest. What is the velocity immediately after lunch?



$p_0 = p_f$ Perfectly inelastic collision

$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v_f$

$(6\text{ kg})(1\text{ m/s}) + (2\text{ kg})(0\text{ m/s}) = (6\text{ kg} + 2\text{ kg}) v_f$

$6\text{ kg m/s} + 0\text{ kg m/s} = (8\text{ kg}) v_f$

$v_f = \frac{6\text{ kg m/s}}{8\text{ kg}} = \boxed{0.75\text{ m/s to the right}}$

b) How much kinetic energy is lost?

$KE_0 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$

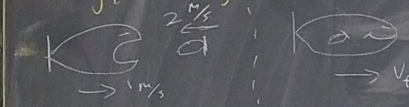
$KE_0 = \frac{1}{2}(6\text{kg})(1\text{m/s})^2 + \frac{1}{2}(2\text{kg})(0\text{m/s})^2$

$KE_0 = 3\text{ J} + 0\text{ J} = 3\text{ J}$

$KE_f = \frac{1}{2} m v_f^2 = \frac{1}{2}(8\text{kg})(0.75\text{m/s})^2 = 2.25\text{ J}$

$\Delta KE = -0.75\text{ J}$

Now small fish has initial velocity of 2 m/s towards the big fish. What is the final velocity now? How does the kinetic energy change?



$p_0 = p_f$

$m_1V_1 + m_2V_2 = (m_1 + m_2)V_f$

$(6\text{kg})(1\text{ m/s}) + (2\text{kg})(-2\text{ m/s}) = (6\text{kg} + 2\text{kg})V_f$

$6\text{ kg m/s} + (-4\text{ kg m/s}) = (8\text{kg})V_f$

$2\text{ kg m/s} = (8\text{kg})V_f$

$V_f = \frac{2\text{ kg m/s}}{8\text{ kg}} =$ **0.25 m/s to the right**

$KE_0 = \frac{1}{2}m_1V_1^2 + \frac{1}{2}m_2V_2^2 = \frac{1}{2}(6\text{kg})(1\text{ m/s})^2 + \frac{1}{2}(2\text{kg})(-2\text{ m/s})^2$

$KE_0 = 7\text{J}$ $KE_f = \frac{1}{2}mV_f^2 = \frac{1}{2}(8\text{ kg})(0.25\text{ m/s})^2$

$KE_f = 0.25\text{J}$ $\Delta KE = -6.75\text{J}$

Classwork

1. A 0.25 kg arrow with a velocity of 12 m/s west collides and sticks to a 6.8 kg target that is at rest.
   a) What is the final velocity of the combined mass?
   b) What is the decrease in kinetic energy during the collision.
2. A student kicks a 0.40 kg soccer ball with a velocity of 8.5 m/s south into a 0.15 kg bucket laying on its side. The bucket travels with the ball after the collision.
   a) What is the final velocity of the combined mass?
   b) What is the decrease in kinetic energy during the collision?
3. A 56 kg ice skater traveling 4.0 m/s north meets and joins hands with a 65 kg skater traveling at 12.0 m/s in the opposite direction. The two skaters continue skating together with joined hands.
   a) What is the final velocity of the two skaters?
   b) What is the decrease in kinetic energy during the collision?