----- Problem 1 -----  A 59 kg person sits with a large box of mass 24 kg at the center of a frictionless frozen pond. To get to the edge of the pond, the person pushes off of the box attaining a velocity of 0.85 m/s East.

• What is the velocity of the box after the push?

----- Problem 2 -----  A horizontally fired .012 kg bullet embeds into a 2.4 kg ballistic pendulum. The “bullet + pendulum” swings rising 0.12 m vertically.

• What was $v_0$ of the bullet?

----- Problem 3 -----  Block $A$ of mass 5 $m$ moves along the $-x$ axis approaching the origin with $v_x = +v_0$. It collides elastically with block $B$ of mass 3 $m$ that lies at rest at the origin.

• What is the velocity of block $B$ after the collision?

----- Problem 4 -----  Clay lump $A$ of mass 1.8 kg has velocity $\vec{v}_A = 2.5 \hat{i}$ m/s. Clay lump $B$ of mass 3.7 kg has velocity $\vec{v}_B = (-0.75 \hat{i} + 1.7 \hat{j})$ m/s. The lumps collide and stick together.

• What is the final velocity of the big lump?

• What percentage of this system’s initial kinetic energy converted into thermal energy?

Answers
1. $v_{2fx} = -2.0896$ m/s (West)
2. $v_0 = 308.26$ m/s
3. $v_{Bx} = (5/4)v_0$
4. $v_f = (0.313636 \hat{i} + 1.143636 \hat{j})$ m/s, (% to heat) = 67.8%