Collisions – Revisited

Conservation of Momentum and Energy

1. An 20.0 kg red curling rock is travelling at 1.8 m/s [W] when it collides head-on elastically with the opponent's yellow rock of the same mass. What is the velocity of both rocks after the collision?
2. A truck of mass 3000kg, moving at 5.0m/s on a level, icy (i.e. assume friction is zero) road, bumps into the rear end of a car moving at 2.0m/s in the same direction. After the impact the truck has a velocity of 3.0m/s and the car a velocity of 6.0 m/s, both forward.
    a. What is the mass of the car?
    b. Calculate the total kinetic energy before and after the collision.
    c. Was the collision elastic?
3. An air track glider of mass 0.200 kg, moving at 1.0 m/s collides elastically with another glider of mass 0.050 kg equipped with a perfectly elastic spring, which is initially at rest.
    a. What are the velocities of each glider after the collision?
    b. What is the total kinetic energy before the collision?
    c. What is the velocity of both gliders at minimum separation?
    d. What is the total kinetic energy at minimum separation?
    e. What is the maximum potential energy stored in the spring during the collision?
4. A 1.00 kg magnetized air puck moving across a level table at 0.24m/s approaches head-on a stationary, similarly magnetized air puck of mass 0.50 kg. If the "magnetic collision" collision is repulsive and perfectly elastic, determine:
    a. The velocity of each puck after the collision
    b. What is the total kinetic energy before the collision?
    c. The velocity of both pucks at minimum separation
    d. The total kinetic energy at minimum separation
    e. The maximum potential energy stored in the magnetic force field during the collision.
5. On a frictionless air track, a 0.30 kg glider moving at 0.55m/s to the right collides with a stationary 0.80kg glider. The collision is cushioned by a bumper made of perfectly elastic spring steel.
    a. What is the velocity of each glider after the collision?
    b. What is the total kinetic energy before the collision?
    c. What is the minimum amount of total kinetic energy during the collision?
    d. How much energy was temporarily stored in the bumper during this collision?

Answers:

1. $V_1'=0$, $V_2'=1.8$m/s[W]

2a. m=1500kg, b. $E_{ki}=40500$J, $E_{kf}=40500$J, c. yes the collision is elastic

3a. $V_1'=0.60$m/s, $V_2'=1.60$m/s, b. $E_{ki}=0.10$J, c. $V_0=0.8$m/s , d. $E_{k\ min\ sep'n}=0.08$J, e. 0.02J

4a. $V_1'=0.08$m/s, $V_2'=0.32$ m/s, b. $E_{ki}=0.0288$J, c. $V_0=0.16$m/s, d. $E_{k\ min\ sep'n}=0.0192$J, e. 0.0096J

5a. $V_1'=-0.25$m/s, $v_2'=0.30$m/s, b. $E_{ki}=0.045$J, c. $E_{k\ min\ sep'n}=0.012$J, d. 0.033J