Honors Physics– Impulse, Momentum, and Collisions
Class Examples

Conservation of Momentum

Conceptual Example:
Two students (m_1 = m and m_2 = 2m) are in rolling chairs. Beginning from rest, they push off away from each other. Student 1 moves to the right with a positive velocity.

A. What was the initial momentum of the two students?
B. What can we infer about the velocity of student 2 after they push off of each other?

Before

$m_2 v_{2o} + m_1 v_{1o} = m_2 v_{2f} + m_1 v_{1f}$

$(2m)(0) + (m)(0) = (2m) v_{2f} + (m) v_{1f}$

$0 + 0 =$

* Negative velocity
* Less than student one (only half in fact)

$v_{2f} = ?$

There are a couple things we can assume.

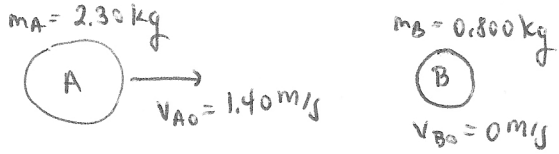
① Since the momentum must add up to zero, if the first student moves forward with a positive velocity, Student 2 must have a negative.

② Because the mass of student 2 is twice that of student one, their student will have less velocity, only half of student one's in fact

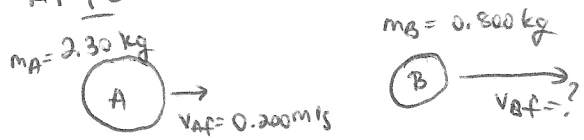
Example 3:
You have a system with two objects, Object A (mass = 2.30 kg) and Object B (mass = 0.800 kg). Initially, Object A has an initial velocity of 1.40 m/s to the right. Object B is stationary. The two collide. After the collision, Object A is still moving to the right, but only with a velocity of 0.200 m/s. Object B also is moving to the right with an unknown velocity. What is the velocity of Object B after the collision?

*Draw a sketch for Object A and B before and after the collision.

BEFORE



AFTER



$m_A v_{Ao} + m_B v_{Bo} = m_A v_{Af} + m_B v_{Bf}$

$(2.30)(1.40) + (0.800)(0) = (2.30)(0.200) + (0.800) v_{Bf}$

$3.22 + 0 = 0.46 + 0.800\, v_{Bf}$

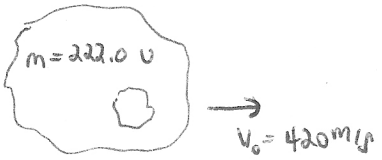
$3.22 = 0.46 + 0.800\, v_{Bf}$

$2.76 = 0.800\, v_{Bf}$

$v_{Bf} = 3.45$ m/s

Example 5: Chemistry Throwback!
An atomic nucleus (mass = 222.0 u) is initially moving at 420.0 m/s. This nucleus emits an alpha particle (mass = 4.000 u) in the same direction as its velocity. The new atomic nucleus slows to 350.0 m/s. What is the velocity of the alpha particle?
(Note: u is the symbol for atomic mass unit, which is a measurement derived from the kilogram. This problem may be evaluated without converting the mass of the particles).

BEFORE



AFTER

$(222.0)(420) = (218.0)(350) + (4.00)(v_f)$

$93,240 = 76,300 + 4.00 \cdot v_f$

$16,940 = 4.00 \cdot v_f$

$v_f = 4235$ m/s