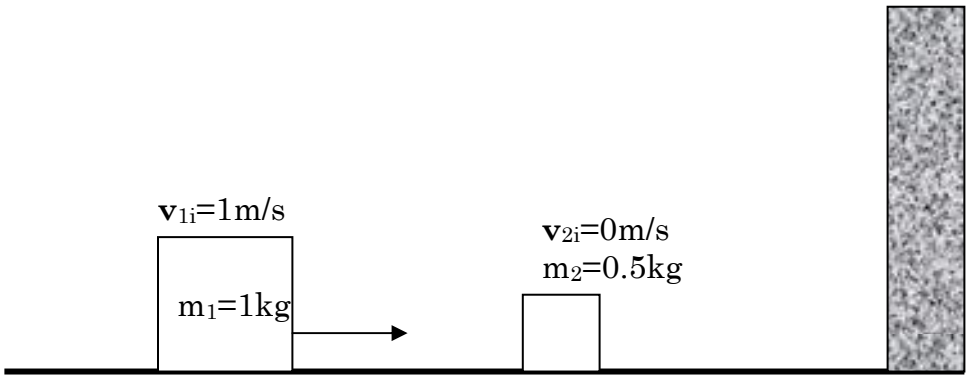
**Physics 211** **Week 7**

**Momentum: Elastic Collisions**

Initially, Block 1 with mass $m_1$=1kg is moving on a frictionless table with velocity $v_1$=1m/s and block 2 with mass $m_2$=0.5kg is at rest. Block 1 collides **elastically** with block 2.




Find the velocities of block 1 and block 2 after the collision. Afterwards, block 2 collides elastically with a wall. What impulse does the wall give to block 2?

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To find the final velocities, we can follow the four-step program for elastic collisions:

1. Find the velocity of the center of mass of the system of blocks.
2. Find initial velocity of each block in the center of mass frame.
3. Find the final velocity of each block in the center of mass frame remembering that in an elastic collision, in the center of mass frame the velocity before the collision is equal to the velocity of the object after the collision.
4. Find the final velocity of each block in the lab frame.

Elastic collisions conserve both kinetic energy and momentum, so you can check the initial and final velocities and masses in the lab frame to see if energy and momentum are conserved before and after the collision. You will find both conservation equations hold true. The velocities that you should obtain are 1/3 *m/s* for the first block and 4/3 *m/s* for the second block, both moving towards the wall.

For the next part, we know that the impulse is equal to the change in momentum. We can assume the wall has infinite mass, which means that the lab frame and center of mass frame are identical in this case. Remembering that the final velocity is simply the opposite sign of the initial velocity ( in the center of mass frame of an elastic collision), you know that block 2 will rebound off the wall with the same velocity that it hits the wall. Therefore, the final momentum will have the same magnitude as, but be in the opposite direction to, the initial momentum. The impulse, or change in momentum, when block two collides with the wall is 4/3 *N-s*. Note that block 2 carries the same magnitude momentum before and after its collision with the wall. The wall delivers a nonzero impulse to block 2, which appears as a change in direction of the momentum vector.