Name: _____ Date: _____

m_r^β Physics Practice: Inelastic collisions at any angle

You've studied head-on collisions, and collisions at right angles. We started with these because they are simpler to analyze. Now we are going to study inelastic collisions between objects approaching from any angle. We will use `http://www.mrbenson.org/pde/collisionAnyAngle/`.

Imagine that you are a test engineer working on the collision simulation. Part of your responsibility will be to verify that the simulation is accurate. That is, it must satisfy the laws of physics. Since the objects stick together in all simulations, they are perfectly inelastic collisions. Assume that all kinetic energy that is lost is converted to heat.

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1. Velocity test 1. Create a simulation with the red object having a 90° heading.

a. What are your simulation parameters for the red object?

b. Show how you verify whether the velocity of the red object (before the collision) matches the selected velocity.

2. Velocity test 2. Create a simulation with the red object having a 25° heading.

a. What are your simulation parameters for the red object?

b. Show how you verify whether the velocity of the red object (before the collision) matches the selected velocity.

3. Stationary object test. Create a simulation with one of the objects having zero velocity.

a. What are your simulation parameters?

b. Verify that momentum is conserved.

4. Rear end collision test. Create a simulation with both objects moving in the same direction, with one object being faster than the other.

a. What are your simulation parameters?

b. Verify that momentum is conserved.

5. Head-on collision test. Create a simulation with the objects colliding head-on, with one object having greater momentum than the other.

a. What are your simulation parameters?

b. Verify that momentum is conserved.

6. Right angle collision test. Create a simulation with the objects colliding at right angles, with different speeds but having momentums that are equal in magnitude.

a. What are your simulation parameters?

b. Verify that momentum is conserved.

7. Acute angle collision test. Create a simulation with the objects of different momentum colliding at an acute angle.

a. What are your simulation parameters?

b. Verify that momentum is conserved.

8. Suppose the software design specification calls for showing how much kinetic energy is given up in the collision. You've been asked to find a formulate for calculating this amount of energy. Assume two masses m_1 and m_2, with distinct velocities $\vec{v_1}$ and $\vec{v_2}$.

a. Find an expression for the velocity $\vec{v}$ after the collision.

b. Find an expression for the kinetic energy after the collision.

c. Find an expression for the kinetic energy lost in the collision.

d. **Test case 1**. Verify your formula makes sense when the two objects have momentum of equal magnitude, and meet head-on.

e. **Test case 2**. Verify your formula makes sense when the two objects have momentum of equal magnitude, and meet at 90°.