# Giancoli Comments

## Chapter 9

Any **thoughts about symmetry are systematically discouraged** in this book—for example, on p 228 we’re told that a billiard ball rolling along the x-axis hits an identical billiard ball at rest at the origin, and the two then go off, one at 45° above the x-axis, one at 45° below. The author goes on: “From symmetry we might guess that the two balls have the same speed. But let us not assume that now.”

We have to spend a lot of time and ink writing down conservation of momentum equations for both sets of components, being careful to figure out sin(-45°) and cos(-45°) correctly. We’re also told that these work whether or not the collision is elastic. Fine—but we’re *not* told that the directions given mean this collision *is* elastic, as would be immediately evident if a vector diagram of the conservation of momentum were drawn! *The discussion of the problem never mentions that this collision is elastic, as it must be from the data given*.

**Conservation of momentum is *never* presented as a vector diagram**—only as a jumble of equations. Is it possible that all the physics education research this book is said to be based on has discovered that most of the audience will never be able to visualize a diagram, or see a symmetry, but can only plug and chug?

That could explain why this is rated as a “highest difficulty” problem: (III) *Prove that in the elastic collision of two objects of identical mass, with one being a target initially at rest, the angle between their final velocity vectors is always 90°,* when it is trivially solved by writing the conservation of momentum as the initial vector forming one side of a triangle, the final two vectors the other two sides, and energy conservation being Pythagoras’ theorem.

In 9.5, conservation of energy is applied to a two-body one-dimensional collision and leads to the discovery that the speed at which the two bodies recede afterwards equals the speed of approach: “an interesting result” – but we haven’t talked about the center of mass yet, and, indeed, we never do talk about the center of mass frame of reference, in which this would be immediately apparent. Giancoli makes a big point about his book being shorter, and shorter explanations are clearer, but here we just find the result from the equations, there’s no insight—no real explanation at all.

Another ill advised shortening of the book was skipping the center of mass frame of reference. The cost of this decision is made clear in reading the solution presented to problem 9.60, which can be solved with little effort using the CM frame. The solution book gives pages of laborious, almost impenetrable explanation—in the time *that* took, one could have become an expert in center of mass techniques, and learned some real physics.

9.60 A mass mA moving at v collides elastically with a mass mB initially at rest. What is the maximum angle through which mA can be scattered?

How to do it: first let’s put mA = 1, mB = m.

The initial total momentum is v, the CM is moving at v/(1 + m).

In the CM frame, the mass 1 is moving at speed mv/(1 + m).

After the collision, mass 1 is moving at this same speed mv/(1 + m), but in the CM frame, could be in any direction.

Back to the lab frame: the mass 1’s velocity vector is cm’s velocity + the velocity in the CM frame.

That would be a vector length v/(1 + m) along the x-axis (the initial velocity’s direction) plus a vector of length mv/(1 + m) in any direction.

If m > 1, the final vector could be scattering through any angle.

If m < 1, the final vector’s tail is at the origin, its head on a circle of radius mv/(1 + m) centered at v/(1 + m).

The biggest scattering angle is when the vector is tangent to the circle: we see that the angle has sinφ = m.

### 9-8 Center of Mass

Cm of a thin uniform rod (p 232). This is found by doing an integral over a uniform line density. Any thoughts of symmetry, or indeed common sense, are not to be tolerated.

But how do we find the CM of an irregular object? We’re told that if it is suspended from a point, it will swing unless the CM is directly below that point. Fine—except that so far we haven’t mentioned rotational motion, torque, or any of that. Perhaps here we are just appealing to common sense? If we’d discussed the CM of two kids on a seesaw, we could have worked from that.

### Chapter 9 Problems

14: radioactive decay” a nucleus emits a 1 ev alpha particle! (What radioactive lifetime does *that* correspond to? The protons probably won’t last that long.)