

# Unit One Homework

## Physics II

Due Sunday, April 5, 2020

College of the Atlantic. Spring 2020

### Instructions:

- Do this problem<sup>1</sup> in pairs. If you happen to have a housemate who is also in this class, do not work with them<sup>2</sup>. The idea is to practice working remotely and connecting with someone who is physically distant.
- You can find a partner on Piazza. Look for folks in the introduction thread and reach out. If you can't find someone, let me know and I'm happy to help make a connection.
- It would be very helpful if one of the two of you has semi-recently taken intro physics. In this problem you'll need to use the idea of conservation of momentum. This problem is one-dimensional, so you won't need trigonometry or vectors.
- This problem might be tricky for some, but the effort will be worth it, as it illustrates what the phrase "the laws of physics are the same in all inertial reference frames" really means. If you have questions or are uncertain where to start, let me know and we can meet via Zoom (or whatever) and discuss.
- "Hand in" the problem on google classroom. You can take a picture of your work, or type up your work, or scan your work.
- In addition to this problem, there are four problems that you should do on Edfinity. You should "hand in" these problems individually, but of course it's totally fine to collaborate with others.

In a happier time, Beowulf takes a cruise on an oceanliner. The oceanliner is moving at a constant speed of 17 m/s relative to the shore. Beowulf is playing shuffleboard. He slides a shuffleboard puck at 10 m/s in the -x direction in the boat frame. The puck has a mass of 750 grams. The moving puck hits an identical puck that was at rest. After the collision the first puck is at rest and the other puck is now traveling at 10 m/s in the -x direction.

1. Show that the total x-momentum<sup>3</sup> of the two-puck system is conserved in Beowulf's reference frame.
2. It just so happens that the oceanliner cruises under a bridge as this shuffleboard game is happening. And it also just so happens that Anastajia is sitting on the bridge. In Anastajia's reference frame, what velocity will each puck have before and after the collision?
3. Show that in Anastajia's reference frame momentum is conserved. Thus, the law of the conservation of momentum holds for both Beowulf and Anastajia, even though they will measure different velocities for the pucks.

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<sup>1</sup>This is based on problem R1S.9 from Thomas A. Moore, *Six Ideas that Shaped Physics: Unit R (2nd ed.)*, McGraw Hill, 2003.

<sup>2</sup>You're probably sick of them, anyway.

<sup>3</sup>Recall that momentum  $p$  of an object with mass  $m$  moving at a speed of  $v$  is given by the formula  $p = mv$ . "Conservation of momentum" means that the total momentum of an isolated system remains the same.