AS – 5300 Physical Gas Dynamics
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Supplementary Exercise – 3
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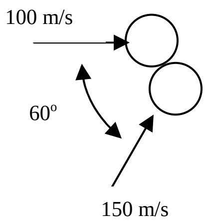
1. Consider a planar collision of two identical spheres. They are colliding with configuration as given in the drawing below.



(a) Find the resultant velocities and directions of the spheres for this collision.
(b) Now perform the same calculation for the inverse collision. Are they the same??
(c) Are the magnitudes of the relative velocity conserved before and after the collision for the above two cases?

2. Given that $f(c_i)$ is a normalized velocity distribution function for the molecules in a gas at rest, use the constraints below to derive the expression for the function $f(c_i)$. This is a repetition from class, but will be a useful practice.

$$\iiint f(c_i)dV_c = 1$$
$$f(c_i)f(z_i) = f(c_i')f(z_i')$$
$$P = NkT$$

3. Derive the speed distribution function $\chi(c)$ from velocity distribution function $f(c_i)$. Are their dimensions the same? Explain.

4. Find the most probable speed of the molecules, the average speed of molecules, and the rms speed of the molecules.

5. Assume a box at a given pressure and temperature with a tiny hole which does not affect the pressure in the box. Molecules are allowed to escape through the hole to an outside space which is in vacuum conditions. (a) Find the net flux of molecules escaping through the hole. (b) Do you recognize the expression? Where did we use this expression and was that correct?

6. Find the fraction of molecules with speed greater than a given value V.

7. Find the energy distribution function $\chi(\varepsilon)$ where ε is the kinetic energy of each molecule.