Neo and Agent Smith are flying towards each other. They collide in mid air and grab onto each other (they stick together).

a) Assume that momentum is conserved in the Matrix and find an expression relating their initial velocities to their final velocity.

b) Let M_N = 70 kg, V_{NI} = 50 m/s, M_S = 100 kg, and V_{SI} = 35 m/s. Put these numbers into your expression and solve for their final velocity.

c) Calculate the pre-collision and post-collision kinetic energy of the system. Does this system conserve kinetic energy through the collision?

Gayle runs at a speed of 4.0 m/s and dives onto a sled that is initially at rest on top of a frictionless snow covered hill sloping down at 30º. After she has traveled 10 m down the slope, her brother Billy hops on the sled; What is their speed after Billy hops on?

m_{Gayle} = 50.0 kg, m_{Billy} = 30.0 kg, m_{sled} = 5.0 kg

Gayle, whose mass is m_G, is running at a speed V_0 towards her sled, which is initially at rest and has a mass m_s. Gayle jumps on the sled. Find the velocity, V_1, of Gayle and her sled after the "collision."

This system **conserves momentum** through the collision. Write a sentence that your grandmother would understand explaining what it meas to conserve momentum.

a) Draw a before and after picture representing the collision. Label all appropriate masses and velocities.
b) Directly under each picture, write the total momentum of the system.
c) Using this information, find an expression that relates V_0 and V_1.

Gayle, whose mass is m_G, is riding on a sled, mass m_s, with an initial velocity V_1. She slides a distance d down a frictionless slope that makes an angle θ with the horizontal. Find the the velocity, V_2, of Gayle and her sled after sliding a distance d.

This system **conserves energy**. Write a sentence that your grandmother would understand explaining what it meas to conserve energy.

a) Draw a before and after picture representing the action. Label all appropriate masses and velocities.
b) Directly under each picture, write an expression for the the total energy of the system.
c) Using this information, find an expression that relates V_1 and V_2.

Gayle, whose mass is m_G, is riding on her sled, mass m_s, at a speed V_2. Her brother Bert, mass m_B, jumps on the sled. Find the velocity, V_3, of the Gayle plus Sled plus Bert combination after the "collision."

This system **conserves momentum** through the collision. Write a sentence that your grandmother would understand explaining what it meas to conserve momentum.

a) Draw a before and after picture representing the collision. Label all appropriate masses and velocities.
b) Directly under each picture, write the total momentum of the system.
c) Using this information, find an expression that relates V_2 and V_3.

A block with a mass of m_1 = 3.5 kg is placed in front of a spring with spring constant k = 2.4×10^4 N/m that has been compressed a distance *d*. After the spring is released, the block slides without friction to a hanging pendulum. The block then slides into a cup with mass m_2 = 5 kg. The cup is hanging from a string with length *l* = 1.4m. After the collision, the resulting pendulum swings up and makes a maximum angle = 26.5°.

What was the original spring compression *d*?