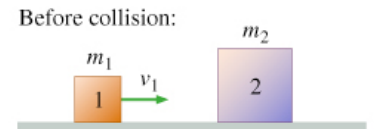


**Cooperative Learning:** work together, and submit one solution to each problem. A “solution” is not just a number. The reasoning needs to be indicated. The units of the number need to be specified. If the answer is a vector, the vector needs to be specified. Magnitude alone is not usually enough. **Write all 3 names on each page you submit.**

1. **1-dimensional collision (5 pts).** The colliding masses in the picture are  $m_1 = 2.0$  kg and  $m_2 = 6.0$  kg. The initial velocity  $v_{1i} = 4.0$  m/s, in the direction shown (choose this as positive x direction.) There is no friction between masses and the plane.



- Is the x-component of momentum conserved? (**yes**, no, maybe)
- Is the total kinetic energy the same before and after collision? (yes, no, **maybe**)
- Suppose after the collision,  $v_{1f} = -2.0$  m/s. What is  $v_{2f}$ ? (**2.0 m/s**) What is  $KE_f - KE_i$ ? (**0J**)
- Suppose after the collision,  $v_{1f} = -3.0$  m/s. What is  $v_{2f}$ ? (**2.3 m/s**) What is  $KE_f - KE_i$ ? (**+9.3J**)
- Suppose after the collision,  $v_{1f} = -1.0$  m/s. What is  $v_{2f}$ ? (**1.7m/s**) What is  $KE_f - KE_i$ ? (**-6.7J**)
- I claim all three outcomes are possible (although one of them requires an unusual set-up.) Explain the three cases. **c is elastic: the masses must have been made from bouncy material like billiard balls. d. has energy input. The masses had initially some stored energy (like compressed springs) that released energy in the collision. e is normal inelasticity. Some energy was lost to heat during the collision.**

2. **1-dimensional totally inelastic collision (2 pts).** The two objects in the figure above collide and move off stuck together.

- Is the x-component of momentum conserved? (**yes**, no, maybe)
- Is the total kinetic energy the same before and after collision? (yes, **no**, maybe)
- What is the final velocity of the stuck-together masses? **1.0 m/s**
- What is  $(KE_f - KE_i)/KE_i$ ? (**(4.0J-16.0J)/16.0J = -0.75**)

3. **2-dimensional totally inelastic collision (3 pts).** An object  $m_1 = 5.0$  kg travels North at 6.0 m/s. Another object  $m_2 = 3.0$  kg travels East at 5.0 m/s. They collide and stick.

- What are the N and E-components of their final velocity? **The original N-component of momentum comes from  $m_1$  and is 30.0 kgm/s. The final N-component of momentum is the same and is shared by all 8.0 kg, so the N-component of final velocity is 3.75 m/s. The original E-component of momentum is 15.0 kgm/s, so the final E component of velocity is 1.875 m/s.**
- What is the initial kinetic energy?  $\frac{1}{2} m_1 v_{1i}^2 + \frac{1}{2} m_2 v_{2i}^2 = 127.5$  J
- What is the final kinetic energy?  $\frac{1}{2} (m_1 + m_2)(v_{fE}^2 + v_{fN}^2) = 70.3$  J