

Object: To observe the collisions of pool balls and compare with theory.

Theory: When two objects collide the momentum of the system is always conserved (we say this because we assume that both of the colliding objects are part of the system under consideration so the collision forces are internal to the system).

If conditions are such that total kinetic energy is also conserved the collision is said to be “totally elastic” or “perfectly elastic.” If the two objects stick together and remain in contact after the collision, we say that the collision is “totally inelastic” or “perfectly inelastic,” and kinetic energy is not conserved. If the objects do not stick together, and there is a loss of kinetic energy then the collision is “partially inelastic.”

A parameter known as the coefficient of restitution has been defined such that it is a measure of the degree of elasticity of a collision:

$$\epsilon = \frac{\text{relative speed of rebound}}{\text{relative speed of approach}} = \frac{v'_B - v'_A}{v_A - v_B}. \quad (1)$$

#### Summary of Collision Types

Totally inelastic	$\epsilon = 0$
Partially inelastic	$0 < \epsilon < 1$
Totally elastic	$\epsilon = 1$
Hyperelastic	$\epsilon > 1$

#### Preliminary:

1. Assume a pool ball moving at speed  $v_A$  has a head-on collision with a stationary ball of equal mass. If the collision is totally elastic ( $\epsilon = 1$ ), show how to find the speed of each ball after the collision.
2. Repeat procedure 1 for  $\epsilon = 0.8$ .
3. Find the velocity of each ball after the collision if the collision is not head-on. Assume an oblique impact such that the line of motion of the first ball is tangent to the surface of the second ball. Also assume that the collision is perfectly elastic and that the balls are perfectly smooth.

Procedure: Experiment with pool balls both with head-on collisions and with oblique collisions and compare observations with theory. Do the collisions appear to be perfectly elastic? What evidence do you have?

